Fachverband Teilchenphysik (T)

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Übersicht der Plenarvorträge, Hauptvorträge, Eingeladene Vorträge und Fachsitzungen

Plenarvorträge

PV I	Mo	13:15–14:00	Z6 - HS 0.004	**Recent Physics Highlights from the LHC** — •Günther Dissertori
PV II	Di	9:00– 9:45	Z6 - HS 0.004	**Der Nachvollzug kanonischer Experimente als Zugang zur wissenschaftshistorischen Analyse experimenteller Praxis** — •Peter Heering
PV III	Di	9:45–10:30	Z6 - HS 0.004	**Scanning New Horizons: Information, Holography & Gravity** — •Robert Myers
PV IV	Di	13:15–13:45	Z6 - HS 0.001	**Technischer Vertrieb als Schlüsselposition im Unternehmen** — •Tobias Mauerer
PV V	Di	19:30–20:30	Z6 - HS 0.004	**Botschafter aus dem All: Was uns Kosmische Strahlung, Antimaterie und Schwarze Löcher über das Universum verraten** — •Karl Mannheim
PV VI	Mi	9:00– 9:45	Z6 - HS 0.004	**Our Dynamic Sun** — •Eric Priest
PV VII	Mi	9:45–10:30	Z6 - HS 0.004	**Physical models of brain circuits - A non-Turing approach to computation** — •Karlheinz Meier
PV VIII	Mi	13:15–13:45	Z6 - HS 0.001	**Physiker in der Automobilindustrie** — •Hartmut Presting
PV IX	Do	9:00– 9:45	Z6 - HS 0.004	**How Light is Gravity ?** — •Claudia de Rham
PV X	Do	9:50–10:35	Z6 - HS 0.004	**Highlights from AMS: 7 years on the International Space Station** — •Iris Gebauer
PV XI	Do	13:15–13:45	Z6 - HS 0.001	**Zwischen Medizinphysik und Consulting - Klinik 4.0 mit OPAS-CA** — •Charles Majer

Hauptvorträge

T 23.1	Di	11:00–11:35	Z6 - HS 0.004	**Faster, Finer, Stronger, Bigger: New Detector Technologies** — •Frank Simon
T 23.2	Di	11:35–12:10	Z6 - HS 0.004	**Deep learning concepts for particle physics** — •Martin Erdmann
T 45.1	Mi	11:00–11:35	Z6 - HS 0.004	**Plasma Wakefield Accelerators - The Wave of the Future or a Side Note in History?** — •Jens Osterhoff
T 45.2	Mi	11:35–12:10	Z6 - HS 0.004	**Auf dem langen Weg zur Sensation? – Direkte Suchen nach neuer Physik am LHC** — •Johannes Erdmann
T 70.1	Do	11:00–11:35	Z6 - HS 0.004	**The Pierre Auger Observatory: the quest for elucidating the nature and origin of UHECRs** — •Markus Roth
T 70.2	Do	11:35–12:10	Z6 - HS 0.004	**Top Quark Physics at the LHC: Probing the New Energy Frontier** — •Carmen Diez Pardos
T 95.1	Fr	9:00– 9:30	Z6 - HS 0.004	**Fünf Jahre Higgs-Boson - Was wissen wir?** — •Karsten Köneke
T 95.2	Fr	9:30–10:00	Z6 - HS 0.004	**Flavour Physics - Prepare for the Rare** — •Thorsten Feldmann
T 95.3	Fr	10:00–10:30	Z6 - HS 0.004	**Solars, steriles and coherent scattering - what is new in low-energy neutrinos?** — •Michael Wurm
T 96.1	Fr	11:00–11:30	Z6 - HS 0.004	**Präzisionstest des Standardmodells am LHC (Starke und elektroschwache Wechselwirkung)** — •Raimund Ströhmer
T 96.2	Fr	11:30–12:00	Z6 - HS 0.004	**New developments for scattering amplitudes** — •Stefan Weinzierl

T 96.3	Fr	12:00–12:30	Z6 - HS 0.004	**LHCb - Status und Highlights** — •Evelina Gersabeck
T 96.4	Fr	12:30–13:00	Z6 - HS 0.004	**A new era in multi-messenger astronomy** — •Marek Kowalski

Eingeladene Vorträge

T 46.1	Mi	14:00–14:24	Z6 - HS 0.001	**Search for New Physics at a Future Beamdump Facility at the CERN SPS: The SHiP Experiment.** — •Daniel Bick
T 46.2	Mi	14:24–14:48	Z6 - HS 0.001	**NNLO QCD in Higgs and vector-boson processes at the LHC** — •Marius Wiesemann
T 46.3	Mi	14:48–15:12	Z6 - HS 0.001	**Searches for Dark Matter at Belle II** — •Torben Ferber
T 46.4	Mi	15:12–15:36	Z6 - HS 0.001	**Search for Dark Matter with the ATLAS detector** — •Katharina Bierwagen
T 46.5	Mi	15:36–16:00	Z6 - HS 0.001	**Highlights from Higgs physics in CMS** — •Chayanit Asawatangtrakuldee
T 47.1	Mi	14:00–14:24	Z6 - HS 0.002	**Wissen ist Macht – die Matrixelement-Methode für Suchen mit Top-Quarks** — •Olaf Nackenhorst
T 47.2	Mi	14:24–14:48	Z6 - HS 0.002	**IAXO & MADMAX - Axion Searches with Helio- & Haloscopes** — •Christoph Krieger
T 47.3	Mi	14:48–15:12	Z6 - HS 0.002	**The CMS Phase-II Tracker Upgrade** — •Thomas Eichhorn
T 47.4	Mi	15:12–15:36	Z6 - HS 0.002	**The Higgs Physics at LHC: Status quo** — •Tatjana Lenz
T 47.5	Mi	15:36–16:00	Z6 - HS 0.002	**Proton-lead and lead-lead collisions with LHCb** — •Michael Winn
T 71.1	Do	14:00–14:24	Z6 - HS 0.001	**Radio detection of cosmic rays – achievements and future potential** — •Tim Huege
T 71.2	Do	14:24–14:48	Z6 - HS 0.001	**Prospects and Techniques of Surface Detector Extensions for IceCube** — •Jan Auffenberg
T 71.3	Do	14:48–15:12	Z6 - HS 0.001	**UHECR propagation: interactions and secondary messengers** — •Denise Boncioli
T 71.4	Do	15:12–15:36	Z6 - HS 0.001	**SQUID readout for microcalorimeter based neutrino experiments** — •Sebastian Kempf
T 71.5	Do	15:36–16:00	Z6 - HS 0.001	**Radio detection of cosmogenic neutrinos in the Antarctic Ice** — •Anna Nelles
T 72.1	Do	14:00–14:24	Z6 - HS 0.002	**Vom fehlenden Baustein zum Alleskönner - Die steile Karriere des Top-Quarks** — •Andrea Knue
T 72.2	Do	14:24–14:48	Z6 - HS 0.002	**Real-time Analysis with the LHCb Trigger, present and future** — •Sascha Stahl
T 72.3	Do	14:48–15:12	Z6 - HS 0.002	**Deep-Learning Ansätze in der Teilchenphysik** — •Gregor Kasieczka
T 72.4	Do	15:12–15:36	Z6 - HS 0.002	**Future Probes of the (Beyond the) Standard Model Higgs Boson** — •Ramona Gröber
T 72.5	Do	15:36–16:00	Z6 - HS 0.002	**Status and final steps towards neutrino mass measurements with the KATRIN experiment** — •Philipp Ranitzsch

Poster-Ausstellung

Poster werden am Montag, 19.3.2018, von 16:00 bis 18:30h im Foyer im Gebäude Z6 präsentiert, und bleiben dort bis Donnerstagabend hängen.

Fachübergreifenden Dissertationspreis-Symposium der Sektion Materie und Kosmos

SYMD 1.1	Mo	14:00–14:30	Z6 - HS 0.004	**The Data Mining Guide to the Galaxy and Beyond** — •Sabrina Einecke
SYMD 1.2	Mo	14:30–15:00	Z6 - HS 0.004	**A novel method for the energy determination of ultra-high energy cosmic rays through radio emission of particle showers** — •Christian Glaser
SYMD 1.3	Mo	15:00–15:30	Z6 - HS 0.004	**Measuring the neutrino mass hierarchy with the future KM3NeT/ORCA detector in the deep sea** — •Jannik Hofestädt

SYMD 1.4	Mo	15:30–16:00	Z6 - HS 0.004	**Milestone toward a nuclear clock: On the direct detection of ^{229m}Th** — •Lars von der Wense, Benedict Seiferle, Peter G. Thirolf

Fachübergreifenden Symposiums Gravitation (SYGR)

SYGR 1.1	Di	14:00–14:30	Z6 - HS 0.004	**New horizons in gravity** — •Lavinia Heisenberg
SYGR 1.2	Di	14:30–15:00	Z6 - HS 0.004	**Binary neutron stars: Einstein's richest laboratory** — •Luciano Rezzolla
SYGR 1.3	Di	15:00–15:30	Z6 - HS 0.004	**Search for Dark Matter** — •Christian Weinheimer
SYGR 1.4	Di	15:30–16:00	Z6 - HS 0.004	**From QFT on curved spacetimes to effective quantum gravity** — •Kasia Rejzner

Fachsitzungen

T 1.1–1.10	Mo	16:00–18:30	Philo-HS1	**Neutrinoastronomie I**
T 2.1–2.10	Mo	16:00–18:30	Philo-HS2	**Silizium-Streifen-Detektoren I**
T 3.1–3.10	Mo	16:00–18:30	Philo-HS3	**Higgs I**
T 4.1–4.10	Mo	16:00–18:30	Philo-HS4	**Suche nach Physik jenseits des Standardmodels**
T 5.1–5.10	Mo	16:00–18:30	Philo-HS5	**Pixel-Detektoren I**
T 6.1–6.9	Mo	16:00–18:20	Philo-HS6	**Suche nach dunkler Materie I**
T 7.1–7.10	Mo	16:00–18:35	Philo-HS7	**Kosmische Strahlung I**
T 8.1–8.9	Mo	16:00–18:25	Z6 - HS 0.001	**Neutrinophysik V**
T 9.1–9.10	Mo	16:00–18:30	Z6 - HS 0.002	**Neutrinophysik IX**
T 10.1–10.10	Mo	16:00–18:30	Z6 - HS 0.004	**Higgs: Erweiterte Modelle I**
T 11.1–11.9	Mo	16:00–18:15	Z6 - SR 1.002	**QCD / Partonstruktur**
T 12.1–12.7	Mo	16:00–17:45	Z6 - SR 1.010	**Theorie: Flavourphysik / Neutrinophysik**
T 13.1–13.6	Mo	16:00–17:30	Z6 - SR 1.013	**Theorie: QFT / Gittereichtheorie**
T 14.1–14.9	Mo	16:00–18:20	Z6 - SR 2.002	**Gasgefüllte Detektoren I**
T 15.1–15.10	Mo	16:00–18:30	Z6 - SR 2.005	**Outreach I**
T 16.1–16.10	Mo	16:00–18:30	Z6 - SR 2.006	**GRID Computing / Experimentelle Methoden I**
T 17.1–17.10	Mo	16:00–18:30	Z6 - SR 2.007	**CP-Verletzung / Mischungswinkel**
T 18.1–18.10	Mo	16:00–18:30	Z6 - SR 2.010	**DAQ / Trigger I**
T 19.1–19.9	Mo	16:00–18:15	Z6 - SR 2.011	**Top-Quarks: Produktion II**
T 20.1–20.8	Mo	16:00–18:05	Z6 - SR 2.012	**Neutrinophysik I**
T 21.1–21.9	Mo	16:00–18:20	Z6 - SR 2.013	**Experimentelle Methoden der Astroteilchenphysik I**
T 22.1–22.8	Mo	16:00–18:30	Z6 - Foyer	**Poster**
T 23.1–23.2	Di	11:00–12:10	Z6 - HS 0.004	**Hauptvorträge I**
T 24.1–24.10	Di	16:30–19:00	Philo-HS1	**Neutrinoastronomie II**
T 25.1–25.9	Di	16:30–18:45	Philo-HS2	**Silizium-Streifen-Detektoren II / Pixel-Detektoren**
T 26.1–26.10	Di	16:30–19:00	Philo-HS3	**Suche nach Supersymmetrie I**
T 27.1–27.10	Di	16:30–19:00	Philo-HS4	**Suche nach Physik jenseits des Standardmodels II**
T 28.1–28.10	Di	16:30–19:05	Philo-HS5	**Suche nach dunkler Materie II**
T 29.1–29.10	Di	16:30–19:05	Philo-HS6	**Kosmische Strahlung II**
T 30.1–30.8	Di	16:30–18:35	Philo-HS7	**Gammaastronomie I**
T 31.1–31.10	Di	16:30–19:00	Z6 - HS 0.001	**Neutrinophysik VI**
T 32.1–32.10	Di	16:30–19:05	Z6 - HS 0.002	**Neutrinophysik X**
T 33.1–33.10	Di	16:30–19:00	Z6 - HS 0.004	**Higgs II**
T 34.1–34.7	Di	16:30–18:15	Z6 - SR 1.002	**Top-Quarks: Eigenschaften I**
T 35.1–35.10	Di	16:30–19:00	Z6 - SR 1.005	**Elektronik**
T 36.1–36.8	Di	16:30–18:35	Z6 - SR 1.010	**Higgs**
T 37.1–37.10	Di	16:30–19:00	Z6 - SR 1.013	**Theorie: QCD / Top-Physik / Elektroschwache Physik**
T 38.1–38.9	Di	16:30–18:45	Z6 - SR 2.002	**Gasgefüllte Detektoren II**
T 39.1–39.9	Di	16:30–18:50	Z6 - SR 2.006	**Flavor Physik I**
T 40.1–40.10	Di	16:30–19:00	Z6 - SR 2.007	**Detektorsysteme I**
T 41.1–41.10	Di	16:30–19:00	Z6 - SR 2.010	**Halbleiterdetektoren / Strahlenhärte I**
T 42.1–42.10	Di	16:30–19:00	Z6 - SR 2.011	**Top-Quarks: Produktion I**

T 43.1–43.8	Di	16:30–18:40	Z6 - SR 2.012	**Neutrinophysik II**
T 44.1–44.10	Di	16:30–19:00	Z6 - SR 2.013	**Experimentelle Methoden der Astroteilchenphysik II**
T 45.1–45.2	Mi	11:00–12:10	Z6 - HS 0.004	**Hauptvorträge II**
T 46.1–46.5	Mi	14:00–16:00	Z6 - HS 0.001	**Eingeladene Vorträge I**
T 47.1–47.5	Mi	14:00–16:00	Z6 - HS 0.002	**Eingeladene Vorträge II**
T 48.1–48.10	Mi	16:30–19:00	Philo-HS1	**Neutrinoastronomie III**
T 49.1–49.8	Mi	16:30–18:30	Philo-HS2	**Andere Gebiete der Physik**
T 50.1–50.10	Mi	16:30–19:00	Philo-HS3	**Suche nach Supersymmetrie II**
T 51.1–51.10	Mi	16:30–19:05	Philo-HS4	**Suche nach Physik jenseits des Standardmodels III**
T 52.1–52.10	Mi	16:30–19:05	Philo-HS5	**Suche nach dunkler Materie III**
T 53.1–53.10	Mi	16:30–19:05	Philo-HS6	**Kosmische Strahlung III**
T 54.1–54.7	Mi	16:30–18:25	Philo-HS7	**Gammaastronomie II**
T 55.1–55.10	Mi	16:30–19:00	Z6 - HS 0.001	**Neutrinophysik VII**
T 56.1–56.10	Mi	16:30–19:00	Z6 - HS 0.002	**Pixel-Detektoren II**
T 57.1–57.10	Mi	16:30–19:00	Z6 - HS 0.004	**Higgs III**
T 58.1–58.8	Mi	16:30–18:35	Z6 - SR 1.002	**Top-Quarks: Eigenschaften II**
T 59.1–59.7	Mi	16:30–18:20	Z6 - SR 1.005	**Elektroschwache Wechselwirkung I**
T 60.1–60.10	Mi	16:30–19:00	Z6 - SR 1.010	**Theorie: Higgs / BSM I**
T 61.1–61.10	Mi	16:30–19:00	Z6 - SR 1.013	**Experimentelle Methoden II**
T 62.1–62.8	Mi	16:30–18:35	Z6 - SR 2.002	**Myondetektoren**
T 63.1–63.10	Mi	16:30–19:00	Z6 - SR 2.005	**Outreach II**
T 64.1–64.10	Mi	16:30–19:00	Z6 - SR 2.006	**Flavor Physik II**
T 65.1–65.10	Mi	16:30–19:05	Z6 - SR 2.007	**Detektorsysteme II**
T 66.1–66.10	Mi	16:30–19:00	Z6 - SR 2.010	**Halbleiterdetektoren / Strahlenhärte II**
T 67.1–67.9	Mi	16:30–18:50	Z6 - SR 2.011	**Neutrinophysik / theoretische Astroteilchenphysik**
T 68.1–68.10	Mi	16:30–19:00	Z6 - SR 2.012	**Neutrinophysik III**
T 69.1–69.10	Mi	16:30–19:00	Z6 - SR 2.013	**Experimentelle Methoden der Astroteilchenphysik III**
T 70.1–70.2	Do	11:00–12:10	Z6 - HS 0.004	**Hauptvorträge III**
T 71.1–71.5	Do	14:00–16:00	Z6 - HS 0.001	**Eingeladene Vorträge III**
T 72.1–72.5	Do	14:00–16:00	Z6 - HS 0.002	**Eingeladene Vorträge IV**
T 73.1–73.8	Do	16:30–18:35	Philo-HS1	**Top-Quarks: Eigenschaften und Zerfälle III**
T 74.1–74.10	Do	16:30–19:00	Philo-HS2	**Higgs: Erweiterte Modelle II / Suchen**
T 75.1–75.9	Do	16:30–18:45	Philo-HS3	**Suche nach Supersymmetrie III**
T 76.1–76.10	Do	16:30–19:00	Philo-HS4	**Suche nach Physik jenseits des Standardmodels IV**
T 77.1–77.9	Do	16:30–19:00	Philo-HS5	**Suche nach dunkler Materie IV**
T 78.1–78.10	Do	16:30–19:00	Philo-HS6	**Kosmische Strahlung IV**
T 79.1–79.8	Do	16:30–18:35	Philo-HS7	**Gammaastronomie III**
T 80.1–80.8	Do	16:30–18:35	Z6 - HS 0.001	**Neutrinophysik VIII**
T 81.1–81.9	Do	16:30–18:45	Z6 - HS 0.002	**Pixel-Detektoren III**
T 82.1–82.10	Do	16:30–19:05	Z6 - HS 0.004	**Higgs IV**
T 83.1–83.8	Do	16:30–18:30	Z6 - SR 1.005	**Elektroschwache Wechselwirkung II**
T 84.1–84.9	Do	16:30–18:50	Z6 - SR 1.010	**Theorie: BSM II**
T 85.1–85.10	Do	16:30–19:05	Z6 - SR 1.013	**Experimentelle Methoden III**
T 86.1–86.10	Do	16:30–19:05	Z6 - SR 2.002	**Kalorimeter**
T 87.1–87.10	Do	16:30–19:00	Z6 - SR 2.005	**Datenanalyse**
T 88.1–88.8	Do	16:30–18:30	Z6 - SR 2.006	**Flavor Physik III**
T 89.1–89.10	Do	16:30–19:00	Z6 - SR 2.007	**Detektorsysteme III**
T 90.1–90.10	Do	16:30–19:00	Z6 - SR 2.010	**DAQ / Trigger II**
T 91.1–91.10	Do	16:30–19:00	Z6 - SR 2.011	**Experimentelle Methoden der Astroteilchenphysik IV**
T 92.1–92.8	Do	16:30–18:40	Z6 - SR 2.012	**Neutrinophysik IV**
T 93.1–93.10	Do	16:30–19:00	Z6 - SR 2.013	**Experimentelle Methoden der Astroteilchenphysik V**
T 94	Do	19:15–20:15	Z6 - HS 0.001	**Mitgliederversammlung des Fachverbandes Teilchenphysik**
T 95.1–95.3	Fr	9:00–10:30	Z6 - HS 0.004	**Hauptvorträge IV**
T 96.1–96.4	Fr	11:00–13:00	Z6 - HS 0.004	**Hauptvorträge V**

Mitgliederversammlung Fachverband Teilchenphysik

Donnerstag 19:15–20:15 Raum Z6-HS 0.001

- Berichte

- Tagungsorte
- Verschiedenes

T 1: Neutrinoastronomie I

Zeit: Montag 16:00–18:30 Raum: Philo-HS1

T 1.1 Mo 16:00 Philo-HS1

Effects of Ice Properties on the Angular Reconstruction of Track-Like Events in IceCube — •Gerrit Wrede for the IceCube-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The IceCube neutrino observatory is searching for point sources in the astrophysical neutrino flux. Relativistic muons created by muon-neutrinos offer a good angular resolution and are thus an ideal channel for the detection of points sources. The accurate reconstruction of the direction of the muons depends on a good understanding of the Antarctic ice. In this talk, a study on the systematic uncertainty of the angular resolution due to inaccurate ice-modelling is presented for different reconstruction scenarios.

T 1.2 Mo 16:15 Philo-HS1

Improving the Reconstruction of Uncontained Events in IceCube — Christian Haack and •Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory has measured the astrophysical neutrino flux from a few 10TeV to a few PeV using multiple detection channels. However, two unsolved questions require larger statistics at PeV energies, namely the existence of a high-energy cutoff and the Glashow resonance. So far, event selections involving cascade-like events induced by neutral-current or charged-current electron neutrino interactions, are limited to contained events, where the interaction vertex is located inside the detector volume. To increase the sensitivity of IceCube to higher energies, the restriction to contained events has to be mitigated, thus including also uncontained events in the neutrino samples. Due to their topology, these events are extremely difficult to reconstruct and to distinguish from the atmospheric muon background. In this talk we will present new reconstruction and background rejection techniques for uncontained events in IceCube.

T 1.3 Mo 16:30 Philo-HS1

Improvements in the Simulation of High Energy Charged Leptons for IceCube — •Jan Soedingrekso, Mario Dunsch, Alexander Sandrock, Thorben Menne, Mathis Börner, and Max Meier for the IceCube-Collaboration — TU Dortmund, Dortmund, Deutschland

IceCube is a cubic kilometer scaled neutrino telescope detecting the Cherenkov light of charged particles propagating through the detector. To improve the reconstruction of the measured events, the systematic uncertainties have to be reduced in the simulation chain. PROPOSAL is a part of the IceCube simulation chain propagating charged leptons. This talk deals with recent improvements in PROPOSAL which can be separated into two topics: On the one hand physical aspects were enhanced to increase the precision of the propagation and reduce the systematic uncertainties. On the other hand programming aspects were improved to increase the performance and simplify usage and maintenance.

T 1.4 Mo 16:45 Philo-HS1

Improving the muon track reconstruction of IceCube and IceCube-Gen2 — •Federica Bradascio for the IceCube-Collaboration — DESY Zeuthen

IceCube is a cubic-kilometer Cherenkov telescope operating at the South Pole. It aims at detecting astrophysical neutrinos and identifying their sources. High-energy muon neutrinos are identified by the secondary muons produced in the interactions with the ice. The muon tracks are reconstructed using a maximum likelihood method, which models the arrival times of Cherenkov photons registered by the photomultipliers. This work aims at improving the muon angular resolution of IceCube and of its planned extension, IceCube-Gen2, in the subdegree range. The current muon reconstruction assumes continuous energy loss along the muon track, and does not take into account photomultiplier related effects like pre-pulses and after-pulses. In the reconstruction scheme presented here, the expected arrival time distribution has been modified in order to parametrize the effect of pre-pulses and the stochastic muon energy losses.

T 1.5 Mo 17:00 Philo-HS1

Muon Veto Study Comparing pDOM and mDOM for IceCube-Gen2 — •Julian Saffer for the IceCube-Gen2-Collaboration — ECAP, Erlangen, Deutschland

IceCube is a large neutrino detector located at the geographic South Pole. An important part in many neutrino analyses for background reduction is the vetoing of atmospheric muons. For the currently planned IceCube extension, IceCube-Gen2, various detector geometries and Digital Optical Module (DOM) designs have been proposed. This talk presents a study in which two DOMs, the pDOM and mDOM, are compared in terms of their veto potential for atmospheric muons using the current baseline geometry for IceCube-Gen2.

T 1.6 Mo 17:15 Philo-HS1

Resolving muon flux components in KM3NeT/ARCA — •Tim Stüven for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

KM3NeT is an extensive research infrastructure in the Mediterranean deep sea which is currently under construction. KM3NeT/ARCA is the instrument part dedicated to high-energy neutrino astronomy at the KM3NeT Italy site off the coast of Sicily. The major goal of ARCA will be to study the origin of the high-energy astrophysical flux detected by IceCube.

The vast majority of events detected by ARCA will be down-going muons from the interactions of cosmic rays in the Earth's atmosphere. In addition, the conventional and prompt atmospheric neutrino flux, as well as the astrophysical flux, will generate incoming muons from all directions, with different energy dependencies. Studies aiming to e.g. identify the flavour composition of the astrophysical flux, or the magnitude of the prompt contribution, will need to simultaneously fit all these contributions. This talk will present the results of simulations of the muon flux expected at ARCA and discuss in which regimes of energy and direction different contributions – especially those of the conventional and prompt atmospheric flux – may be disentangled.

T 1.7 Mo 17:30 Philo-HS1

Strings for absorption length in water — Michael Böhmer, Christian Fruck, •Andreas Gärtner, Roman Gernhäuser, Felix Henningsen, Simon Hiller, Kilian Holzapfel, Klaus Leismüller, Laszlo Papp, Immacolata Rea, and Christian Spannfellner — Technische Universität München

Large scale neutrino telescopes such as IceCube, Antares and GVD have shown their scientific potential on numerous occasions in the past. Due to their size of up to cubic kilometers and their location deep below the surface of water or ice, any new installation poses a large challenge on materials and infrastructure. Ocean Networks Canada potentially provides the necessary infrastructure for numerous scientific experiments at the seabed of the Cascadia Basin off the coast of Vancouver Island. The "Strings for absorption length in water" (STRAW) project will deploy two 140m strings with optical pulsers and sensors for measuring the relevant water properties (absorption, scattering, radioactivity and bioluminescence) for a large scale detector at this site and assessing its feasibility. This talk will give a brief overview of the site and the general concept of the STRAW project.

T 1.8 Mo 17:45 Philo-HS1

Strings for absorption length in water - Optical instruments — Michael Böhmer, Christian Fruck, Andreas Gärtner, Roman Gernhäuser, Felix Henningsen, Simon Hiller, Kilian Holzapfel, Klaus Leismüller, Laszlo Papp, Immacolata Rea, and •Christian Spannfellner — Technische Universität München

The "Strings for absorption length in water" (STRAW) project aims to assess the feasibility and optical conditions for a possible future large scale neutrino detector off the shore of Vancouver Island. To investigate the feasibility of a future neutrino telescope, two test strings with optical modules will be deployed with the support of Ocean Networks Canada, an institution of the University of Victoria. The light source for the intended absorption and scattering measurement will be the Precision Optical Calibration Module (POCAM) isotropic nanosecond pulsers developed for IceCube-Gen2, successfully tested last year at the Baikal Gigaton Volume Detector. The light sensor sDOM containing photomultiplier tubes will measure the background luminescence and detect the attenuated POCAM flashes to monitor the water proper-

ties over the course of two years. This talk will summarize the optical instruments planned for deployment in June 2018.

T 1.9 Mo 18:00 Philo-HS1

Data-driven approach for hadronic interactions in the estimation of atmospheric lepton fluxes — •Matthias Huber[1] and Anatoli Fedynitch[2] — [1]Technische Universität München, Physik-Department, James-Franck-Str. 1, 85748 Garching — [2]DESY, Platanenallee 6, 15738 Zeuthen

Precise knowledge of atmospheric neutrino and muon fluxes is essential in the search for astrophysical neutrinos and the measurements of neutrino oscillations. Atmospheric leptons are created in extensive air shower cascades initialized by cosmic rays (CRs) entering the Earth's atmosphere. The evolution of an atmospheric particle shower can be described by cascade equations, which characterize the transport and conversion of various particle species through the atmosphere. The Matrix Cascade Equations (MCEq) software is using this approach in a semi-analytical way to estimate the flux of atmospheric particles at the surface of Earth. The precision of these leptonic fluxes is mainly limited by the uncertainties in the CR spectrum and the lack of knowledge from hadronic particle interactions within the cascade. For the latter input from Monte Carlo event generators (SIBYLL or EPOS) is integrated in the current version of MCEq. Over the last years, fixed target experiments at CERN operated high precision measurements to study the behavior of such hadronic particle interactions. In this talk a method to incorporate these experimental results to the MCEq framework and the potential of this approach to reduce the uncertainties of atmospheric lepton fluxes are presented.

T 1.10 Mo 18:15 Philo-HS1

Radiative corrections to the energy loss of high-energy muons — Alexander Sandrock, •Thorben Menne, and Jan Soedingrekso — TU Dortmund

High-energy muons can travel large thicknesses of matter. For underground neutrino and cosmic ray detectors the energy loss of muons has to be known accurately for simulations. The processes through which muons loose energy are ionization, direct pair production, bremsstrahlung and inelastic nuclear interaction. Next-to-leading order corrections to the bremsstrahlung energy loss are presented.

T 2: Silizium-Streifen-Detektoren I

Zeit: Montag 16:00–18:30 Raum: Philo-HS2

T 2.1 Mo 16:00 Philo-HS2

Development and characterisation of a Service Hybrid prototype for CMS two-sided silicon strip modules — Lutz Feld[1], Christian Dziwok[2], Katja Klein[1], Martin Lipinski[1], •Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], Max Rauch[1], Nicolas Röwert[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

The CMS collaboration is developing two-sided silicon strip Modules for the second phase of the CMS outer tracker upgrade. This upgrade will enable the CMS experiment to utilize the high luminosity provided by the future HL-LHC. The RWTH Aachen contributes to this effort with the development of the Service Hybrid, which is responsible for high and low voltage distribution on the module and the data connection via optical links to the back-end electronics. The main feature of the low voltage distribution is a two-stage DC-DC conversion scheme. The current project and prototype status of the Service Hybrid is presented together with results of electrical test measurements. During the production a test system for the Service Hybrid will be needed. The design for a first test system prototype is presented, as well as the status of the test software.

T 2.2 Mo 16:15 Philo-HS2

Wirebonding on 2S Modules of the Phase-2 CMS Detector — Christian Dziwok[1], Lutz Feld[2], Katja Klein[2], Oliver Pooth[1], Marius Preuten[2], Max Rauch[2], Nicolas Röwert[2], and •Tim Ziemons[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]I. Physikalisches Institut B, RWTH Aachen University

The LHC will be upgraded to the HL-LHC in the Long Shutdown 3 starting 2024. To fulfill the requirements, the CMS detector will be upgraded in the Phase-2 Upgrade. Among others the silicon tracking system will be completely replaced by a new system providing an extended acceptance, an improved granularity and the feature to include its tracking information into the level-1 trigger. The new Outer Tracker will consist of 2S modules consisting of two strip sensors and PS modules with a macro-pixel sensor and a strip sensor. The electrical connection between the strip sensors and the front-end electronics is realized by thin aluminum wire bonds.

In this talk the process of wire bonding is introduced and its implementation in the 2S module series production is discussed. For this, a procedure of parameter optimization is developed and applied on a 2S dummy module.

T 2.3 Mo 16:30 Philo-HS2

Assembly of 2S-Module Prototypes for the Phase-2 Upgrade of the CMS-Tracker — Christian Dziwok[2], Lutz Feld[1], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], Max Rauch[1], •Nicolas Röwert[1], and Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

In the context of the Long Shutdown 3 around 2025 the current strip tracker of the CMS experiment will be replaced as required for the High Luminosity LHC (CERN) with a planned instantaneous luminosity of $5{\cdot}10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$. Around 8000 conceptually new silicon modules have to be built that will each be equipped with two identical vertically stacked silicon strip sensors. Through the difference in the hit position in the two sensors − caused by the magnetic field of 3.8 T inside the detector bending the tracks of charged particles − it is possible to select high transverse momentum tracks for the L1 trigger already on the module itself.

To manufacture these modules an assembly process is needed that guarantees high precision along with proper electrical isolation and can be realized with simple-to-use tools to facilitate mass production.

In this talk the current progress and selected challenges of the assembly will be presented.

T 2.4 Mo 16:45 Philo-HS2

Thermische Messungen mit 2S-Modulen für das Phase-2-Upgrade von CMS — Christian Dziwok[1], Lutz Feld[2], Katja Klein[1], Martin Lipinski[1], Alexander Pauls[1], Oliver Pooth[2], Marius Preuten[1], •Max Rauch[1], Nicolas Röwert[1] und Tim Ziemons[2] — [1]1. Physikalisches Institut B, RWTH Aachen — [2]3. Physikalisches Institut B, RWTH Aachen

Im Rahmen des Phase-2-Upgrades von CMS am LHC (CERN) wird der derzeitige Siliziumspurdetektor (Tracker) ausgetauscht werden, voraussichtlich ab dem Jahr 2024. Im neuen Tracker werden u.A. etwa 8500 Stück der neuartigen 2S-Siliziumstreifenmodule eingesetzt werden. Ein 2S-Modul besteht aus zwei etwa 10 cm × 10 cm großen Siliziumstreifensensoren und drei Hybriden zur Spannungsversorgung und Auslese. Die 2S-Module werden mit einem zweiphasigen CO_2-System bei einer nominellen CO_2-Temperatur von −35 °C gekühlt. Das thermische Verhalten der 2S-Module wie z.B. der Effekt des „Thermal Runaway“ wird mit FE-Simulationen abgeschätzt. In diesem Vortrag werden thermische Messungen mit 2S-Dummy-Modulen vorgestellt, die die späteren Detektorbedingungen möglichst gut nachahmen, systematische Messfehler minimieren und durch die die in den FE-Simulationen gemachten Annahmen wie Klebeschichtdicken, Wärmeleitfähigkeiten, etc. überprüft werden.

T 2.5 Mo 17:00 Philo-HS2

Mini-2S-Module beam test for CMS Binary Chip 3 — •Christian Dziwok[1], Lutz Feld[2], Katja Klein[2], Oliver Pooth[1], Marius Preuten[2], Max Rauch[2], Nicolas Röwert[2], and Tim Ziemons[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]I. Physikalisches Institut B, RWTH Aachen University

For the upcoming CMS Phase-2 Upgrade the L1 trigger will receive in addition track information from the Outer Tracker. The Outer Tracker will be built from silicon dual-strips (2S) and pixel-strip (PS) combina-

tion modules, having a stack of silicon sensors in either configuration. The readout chips for the two sensor planes build coincident signals based on an chosen acceptance range. This talk presents the general program and setup used for the latest beam test at Fermi National Accelerator Laboratory. Using the 120 GeV proton beam on prototype mini-2S-modules, the CMS Binary Chip 3.0 (CBC3) was tested.

T 2.6 Mo 17:15 Philo-HS2

Messung der Interstripkapazität von ATLAS-ITk-R0-Streifen-Sensoren — Silke Altenheiner, Claus Gössling, •Marius Hötting, Kevin Kröninger, Jonas Lönker und Felix Wizemann — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Um die gesteigerten Anforderungen durch das Upgrade auf den High-Luminosity LHC erfüllen zu können, ist geplant, den Inneren Detektor des ATLAS-Experiments zu ersetzen. Der neue Spurdetektor, genannt Inner Tracker (ITk), soll in den äußeren Lagen aus Silizium-Streifenmodulen bestehen. Ein Bestandteil dieser äußeren Lage sind die R0-Module. Der R0-Sensor eines solchen Moduls besteht aus einem Teilstück eines Kreisbogens, wobei dieses Teilstück in vier weitere Segmente unterteilt ist. Aufgrund der Strukturierung unterschieden sich somit die einzelnen Segmente im Bezug auf den Flächeninhalt und den Streifenabstand voneinander.

Vorgestellt werden die Ergebnisse der IV- und Interstrip-Messung von R0-Sensoren. Insbesondere wurde die Interstripkapazität in Abhängigkeit der Frequenz und der Betriebszeit in Labormessungen untersucht. Im Rahmen der Bachelorarbeit wurden zudem die Ergebnisse mit den geforderten ITk-Spezifikationen verglichen.

T 2.7 Mo 17:30 Philo-HS2

Infrared tests on the ATLAS thermomechanical petal prototype built at DESY. — •Yasiel Delabat Diaz, Claire A. David, Ingrid-Maria Gregor, Jan-Hendrik Arling, and Sergio Diez Cornell — Deutsches Elektronen-Synchrotron (DESY)

The infrared measurements on the thermomechanical petal prototype of the ATLAS end-cap strip detector were performed using a customized thermal chamber built at DESY. Using for the first time CO_2 cooling for the prototype's thermal cycles, temperatures of around -25 $^{\circ}C$ were reached. After each cycle, it was observed that the sensors tend not to keep thermal memory (i.e. they are not damaged). Preliminary comparisons with FEA simulations also showed fairly similar behaviour with respect to the measurements performed on both sides of the petal. In addition, a thermographic correction squeme was investigated, aiming to use a mathematical approach for emissivity correction that would eliminate the necesity of covering the petal surface with high emissivity black tape. With that purpose, the IR camera's spectral response scale factor was estimated and the viewing angle influence in the measurements was studied founding it to be negligible.

T 2.8 Mo 17:45 Philo-HS2

Study of a silicon strip sensor with embedded pitch adapters using electron testbeam data — •Sam Yanwing Ng, Heiko Lacker, and Laura Rehnisch — Humboldt-Universität zu Berlin

In the early prototyping stage of the high-luminosity upgrade of the ATLAS inner tracker, silicon strip sensors with embedded pitch adapter (EPA) structures were proposed as an approach to improve the challenging wire-bonding condition in the end-cap region due to different bond-pad layout on sensors and readout chips. Silicon strip sensors of an end-cap prototyping layout (petalet) with various EPA structures have been produced by embedding a second metal-track layer at Centro Nacional de Microelectrónica (IMB-CNM, CSIC), Barcelona, Spain. Introducing the second metal layer may lead to performance loss, e.g. signal loss due to the increase of the inter-strip capacitance, or unwanted capacitive coupling between the two metal layers (cross talk) or between the silicon bulk and second the metal layer (pick up). Prototype detector modules built with EPA petalet sensors were subjected to test-beam experiments at DESY using the 4.4 GeV electron beam with EUDET pixel telescope. First preliminary results will be reported.

T 2.9 Mo 18:00 Philo-HS2

Test Beam Studies of Silicon Strip Detectors for the ATLAS ITk-Upgrade — •Moritz Wiehe — Albert-Ludwigs-Universität Freiburg

The inner tracking detector of the ATLAS-experiment will be upgraded for the application at the High Luminosity LHC. The current silicon tracker (SCT) and transition radiation tracker (TRT) will be replaced by an all silicon tracker (Inner Tracker, ITk).

To verify the functionality and performance of silicon strip detector modules, test beam studies are carried out. Results of a test beam at DESY in 2017 are presented, where two devices, a short strip barrel module and an R0 endcap module, were tested. The most important figures of merit are the efficiency, the noise level and tracking accuracy. Of special importance is, how the efficiency and spatial resolution depend on the track position.

T 2.10 Mo 18:15 Philo-HS2

Test-beam results of a prototype module with radial strips for the ATLAS ITk Strip Detector — •Edoardo Rossi and Xiaocong Ai — DESY, Hamburg

Starting in 2022, the LHC will be upgraded to the High Luminosity-LHC which will have a luminosity almost five times larger than the present luminosity. In order to cope with the higher radiation level and with the higher pile up, the ATLAS experiment needs a complete replacement of the current tracking system with an all silicon detector, the Inner Tracker (ITk).

The ITk Strip Detector will implement four barrel layers and six end-caps on each side. Each end-cap will be built with modules with implemented radial strips.In this presentation, test-beam results obtained with an unirradiated prototype module with radial strips are described. The measurements were performed at DESY. The techniques used for the track reconstruction and for the analysis of the data are described in detail.

T 3: Higgs I

Zeit: Montag 16:00–18:30 Raum: Philo-HS3

T 3.1 Mo 16:00 Philo-HS3

Higgs to Tau Pair coupling measurement in the lepton-hadron final state with the ATLAS Detector — •Antonio De Maria[1,2] and Arnulf Quadt[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]University of Pisa

The decay of the Higgs boson into a tau lepton pair is currently the only accessible channel to establish the Higgs-Yukawa coupling to leptons. In this context, the final state in which one tau decays hadronically and the other one decays leptonically (lepton-hadron channel) plays an important role due to the high branching ratio and the moderate background. This talk outlines the main aspects of the ongoing analysis on the coupling measurement in this final state using data from proton-proton collisions recorded by the ATLAS detector at a center-of-mass energy of 13 TeV during 2015-2016. The final part of the talk will be dedicated to the description of further developments like the addition of a low lepton transverse momentum category and the impact of the missing transverse energy reconstruction quality on event selection and tau pair mass reconstruction.

T 3.2 Mo 16:15 Philo-HS3

Tau Identification and Search for SM $H \to \tau\tau$ with ATLAS — •Théo Megy, Lei Zhang, and Karsten Köneke — Albert-Ludwigs-Universität Freiburg

The decay of a Higgs boson into a pair of tau leptons is the most privileged channel in order to access Higgs boson couplings to leptons. The run 1 analysis in ATLAS reached an evidence for this process of 4.5σ, and the observation was reached by combining this result with CMS's. The aim is now to rediscover this process at 13 TeV with ATLAS. For this three final states, depending on the tau decay, are to be investigated. The semi-leptonic channel, in which the two tau leptons decay leptonically and hadronically respectively, is considered here.
An identification algorithm is used to select the hadronically decaying tau lepton, and suppress background events containing a jet faking a tau lepton. The analysis is therefore sensitive to the precise knowledge of the identification efficiency of tau leptons. The impact of the use of different identification working points on the analysis will be discussed. The possibility to use continuous tau identification in order to increase

the sensitivity of the analysis will be introduced. The goal is to split the cut-based analysis signal region into several identification sub-regions. New identification working points are necessary for this, and as a consequence new scale factors need to be measured. The introduction of a flattened BDT might be helpful to define optimal working points. The use the continuous tau identification is also considered in the multivariate analysis.

T 3.3 Mo 16:30 Philo-HS3

Prospects for VBF $H \to \tau_{\text{lep}}\tau_{\text{had}}$ measurements at the High Luminosity LHC with the ATLAS detector — •Tobias Fitschen, Stan Lai, and Michel Janus — II. Physikalisches Institut, Georg-August-Universität Göttingen

Due to its status as the heaviest lepton in the Standard Model, the τ lepton serves as a particularly important probe for the coupling of the Higgs boson to fermions. Despite its larger branching fraction compared with the Higgs discovery channels ($H \to ZZ^*$ and $H \to \gamma\gamma$), the $H \to \tau\tau$ channel evaded observation until recently. This is a consequence of the di-tau signal being harder to separate from background processes.

The proposed High Luminosity upgrade for the LHC promises to deliver a significant improvement in instantaneous and consequently integrated luminosity. This has the advantage of a larger data sample but comes with the drawback of increased pile-up, further complicating the separation of signal and background, particularly in the $H \to \tau\tau$ channel.

This talk presents an approach for emulating the expected conditions at the High Luminosity LHC by overlaying pile-up jets and by degrading jet and $E_{\text{T}}^{\text{miss}}$ resolution in currently available data. The result of this process can then be used to make a prediction on the sensitivity to the VBF $H \to \tau_{\text{lep}}\tau_{\text{had}}$ decay channel with the ATLAS detector using the predicted High Luminosity LHC dataset.

T 3.4 Mo 16:45 Philo-HS3

Measurements of Simplified Template Cross Sections in the H→ $\tau\tau$ decay channel — •Fabian Becherer, Elias Coniavitis, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

The measurement of Simplified Template Cross Sections (STXS) is a new strategy to study the Higgs boson at the LHC. The measurements of the signal strength μ and coupling modifiers κ used in Run 1 make use of assumptions, such as the Standard Model kinematics or extrapolating from the measured phase space to the global phase space. These assumptions introduce theoretical uncertainties on the determined results and dependencies on the underlying physics model. The STXS technique allows the reduction of theory dependencies in a systematic way, which are directly folded into the measurements. It provides more finely-grained measurements of cross sections in well-defined phase space regions. These measurements will benefit from the global combination of the measurements in all decay channels and the higher cross section for the Higgs boson production at $\sqrt{s}$=13 TeV in Run 2. First results have been published by ATLAS utilising this technique in the H→ZZ* →4l and H→ $\gamma\gamma$ decay channel in 2017. This talk will present the first implementation of this technique in the H→ $\tau\tau$ decay channel at the ATLAS experiment. This will form an important input to combined ATLAS STXS results, in particular for vector boson fusion and high transverse momentum topologies.

T 3.5 Mo 17:00 Philo-HS3

Standard Model $H \to \tau\tau$ analysis with a multiclass neural net approach — Günter Quast, Raphael Friese, Roger Wolf, •Sebastian Wozniewski, and Stefan Wunsch — Karlsruhe Institute of Technology, Karlsruhe, Deutschland

Higgs physics is turning from discovery to measurement. One important element in the study of the discovered Higgs boson at 125 GeV is the investigation of its coupling to fermions. At the LHC, best access to this coupling is provided in the di-τ final state. In this talk, a multiclass neural net approach for the Standard Model $H \to \tau\tau$ analysis of CMS is presented, with the aim to optimally prepare the signal for the estimation of cross sections and properties of the coupling.

T 3.6 Mo 17:15 Philo-HS3

Search for $H \to \tau\tau$ decays using multivariate techniques in proton-proton collisions at $\sqrt{s} = 13\,\text{TeV}$ with the ATLAS Detector — •Frank Sauerburger and Karsten Köneke — Albert-Ludwigs-Universität, Freiburg, Deutschland

A multivariate analysis (MVA) using machine learning techniques to study the standard model decay of the Higgs boson to two τ leptons ($H \to \tau^+\tau^-$) is presented. The analysis focuses on the decay channel, in which one τ decays leptonically and the other τ hadronically. The background is estimated with a combination of Monte Carlo simulation and data-driven methods. A boosted decision tree (BDT) is trained on the background and signal model. The BDT is employed to classify events into background and signal in order to enhance the sensitivity of the analysis. The analysis is performed using a dataset of proton-proton collisions at a center-of-mass energy $\sqrt{s} = 13\,\text{TeV}$ corresponding to an integrated luminosity of $36.1\,\text{fb}^{-1}$ recorded with the ATLAS detector at the LHC during 2015 and 2016.

T 3.7 Mo 17:30 Philo-HS3

Measurement of the $H \to \tau\tau$ coupling exploiting tau lepton decay mode classification in the semi-leptonic final state at ATLAS — Philip Bechtle, Klaus Desch, Christian Grefe, •Lara Schildgen, and Peter Wagner — Physikalisches Institut, Universität Bonn

The decay of the Higgs boson into fermions plays an important role to gain a deeper understanding of the coupling properties of the Higgs. Because of the distinct signatures of the decaying tau leptons, the decay of the Higgs into a tau lepton pair is a unique channel to measure the Higgs coupling to fermions and is the first fermionic channel which gave a significance exceeding 5σ in combined measurements of ATLAS and CMS.

Due to its short lifetime, the tau lepton decays before reaching the detectors and is therefore reconstructed by its decay products. The reconstruction algorithm for hadronic taus used in ATLAS has been improved and extended for run-2. In particular, it allows identification of different hadronic tau decay modes. In this talk we will discuss how this information can be used to improve the measurement of the decay of Higgs bosons into tau leptons using proton-proton collision data collected with the ATLAS detector at a center-of-mass energy of 13 TeV. We will focus on the semi-leptonic final state where only one of the two taus decays hadronically.

T 3.8 Mo 17:45 Philo-HS3

Optimizing the measurement of the signal strength for Higgs-boson production in the $H \to \tau\tau \to 2\ell 4\nu$ decay using multivariate techniques at $\sqrt{s} = 13\,\text{TeV}$ with the ATLAS detector — •Benjamin Rottler[1], Markus Schumacher[1], and Duc Bao Ta[2] — [1]Albert-Ludwigs-Universität Freiburg — [2]Johannes Gutenberg-Universität Mainz

The analysis of the decay of the Higgs boson to τ-leptons allows the determination of the τ-lepton Yukawa coupling as well as the coupling strength and structure of the Higgs boson to weak gauge bosons and gluons. Both the ATLAS and CMS experiment observed individually evidence for the Higgs to τ-lepton decay in Run-1. In Run-2 a higher sensitivity of this decay is expected due to the larger integrated luminosity and the enhanced cross-section at $\sqrt{s} = 13\,\text{TeV}$.

The selection for Run-2 can be optimized to the new run conditions and reconstruction tools with the help of multivariate analysis (MVA) techniques by maximizing the expected significance. In this talk an approach based on boosted decision trees (BDTs) is developed to increase the sensitivity of the $H \to \tau\tau \to 2\ell 4\nu$ channel for the full 2015 and 2016 Run-2 datasets corresponding to an integrated luminosity of $36.1\,\text{fb}^{-1}$ at a center-of-mass energy of $\sqrt{s} = 13\,\text{TeV}$. The choice of the BDT hyperparameters and collection of input variables used in the BDTs are optimized using a k-fold cross-validation method.

T 3.9 Mo 18:00 Philo-HS3

Measurement of the tau energy scale for Higgs analyses in the di-tau final state with the ATLAS experiment — •Michael Hübner, Philip Bechtle, Klaus Desch, Christian Grefe, and Peter Wagner — Universität Bonn

The decay of the Higgs boson into fermions, and tau leptons especially, is an interesting way to test the Standard Model. With this decay it is possible to probe, among other things, the Yukawa coupling of the Higgs to fermions and to test if the Higgs boson is a purely CP-even scalar or a CP-mixture.

The tau energy scale is one of the most important systematics for the Higgs coupling analysis. I will show a method to measure the tau energy scale with better precision than the conventionally used method. Additionally, it is possible to extract the energy scale for π^0s at the same time as the tau energy scale with the presented method.

T 3.10 Mo 18:15 Philo-HS3

Status of the $\mu \to \tau$ Embedding Method — •Per Ahrens, Roger Wolf, and Günter Quast — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

In the $\mu \to \tau$ embedding method muons from selected $Z \to \mu\mu$ events in data are replaced by simulated τ decays to estimate the background from $Z \to \tau\tau$ events in Higgs boson searches in the di-τ final state at the LHC. After successful use with the LHC run-1 data of CMS, the method has been completely re-implemented to cope with the changed experimental environment and correspondingly adapted reconstruction software. The current status of the method is presented.

T 4: Suche nach Physik jenseits des Standardmodels

Zeit: Montag 16:00–18:30 Raum: Philo-HS4

T 4.1 Mo 16:00 Philo-HS4

New physics results based on data and software preservation — •Andrii Verbytskyi, Siegfried Bethke, and Stefan Kluth — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

The speaker will present recent results on jet physics and precision determinations of the strong coupling constant, and explain how such results are enabled by the consistent preservation of data and software of experiments which have stopped data taking.

T 4.2 Mo 16:15 Philo-HS4

Hadron Production in Photon-Photon Processes at the ILC and new Physics signatures with small mass differences — •Kollassery Swathi Sasikumar[1,2], Carl Mikael Berggren[1], and Jenny List[1] — [1]DESY,Notkesstrasse 85, Hamburg — [2]Dept.of Physics, Universität Hamburg, Hamburg

Being an e^+e^- collider ILC has the prospect of providing very clean physics environment for making high precision measurements. In addition to the desired e^+e^- collisions, parasitic collisions of real and virtual photons radiated off the e^+e^- beams occur at the rates depending on the center-of-mass energy (ranging from 250 GeV to 1 TeV) and other beam parameters e.g at a centre of mass energy 500 GeV the expectation value is about 1.05 $\gamma\gamma$ events per bunch crossing. It is important to estimate the impact of these backgrounds which pile-up on each e^+e^- event. In the studies of BSM processes with small mass differences, where the visible decay products have low transverse momenta, the removal of these backgrounds is very challenging due to their similar natures. For example, here we discuss a specific case of light higgsinos with sub-GeV mass splittings, where the standard methods to remove this background remains inadequate. In this context we discuss an algorithm developed using the concept of displaced vertices to identify and cluster the tracks from same origin and its application on the low ΔM higssino analysis.

T 4.3 Mo 16:30 Philo-HS4

Search for dark matter in events with a Z boson and missing transverse energy at CMS — •Andreas Albert, Thomas Hebbeker, and Arnd Meyer — III. Physikalisches Institut A, RWTH Aachen University, Aachen

Understanding the origin of dark matter (DM) is one of the most pressing tasks in physics today. As ample astrophysical evidence has shown, DM occupies a significant fraction of the cosmological energy budget, for which the standard model of particle physics cannot account. If DM consists of particles, it may be produced in particle collisions. A search for DM particles in proton-proton collision events with a center-of-mass energy of 13 TeV at the CERN LHC is presented. The analysis is based on a dataset corresponding to an integrated luminosity of approximately 36/fb collected in the CMS experiment in 2016. Since hypothetical DM particles would not be directly detectable in CMS, events with large missing transverse energy (MET) are selected. Additionally, a muon or electron pair compatible with the decay of a Z boson from initial state radiation is required in order to select a well-defined topology. A shape analysis of the MET spectrum then allows to search for a signal.

Following an introduction to the analysis concepts, recent developments in the used experimental techniques and results of the analysis are presented. A special focus is put on interpretations of the beyond the most simplistic cases of DM production.

T 4.4 Mo 16:45 Philo-HS4

Large Extra Dimension Searches with the CMS Experiment — •Markus Radziej, Thomas Hebbeker, Arnd Meyer, and Tobias Pook — RWTH Aachen, III. Phys. Inst. A

With the Higgs Boson discovery at a mass of 125 GeV, the hierarchy problem becomes a pressing issue. One of the most prominent, potential solutions is the addition of extra spatial dimensions. A particularly interesting model has been suggested by Arkani-Hamed, Dimopoulos and Dvali, allowing for non-resonant excesses in the dilepton mass spectra at high energies.

Topic of the presented analysis is the dimuon final state. The results are based on the data recorded by the CMS experiment during 2016 at a center-of-mass energy of $\sqrt{s} = 13\,\text{TeV}$.

T 4.5 Mo 17:00 Philo-HS4

Measurement of the muon flux in a SPS test beam for the SHiP experiment — •Stefan Bieschke, Caren Hagner, Daniel Bick, Joachim Ebert, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The SHiP experiment is a proposed beam dump experiment at CERN, dedicated to the Search for Hidden Particles. A high intensity, 400 GeV proton spill from the SPS delivered to a beam dump produces a large number of muons that need to be diverted from the detector. Knowledge of both the flux and the spectrum of the muons is crucial in order to design and optimize a magnetic muon shield for the hidden sector detector. Therefore, in a mid 2018 SPS test beam experiment, a replica of the proposed SHiP target will be used as beam dump and after a hadron stop, drift tubes will be placed as muon tracker and spectrometer.

T 4.6 Mo 17:15 Philo-HS4

Search for HNL $\to \rho\mu$ decays in SHiP using the Surrounding Background Tagger — •Sandra Gerlach — Humboldt-Universität zu Berlin

The SHiP (Search for Hidden Particles) experiment is a proposed fixed-target experiment at the CERN SPS. It aims to explore the domain of hidden particles at the $\mathcal{O}$(GeV) mass scale, such as heavy neutral leptons (HNLs).

Protons of 400 GeV momentum are dumped on a tungsten-molybdenum target, where HNLs can be produced from heavy-flavour meson decays. The HNLs may decay in a 50 m long vacuum decay vessel enclosed by the Surrounding Background Tagger (SBT), whose purpose is the suppression of background, in particular, from neutrino and muon interactions in the decay vessel walls.

This talk discusses the reconstruction of the decay HNL $\to \rho\mu$ in the SHiP detector and the role of a liquid-scintillator based SBT in not only suppressing of background but also in extending the signal acceptance for this specific decay.

T 4.7 Mo 17:30 Philo-HS4

Estimation of muon DIS (Deep Inelasctic scattering) background for the SHiP Experiment — •Plamenna Venkova for the SHiP LScin SBT-Collaboration — Humboldt University, Berlin, Germany

SHiP is a general-purpose fixed-target facility, proposed to be constructed at the CERN SPS accelerator complex. Dumping 2×10^{20} protons with momentum of 400 GeV on a molybdenum-tungsten target over a time of five years allows probing a wide variety of models containing light long-lived exotic particles with masses below $O(10)$ GeV such as Heavy Neutral Leptons (HNLs).

After stopping hadrons and filtering out muons, the HNLs can decay in the decay vessel, which is enclosed by a surrounding background tagger (SBT). The decay products of the HNLs are detected in a subsequent spectrometer.

One of the main background to the hidden particle decay signals originates from deep inelastic scattering of muons in the vicinity of the decay vessel producing V^0 particles. Their decay modes can mimic the topology of the signal events.

In this talk, an estimation of this background is presented and the

role of the SBT to suppress the background in the offline analysis is discussed.

T 4.8 Mo 17:45 Philo-HS4

Search for low relativistic magnetic monopoles utilizing luminescence light with the IceCube detector* — •Frederik Lauber for the IceCube-Collaboration — Bergische Universität Wuppertal, Deutschland

Magnetic monopoles are hypothetical particles predicted by many Beyond the Standard Model theories. They are carriers of single elementary magnetic charge. This work considers intermediate mass monopoles which have been created shortly after the Big Bang.

There is no recent search for the low relativistic range $(0.1\,c - 0.5\,c)$. This is due to the predominant usage of Cherenkov light as a detection mechanism and the usage of detection media with a Cherenkov threshold above the aforementioned velocity range in current experiments.

However, highly ionizing particles such as magnetic monopoles produce luminescence light in water and ice. While the light yield of this process is much lower in comparison to Cherenkov light, simulations show that IceCube should be capable to detect this light. IceCube also has a large effective detection volume which is needed to detect magnetic monopoles due to the previous flux limits.

An update on the ongoing search in the low relativistic range, utilizing luminescence light as a detection method with IceCube for the first time, is presented. Signal simulation is compared to data, which has been taken with the new monopole filter of IceCube, and background simulation on different cut levels will be shown as well as a set of neural networks to separate background from signal. ** Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 4.9 Mo 18:00 Philo-HS4

Model Unspecific Search in CMS - 2016 Results — •Tobias Pook, Deborah Duchardt, Saranya Ghosh, Thomas Hebbeker, Jonas Lieb, Arnd Meyer, and Jonas Roemer — III. Physikalisches Institut A, RWTH Aachen University

The CMS Detector recorded a dataset of about $36 fb^{-1}$ during 2016 at a center of mass energy of 13 TeV. This dataset presents a unique opportunity to find new phenomena beyond the Standard Model.

The majority of searches for new physics are optimized for an established signal hypothesis in one or few decay channels. These searches cover only a fraction of all observed final states with model dependent analysis strategies. The Model Unspecific Search in CMS (MUSiC) provides a unique procedure to search for new physics at CMS in several hundred final states that are not all covered by dedicated analyses. This talk extends the previous introductory talk and presents results from an automated search for deviations in significant parts of the complete 2016 dataset.

The observed distribution of deviations is compared to a standard model only expectation estimated from pseudo experiments. The overall agreement between current CMS data and simulations is evaluated and most significant deviations are discussed.

T 4.10 Mo 18:15 Philo-HS4

Model Unspecific Search in CMS - 2016 Introduction — •Saranya Ghosh, Tobias Pook, Deborah Duchardt, Thomas Hebbeker, Jonas Lieb, Arnd Meyer, and Jonas Roemer — III. Physikalisches Institut A, RWTH Aachen University

In 2016, the CMS experiment recorded an integrated luminosity of 35.9fb^{-1} of proton-proton collision data at a center of mass energy of $\sqrt{s}$ =13 TeV. This increase in energy and luminosity compared to the $\sqrt{s}$ =7, 8 TeV dataset collected during Run I of the LHC presents a unique opportunity in the search for new physics beyond the standard model.

The Model Unspecific Search in CMS (MUSiC) searches for physics beyond the standard model independent of theoretical models. Using an automated method, kinematic distributions of the data are compared with the standard model expectation in several different final states. Therefore, MUSiC reduces the chance of overlooking new physics, since even final states not covered by dedicated analyses are investigated.

This talk presents the motivation, concept and methods used for the MUSiC analysis of the 2016 dataset collected by CMS and gives an introduction to the interpretation of a global comparison of simulation and data that will be presented in a following talk.

T 5: Pixel-Detektoren I

Zeit: Montag 16:00–18:30 Raum: Philo-HS5

T 5.1 Mo 16:00 Philo-HS5

A Monolithic Pixel Sensor Prototype for the ATLAS Experiment in AMS 180 nm HV-CMOS Technology — •Adrian Herkert[1], Heiko Augustin[1], Niklaus Berger[2], Sebastian Dittmeier[1], Carsten Grzesik[2], Jan Hammerich[1], Lennart Huth[1], David Immig[1], Jens Kröger[1], Ivan Perić[3], Mridula Prathapan[3], André Schöning[1], Iurii Sorokin[2], Alena Weber[3], Dirk Wiedner[1], and Marco Zimmermann[2] — [1]Physikalisches Institut Heidelberg — [2]Institut für Kernphysik Mainz — [3]Karlsruher Institut für Technologie

With the high luminosity upgrade of the LHC accelerator the ATLAS detector will be upgraded too. As part of that the inner tracker (ITK) will be completely exchanged, not only because the current tracker will reach the end of its lifetime at the end of Run 3 but also to cope with the increased pileup. Hybrid pixel and strip detectors are well established technologies and form the baseline of the ITK design as described in two Technical Design Reports. As alternative for the outermost pixel barrel layer, monolithic pixel detectors are considered which combine sensor and readout ASIC in one chip.
ATLASPix1 is, amongst others, a prototype for a monolithic pixel sensor demonstrator. It is produced in the AMS 180 nm HV-CMOS process aH18.
In this talk, the ATLASPix1 sensor will be introduced and first characterization results from several testbeam campaigns will be presented.

T 5.2 Mo 16:15 Philo-HS5

Large area HVCMOS pixel sensor prototype for ATLAS detector upgrade — •Mridula Prathapan, Hui Zhang, Alena Weber, and Ivan Peric — KIT, Karlsruhe, Germany

HVCMOS pixel sensors have been proposed for the upgrade of ATLAS experiment. They are implemented in commercial HVCMOS technologies which makes the production cost effective when compared to hybrid sensors. The HVCMOS detectors are monolithic which means that the readout electronics and the sensor part are implemented on the same substrate. A high voltage is used to create a depletion region where the particle detection occurs. A large area prototype for ATLAS experiment named ATLASpix1 has been designed and fabricated in AMS 180nm high voltage CMOS process technology. ATLASpix1 includes three different design flavours in terms of pixel size and readout logic. The chips have been fabricated using wafers of different resistivity. The sensor contains a pixel matrix and a full readout chain that supports triggering with programmable latency and fast data transmission. A faster readout scheme called Parallel Pixel to Buffer readout (PPtB) has been introduced. Currently we are working on the reticle size (2cm x 2cm) sensor that can be used to construct detector modules for ATLAS experiment. A few design improvements on ATLASpix1 such as electronic circuits for amplitude measurement, time walk correction, hit sorting and readout data formatting have been developed and submitted for fabrication on a test chip. The status of current developments on HVCMOS sensor design in AMS 180nm will be presented with emphasis on design details.

T 5.3 Mo 16:30 Philo-HS5

Charakterisierung von HVCMOS Sensoren für den ATLAS Pixeldetektor — •Felix Ehrler, Ivan Perić und Rudolf Schimassek — IPE, Karlsruher Institut für Technologie

Hochspannungs CMOS (HVCMOS) Pixelsensoren sind verarmte aktive Pixelsensoren, die in einem kommerziellen Standardprozess implementiert sind. Dank ihrer Strahlenhärte und schnellen Signalgeneration werden HVCMOS Sensoren für mehrere Experimente benutzt werden, beziehungsweise sind für diese vorgeschlagen: Mu3e, ATLAS, CLIC.

Im Jahr 2017 wurden vier monolithische HVCMOS Pixelsensoren gemeinsam in der 180 nm Technologie AMS aH18 auf Wafern mit verschiedenen Resistivitäten produziert. Ihre Gesamtfläche beträgt etwa

22×22 mm^2. Ein Sensor zielt auf den Einsatz im Mu3e Experiment ab, während die drei anderen für den Einsatz im ATLAS-Detektor konzipiert sind.

Jeder der vier Sensoren vereint spezielle Eigenschaften in sich, die auf die jeweilige Anwendung zugeschnitten sind. Dazu zählen innovative Konzepte wie die Parallel-Pixel-to-Buffer (PPtB) Auslesearchitektur für höchste Trefferraten, getriggerte Auslese, isolierte PMOS-Transistoren und Timewalk-Korrektur durch Signalhöhenbestimmung.

In diesem Beitrag werden Testergebnisse dieser Sensoren wie allgemeine Funktionalität, Messungen der Orts- und Zeitauflösung bei höchsten Auslesegeschwindigkeiten unter Labor- und Testbeam-Bedingungen präsentiert.

T 5.4 Mo 16:45 Philo-HS5

Characterization of a depleted monolithic active pixel sensor prototype in 130 nm Toshiba technology — •Christian Bespin, Tomasz Hemperek, Toko Hirono, Fabian Hügging, Tetsuichi Kishishita, Hans Krüger, Piotr Rymaszewski, Norbert Wermes, and Jochen Dingfelder — Physikalisches Institut der Universität Bonn

Monolithic active silicon pixel sensors using commercial CMOS technology are currently under investigation for usage in environments with high particle rates and high radiation doses as in the upcoming HL-LHC. A prototype of a depleted monolithic active pixel sensor (DMAPS) in 130 nm Toshiba technology is characterized. It consists of different flavors with a pixel pitch of 20 um and 40 um. The pixels are read out using a 3T circuit. Results from gain and noise measurements are presented together with measurements with radioactive sources and a 2.5 GeV electron beam.

T 5.5 Mo 17:00 Philo-HS5

A 65 nm pixel readout chip in 65 nm process with passive CMOS sensor — •Daniel Coquelin, Michael Daas, Tomek Hemperek, Fabian Hügging, Hans Krüger, David-Leon Pohl, Mark Standke, and Norbert Wermes — Nussallee 12, 53115 Bonn

For the high luminosity LHC the ATLAS detector must be upgraded. The tracking detector will be an all silicon tracker with several layers of hybrid pixel detectors. In view of this upgrade, a pixel readout chip in 65 nm TSMC CMOS process was developed (FE65-p2). It consists of 64x64 pixels with a pitch of 50 x 50 um. A passive CMOS sensor from Lfoundry in 130 nm CMOS process with small 50 x 50 um pixels and a bulk resistivity of 4-5 kOhm-cm is bump bonded to the readout chip. The prototype sensor is characterized using IV curves, threshold measurements, as well as electron and X-ray sources.

T 5.6 Mo 17:15 Philo-HS5

Planare n$^+$-in-n Quadmodule für das ITk-Upgrade des ATLAS-Experiments — Silke Altenheiner[1], Sascha Dungs[1,2], •Andreas Gisen[1], Claus Gössling[1], Valerie Hohm[1], Reiner Klingenberg[1], Kevin Kröninger[1], Anna-Katharina Raytarowski[1] und Mareike Weers[1] — [1]TU Dortmund, Experimentelle Physik IV — [2]CERN

Um den Anforderungen des High Luminosity LHC (HL-LHC) gerecht werden zu können, wird es nötig sein, den aktuellen Tracker des ATLAS-Experiments zu ersetzen. Deswegen wird derzeit ein neuer Spurdetektor geplant, der sogenannte Inner Tracker (ITk). In dessen Pixeldetektor sind auch Vierchip- bzw. Quadmodule vorgesehen. Diese bestehen aus einem Siliziumsensor, der zusammen mit vier Auslesechips eine Einheit bildet.

Der derzeitige innerste Spurdetektor des ATLAS-Experiments besteht aus planaren n$^+$-in-n-Silizium-Pixelsensoren. Aus vergleichbaren Sensoren und vier FE-I4 Auslesechips wurden erste Prototypen planarer n$^+$-in-n Quadmodule hergestellt. Diese wurden im Labor und im Testbeam charakterisiert. Dabei wurde der Schwerpunkt auf die Regionen zwischen den Auslesechips gelegt, besonders auf den zentralen Bereich zwischen den vier Auslesechips. Dort auf dem Sensor befinden sich spezielle Pixelzellen, die die Lücke zwischen den Auslesechips berücksichtigen. Ein Quadmodul wurde am CERN-PS mit Protonen bestrahlt und danach erneut im Testbeam charakterisiert.

Dieser Beitrag stellt die Ergebnisse dieser Messungen vor.

T 5.7 Mo 17:30 Philo-HS5

TCAD Simulation for the study of the MuPix Sensor — •Annie Meneses Gonzalez for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg, Germany

The goal of the Mu3e experiment is to search for the lepton flavor violation decay $\mu^+ \to e^+e^-e^+$ with an ultimate sensitivity (in phase II) of one in 10^{16} μ -decays, four orders of magnitude better than the current experimental limit. This gain is considered possible by fully exploiting advances in silicon detector technologies, data transfer, and processing.

The main challenges of the experiment are to run in a high rate muon beam, excellent momentum resolution and precise vertex and timing resolution. Due to the low momenta of the decays electrons, multiple Coulomb scattering is dominating the momentum measurement precision. The Mu3e pixel tracker is based on thin High-Voltage Monolithic Active Pixel Sensors which allows to integrate sensor and readout functionalities in the same device, reducing the material budget and improving the momentum resolution.

Technology Computer Aided Design (TCAD) is used to develop and optimize semiconductor processing technologies and devices. In this work results from TCAD Simulation on the charge collection time of the MuPix7 sensor are presented and compared to experimental data for different bias voltages and hits positions inside the pixel cell. Using the same physics model, some main characteristics of the MuPix8 prototype are also presented.

T 5.8 Mo 17:45 Philo-HS5

The First Large Scale Fully Monolithic HV-CMOS Sensor: MuPix8 — •Heiko Augustin[1], Alena Larissa Weber[1,2], Mridula Prathapan[2], and Ivan Peric[2] for the Mu3e-Collaboration — [1]Physikalisches Institut Heidelberg — [2]Karlsruher Institut für Technologie

The Mu3e experiment is dedicated to the search for the lepton flavour violating decay $\mu^+ \to e^+e^-e^+$ with an unprecedented sensitivity of one in 10^{16} decays. In the Standard Model this decay is suppressed to a branching ratio below 10^{-54}. Thus, any observation of a signal is a clear sign for New Physics. To reach the sensitivity goal a pixel tracker with low material budget and high rate capability is required. The technology of choice are High Voltage Monolithic Active Pixel Sensors (HV-MAPS) produced in the AMS aH18 180 nm HV-CMOS process, which allows to build fast pixel detectors thinned to 50 μm.

In this talk the architecture of the first large 2×1 cm^2 prototype MuPix8 is presented. It houses three 1.25 Gbit/s data links and tests circuits for timewalk suppression, aiming at a time resolution below 10 ns.

Further the next step towards a full module integration of the final pixel sensor with the test of a reduced slow control scheme on the MuPix9 chip is presented.

T 5.9 Mo 18:00 Philo-HS5

First results from the MuPix8, a large HV-MAPS prototype — •Jan Hammerich for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment is searching for the charged lepton flavor violating (cLFV) decay $\mu \to eee$ with a planned sensitivity of 1 in 10^{15} decays for phase 1. To achieve such a sensitivity, a fast, high resolution tracking detector is required which has a material budget of 1 ‰ to reduce multiple Coulomb scattering.

A suitable technology for these requirements is the High Voltage Monolithic Active Pixel Sensor (HV-MAPS) concept. It combines fast charge collection via drift with a fully monolithic architecture of sensor and readout in one chip which can be thinned to 50 μm.

The MuPix8 is the first large scale HV-MAPS prototype for Mu3e with a size of $1 \times 2\, cm^2$. Efficiency and time resolution have been measured in testbeam campaigns at DESY. Additionally, measurements with testpulses and radioactive sources are presented.

T 5.10 Mo 18:15 Philo-HS5

MuPix9 - a HV-MAPS prototype with serial powering — •Alena Larissa Weber[1,2], Heiko Augustin[1], Mridula Prathapan[2], and Ivan Peric[2] — [1]Physikalisches Institut Heidelberg — [2]Karlsruher Institut für Technologie

The Mu3e experiment is searching for the charged lepton flavour violating decay $\mu^+ \to e^+e^-e^+$ with a sensitivity of one in 10^{16} decays (in phase II). The core elements of the detector are High Voltage Monolithic Active Pixel Sensors (HV-MAPS) which are designed and produced in the AMS aH18 HV-CMOS process with a minimal gate length of 180nm.

In 2017 a large prototype (1 x 2 cm^2) called MuPix8 was submitted, produced and passed the first tests successfully. Currently, we are working towards the final MuPix design. For the final version several new features are required regarding the powering and the command de-

coder. To test new circuits, a smaller sensor prototype was developed, the MuPix9. On this chip, novel serial powering concepts for the Mu3e experiment were realized using two power regulators. Furthermore the powering of the analog and digital part was separated. Serial powering concepts enable significant reduction of the power supply current and necessary power connections to the sensor-chip.

In this talk different concepts of serial powering for the MuPix sensor and the architecture of the MuPix9 will be presented.

T 6: Suche nach dunkler Materie I

Zeit: Montag 16:00–18:20 Raum: Philo-HS6

Gruppenbericht T 6.1 Mo 16:00 Philo-HS6

Direct Dark Matter Search with the CRESST-III Experiment — •Andrea Münster for the CRESST-Collaboration — Physik-Department E15 und Excellence Cluster Universe, Technische Universität München, Garching, Germany

The CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) experiment, located at the Gran Sasso underground laboratory (LNGS) in Italy, aims at the direct detection of dark matter particles via their elastic scattering off nuclei. The target material consists of scintillating $CaWO_4$ single crystals operated as cryogenic detectors at millikelvin temperatures. For several years, these crystals have successfully been produced within the collaboration at the Technical University of Munich (TUM) and a significant improvement in radiopurity could be achieved. In CRESST-II Phase 2, an extended physics run between 2013 and 2015, the experiment demonstrated its leading sensitivity in the field of direct searches for dark matter masses below 1.7 GeV/c^2 . A further detector optimization for the search of low-mass dark matter particles was performed for CRESST-III, whose Phase 1 started taking data in summer 2016. In this talk the performance of the CRESST-III detectors as well as first results will be presented. Requirements and perspectives for the upcoming CRESST-III Phase 2, in particular with respect to radiopurity, will be discussed.

T 6.2 Mo 16:20 Philo-HS6

Modelling of electromagnetic backgrounds in the CRESST experiment — •Holger Kluck[1,2] and Cenk Türkoğlu[1,2] for the CRESST-Collaboration — [1]Institut für Hochenergiephysik der Österreichischen Akademie der Wissenschaften, 1050 Wien, Österreich — [2]Atominstitut, Technische Universität Wien, 1020 Wien, Österreich

CRESST searches directly for dark matter (DM) with $CaWO_4$ crystals operated as cryogenic calorimeters. It established leading limits for the spin-independent DM-nucleon scattering cross-section down to DM-particle masses of 350 MeV/c^2. At this mass regime, the rejection power against electromagnetic background starts to degrade. The background in the region of interest is mainly caused by β and γ decays of radioactive contaminations in the $CaWO_4$ crystals and their Cu surrounding. To gain a reliable understanding of these background components a detailed Geant4 model of the contaminations is under development.

In this contribution we report the current status of the benchmark simulation used to validate the model. We discuss the absolute normalization of the simulation via sideband measurements of α decays. Finally, we show preliminary results of a validation against experimental reference data.

T 6.3 Mo 16:35 Philo-HS6

Background suppression through pulseshape analysis in the DEAP-3600 dark matter detector — •Moritz Burghardt[1] and DEAP Collaboration[2] — [1]TU München — [2]SNOLAB, Canada

DEAP-3600 is a dark matter direct detection experiments at SNOLAB, Canada using a single phase liquid argon target. Upon energy deposition of ionising particles, liquid argon emits light through the decay of short-lived singlet state and long-lived triplet state excimers. This light makes up the only dark matter signal channel and is detected by an array of 255 photomultiplier tubes. In order to reach the projected sensitivity to WIMP-nucleon cross sections of 10^{-46} cm^2 for 100 GeV WIMPs, the electronic recoil background, which is dominated by the beta-decaying ^{39}Ar, has to be suppressed by a factor of at least 10^{-8}. This is achieved through pulseshape discrimination (PSD): electronic recoils produce a different singlet to triplet excimer ratio than the nuclear recoil signal from a WIMP interaction, leading to different time structures of the pulse shape. In this talk, prompt-window-based and likelihood-based PSD-parameters are presented and evaluated based on their discrimination power in DEAP-3600.

T 6.4 Mo 16:50 Philo-HS6

Radon background in the dark matter experiment XENON1T — •Natascha Rupp — Max Planck Institut für Kernphysik, Heidelberg

The dark matter experiment XENON1T aims for a direct detection of WIMPs (weakly interacting massive particles) by using liquid xenon as target material. The noble and radioactive gas radon constitutes the dominant background source in XENON1T. It constantly emanates into the liquid xenon and potentially reaches the sensitive volume, where the decay of its daughter isotopes can mimic dark matter interactions. A careful selection of low-radon-emanating detector materials mitigates this source of background. Therefore, radon emanation measurements of the individual detector parts are performed before construction. A few results of those measurements are presented. Furthermore, the level of radon and certain daughter isotopes is determined in the data analysis, which allows to set limits on the induced background rate. It was seen that the total radon level in the detector determined by emanation measurements and in data analysis agree well with one another.

T 6.5 Mo 17:05 Philo-HS6

Simulation studies for the MADMAX Axion direct detection experiment — •Jan Schütte-Engel for the MADMAX-Collaboration — University Hamburg, Deutschland

Axions are hypothetical particles introduced to solve the strong CP problem of the Standard Model. In addition axions can resolve the dark matter mystery. Axions with masses in the range of a few μeV up to a few hundreds of μeV are furthermore motivated by the scenario in which the Peccei-Quinn symmetry is broken after inflation, and in which the vacuum realignment mechanism and decays of topological defects contribute to the dark matter density. These motivate the search for axions in direct detection experiments on Earth, and the development of new techniques to become sensitive to this specific axion mass region.

One option is the MADMAX experiment, a haloscope utilizing dielectric media to enhance the signal of photons converted axions. This talk will focus on the simulation of the MADMAX direct detection axion experiment, and especially on the investigation of the dielectric discs, including real experimental conditions and discussing some of the signal loss mechanisms which may impair the axion detection.

T 6.6 Mo 17:20 Philo-HS6

Potential sensitivity of dark-matter searches for hidden photons with the FUNK experiment — •Arnaud Andrianavalomahefa[1], Kai Daumiller[1], Babette Döbrich[2], Ralph Engel[1], Joerg Jaeckel[3], Marek Kowalski[4,5], Axel Lindner[4], Hermann-Josef Mathes[1], Javier Redondo[6], Markus Roth[1], Thomas Schwetz-Mangold[1], Christoph M. Schäfer[1], Ralf Ulrich[1], and Darko Veberic[1] — [1]Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]Physics Department, CERN, Geneva, Switzerland — [3]Institute for Theoretical Physics, Heidelberg University, Germany — [4]Deutsches Elektronen Synchrotron (DESY), Zeuthen, Germany — [5]Department of Physics, Humboldt University, Berlin, Germany — [6]Department of Theoretical Physics, University of Zaragoza, Spain

The FUNK experiment is dedicated to look for an eventual signal from a new subclass of light particles, dubbed hidden photons (HP), which could explain the whole cold dark matter. The experimental apparatus uses a large parabolic metallic mirror (~ 15 m^2) where a faint electromagnetic signal resulting from a HP-to-photon conversion may emerge from the mirror's dielectric surface and gets focused at its center of curvature where a suitable detector is placed. Current measurements are performed in the optical range frequency and look for HP with mass ~ 1 eV. The same setup is also suitable for a broadband scan in regime where diffraction effects can be neglected. We discuss the prospective sensitivity of FUNK in the terahertz domain.

T 6.7 Mo 17:35 Philo-HS6

Mitigating detector effects in Dark Matter searches with the ATLAS Experiment — •Thomas Spieker — Kirchhoff Institut für Physik Heidelberg

The particle nature of Dark Matter (DM) is one of the main open questions in particle physics. So far, none of its detection attempts were successful. Testing and constraining the many models and theories predicting DM is a challenge as only few of them can be considered in an analysis. The search results are usually presented at detector level, which makes reinterpretation in terms of additional models difficult.

A Dark Matter search in final states with missing transverse momentum and jets was performed with the ATLAS Experiment using a novel approach. The results were unfolded to particle level using bin-to-bin unfolding. This simplifies the comparison of new theories with the presented results, as any detector effects are fully corrected for and can be compared at particle level. In a new, more refined iteration of the analysis the unfolding procedure will be performed using an iterative, dynamically stabilized Bayesian method. This approach depends less on the Monte Carlo modeling of the relevant processes and therefore yields a more reliable result at particle level. By using unfolding techniques in searches a much wider range of theories can be probed, just as changes in existing models can be compared more easily.

T 6.8 Mo 17:50 Philo-HS6

Suche nach Dunkler Materie in Assoziation mit einem hadronisch zerfallenden W- oder Z-Boson mit den Run-2-Daten des ATLAS-Detektors — •Philipp Gadow, Sandra Kortner, Oliver Kortner, Hubert Kroha, Patrick Rieck und Makoto Teshima — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Die Existenz Dunkler Materie wird durch zahlreiche astrophysikalische Hinweise untermauert, jedoch steht ein Nachweis der genauen Teilchennatur noch immer aus. Hypothetische Teilchen der Dunklen Materie können in pp-Kollisionen am LHC in Paaren gemeinsam mit Teilchen des Standardmodells erzeugt und so über Signaturen mit fehlendem Transversalimpuls nachgewiesen werden.

Dieser Vortrag stellt die Suche nach Dunkler Materie in assoziierter Produktion mit einem hadronisch zerfallenden W- oder Z-Boson vor, basierend auf den Run-2-Daten des ATLAS-Detektors. Die Signalsignatur ergibt sich aus den als Jets rekonstruierten Zerfallsprodukten der Vektorbosonen und dem fehlenden Transversalimpuls der nicht mit dem Detektor wechselwirkenden Teilchen der Dunklen Materie.

Die Ergebnisse der Suche werden vorgestellt, welche im Rahmen von vereinfachten Modellen interpretiert werden.

T 6.9 Mo 18:05 Philo-HS6

Search for Dark Matter in the Mono-Higgs Channel — •Andrea Matic and Jeanette Lorenz — Ludwig-Maximilians-Universität München

Astrophysical measurements show that a significant fraction of the mass-energy density in the universe consists of dark matter (DM). However, the particle nature of DM is still unknown. Dark matter candidates need to be massive particles, which might be weakly interacting. If produced in proton-proton collisions at the LHC, DM particles would not interact with the detector material and the resulting signature would be characterized by high missing transverse energy.

A search for DM is presented, which is based on data taken with the ATLAS detector at a center-of-mass energy of 13 TeV. The channel studied is sensitive to the pair production of DM particles in association with a Higgs boson, which decays further into two b-quarks. Depending on the momentum of the Higgs boson, this decay can have two different signatures: Either two resolved b-jets or one large-radius jet with two b-tagged tracks.

This talk presents the analysis strategy in the mono-Higgs channel and the statistical interpretation of the results.

T 7: Kosmische Strahlung I

Zeit: Montag 16:00–18:35 Raum: Philo-HS7

Gruppenbericht T 7.1 Mo 16:00 Philo-HS7

Ultra-high energy cosmic rays - Recent results and status of the Pierre Auger Observatory — •Daniela Mockler for the Pierre Auger-Collaboration — Institut für Experimentelle Teilchenphysik, Karlsruhe Institut für Technologie

The Pierre Auger Observatory is the world's largest detector arrangement for detecting extensive air showers initiated by cosmic rays with energies above 3×10^{17} eV. Equipped with 1660 water-Cherenkov stations, the surface detector array (SD) spans an area of 3000 km^2. The combination with 27 fluorescence telescopes (FD) that overlook the atmosphere and measure the calorimetric energy allows for a hybrid detection. The Pierre Auger Observatory is extended by buried scintillators for a direct muon detection (AMIGA) as well as radio antennas measuring the emission of radio signals from air showers (AERA). The current upgrade (AugerPrime) with scintillators on top of each detector station will allow the discrimination between the electromagnetic and muonic shower components. Thus, it will extend the sensitivity for primary masses which allows for an improved search for possible sources of cosmic rays at the highest energies.
An overview of the latest results and the current status of the Pierre Auger Observatory will be given in this talk.

T 7.2 Mo 16:20 Philo-HS7

Derivation of the longitudinal profile of extensive air showers generated by cosmic rays — •Isabel Astrid Goos[1] and Xavier Bertou[2] for the Pierre Auger-Collaboration — [1]Universidad Nacional de San Martín, Buenos Aires, Argentinien — [2]CONICET, San Carlos de Bariloche, Argentinien

The present work focuses on extended air showers generated by high energy cosmic rays. The concept of air shower universality states that all the information about the primary particle can in principle be recovered from the measurement of the observables X_{max} and N_μ. Both observables have a common origin: the production of π^0 and $\pi^{+/-}$, which are produced collectively along the shower axis. The aim is to understand the relationship between these two observables in order to be able to extract information about the development of the hadronic core of the shower.

The pion distribution varies heavily from shower to shower. Thus the first step is to understand the effect of different pion distributions on the values of X_{max} and N_μ. In order to do that our first approach was to analyze sets of Monte Carlo simulations of extensive air showers carried out with CONEX where all secondaries of each interaction can be stored. The procedure used was to add up all the electromagnetic subcascades generated by the neutral pions and then compare the resulting longitudinal profile with the real one corresponding to that shower. This reconstruction adjusts very well the electromagnetic longitudinal profile, even so for ultra-high-energy cosmic rays.

T 7.3 Mo 16:35 Philo-HS7

Air Shower Reconstruction using Deep Convolutional Neural Networks at the Pierre Auger Observatory — •Jonas Glombitza, Niclas Eich, Martin Erdmann, and Lukas Geiger — III. Physikalisches Institut A, RWTH Aachen

The surface detector of the Pierre Auger Observatory measures the footprint of charged particles of ultra-high energy cosmic ray induced air showers on ground level. Reconstructing the properties of primary cosmic rays like energy and mass remains a challenging task. Recently, progress has been made in machine learning by techniques associated with deep neural networks. Applying this new techniques on air shower physics has the potential to improve the reconstruction quality.

In this talk we present AixNet, a deep convolutional network architecture, which is used to reconstruct energy, direction and the mass sensitive observable Xmax. We assess the performance of AixNet using CORSIKA based air showers, discuss network causality and outline the potential of AixNet for data applications by adversarial training methods.

T 7.4 Mo 16:50 Philo-HS7

Improving Photon/Hadron Separation in the Hybrid Data of the Pierre Auger Observatory Utilizing Information from SD Traces — •Philip Ruehl, Marcus Niechciol, and Markus Risse for the Pierre Auger-Collaboration — Universität Siegen, Department Physik

A key question in the field of astroparticle physics is the composition of cosmic rays at the highest energies (above 10^{17} eV). A discovery of photons in this energy range would play a major role in this task and would have an immense impact not only on astrophysics and particle physics, but also on fundamental physics. The Pierre Auger Observatory near Malargüe, Argentina, is the world's largest detector for cosmic-ray-induced extensive air showers. Its two main components, namely the surface detector (SD) and the fluorescence detector (FD) provide complementary information in so-called hybrid events, i.e. air showers which are simultaneously measured by both detectors.

In this contribution we explore the possibilities of using the detailed time structure of the SD traces in hybrid events to improve the separation power between photon- and hadron-induced air showers.

Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik.

T 7.5 Mo 17:05 Philo-HS7

Eine rotationssymmetrische Lateralverteilung für Radioemissionen geneigter Luftschauer — •Tim Huege[1,2] und Lukas Brenk[3] — [1]Karlsruher Institut für Technologie, Institut für Kernphysik, Karlsruhe — [2]Vrije Universiteit Brussel, Brussel, Belgien — [3]Karlsruher Institut für Technologie, Institut für Experimentelle Teilchenphysik, Karlsruhe

Die Radiodetektion geneigter Luftschauer erhält im Moment große Aufmerksamkeit. Geneigte Schauer leuchten große Flächen am Boden mit messbaren Radiosignalen aus und sind daher mit wenig dichten Radioantennenfeldern messbar. Zudem verspricht eine kombinierte Messung von Radiosignalen und Sekundärteilchen geneigter Schauer eine hohe Massensensitivität.

Um dieses Potential auszuschöpfen, muss eine Eventrekonstruktion für geneigte Luftschauer entwickelt werden, welche aus den gemessenen Radiosignalen die Energie und ggf. einen Schätzer für die Masse des Primärteilchens ableitet. Der erste Schritt auf diesem Weg ist die Entwicklung eines Modells für die Lateralverteilung der Radiosignale, welche im Fall geneigter Schauer zusätzlich zu den üblichen Asymmetrien durch Ladungsüberschuss und geomagnetische Emission auch noch Asymmetrien durch "early-late"-Effekte aufweist.

In diesem Vortrag stellen wir ein Modell für die Lateralverteilung der Radiosignale geneigter Schauer vor, das sämtliche Asymmetrien herausrechnet und die Lateralverteilung erfolgreich mit einer rotationssymmetrischen Funktion des Energieflusses beschreibt.

T 7.6 Mo 17:20 Philo-HS7

Suche nach primären Photonen mit Energien zwischen 10^{17} und 10^{18} eV am Pierre-Auger-Observatorium — •Simon Eickhoff, Marcus Niechciol und Markus Risse — Universität Siegen

Die Suche nach ultrahochenergetischen Photonen am Pierre-Auger-Observatorium beschränkte sich bisher auf Energien oberhalb von 10^{18} eV. In dem Beitrag wird eine Analyse vorgestellt, die sich auf den Energiebereich von 10^{17} bis 10^{18} eV konzentriert. Hierzu werden Daten verwendet, die von den am Pierre-Auger-Observatorium installierten Niederenergie-Erweiterungen aufgenommen werden: Hierbei handelt es sich um drei zusätzliche Fluoreszenzteleskope (HEAT) sowie zusätzliche Oberflächendetektorstationen, mit denen ein dichteres Netz mit einem halbierten Detektorabstand von 750 m realisiert wurde. In der vorgestellten Analyse werden dieselben Observablen verwendet wie im Energiebereich oberhalb von 10^{18} eV: Zum einen die atmosphärische Tiefe des Schauermaximums (Observable X_{max}), zum anderen Charakteriska der lateralen Verteilung auf dem Erdboden (Observablen S_b und N_{Stations}). Diese Observablen werden in einer multivariaten Analyse kombiniert, um Photon-induzierte Luftschauer von solchen hadronischen Ursprungs zu trennen. Im Beitrag werden die Ergebnisse dieser Studien vorgestellt.

Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik.

T 7.7 Mo 17:35 Philo-HS7

A Method of Searching for Origins of Cosmic Rays correcting for Galactic Magnetic Field Deflections and Charge Composition — •Martin Urban, Martin Erdmann und Marcus Wirtz — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

We present a new method of searching for origins of ultra-high energy cosmic rays directly from observed data. We include corrections for deflections in the galactic magnetic field according to the individual cosmic ray charges. The analysis procedure is iterative and consists of the following steps. Initially, we assign to each cosmic ray a charge hypothesis and apply corresponding corrections for the galactic field to obtain directions outside our galaxy. We then search for directions indicating an enhanced cosmic ray arrival probability using a clustering algorithm. The cluster directions form a set of source candidates. Hereafter, the initial charge assignments of the cosmic rays are disregarded, and a stacked source analysis is performed to evaluate the validity of the set of source candidates. The consistency of the observed cosmic rays with the expected arrival probability distributions on Earth is used in a likelihood ratio method on one hand for the evaluation of the set of source candidates, and on the other hand for assigning charges to each cosmic ray. The procedure can be repeated optimizing for the most likely set of sources. We present the method and its performance using a simulated astrophysical scenario.

T 7.8 Mo 17:50 Philo-HS7

Analysis of non-event trigger data of the Pierre Auger Observatory — •Martin Schimassek, Darko Veberič, and Ralph Engel for the Pierre Auger-Collaboration — Karlsruher Institut für Technologie, Deutschland

The Pierre Auger Observatory was built to measure cosmic rays of the highest energies and lowest flux. For this purpose, the 1660 surface detectors of the detector array cover an area of about 3000 km^2 and are overlooked by four telescope stations. Additionally to the high energy event data, the time stamps of the triggers of each detector station of the surface array are stored since the beginning of 2016. In this contribution, the potential of this data set with respect to non-standard physics analyses is highlighted. This includes considerations of trigger efficiency for very inclined events, lightning related trigger patterns, and searches for spatially extended events.

T 7.9 Mo 18:05 Philo-HS7

Cosmic ray anisotropy searches with AMS-02 — Iris Gebauer, Kai Fabian Bindel, Maura Graziani, and •Stefan Zeissler — Karlsruher Institut für Technologie (KIT)

The Alpha Magnetic Spectrometer (AMS-02) is a state-of-the-art particle detector designed to operate as an external module on the International Space Station (ISS). In this unique space environment, cosmic particles can be measured with high precision over an energy range from GeV up to TeV. The AMS collaboration provided precise measurements of the electron and positron fluxes, which indicate an additional source of positrons among the various cosmic particles. Possible candidates for such a source are local pulsars, a local source of positrons produced in proton-gas interactions or dark matter annihilation. In the first two cases, a possible anisotropy in the electrons and positrons incoming direction at Earth might be detectable. To determine the level of isotropy, the measured data is compared to reference maps, which simulate a measurement of the isotropic sky. A common choice of reference maps are proton count maps or shuffled maps, which redistribute measured incoming directions over the whole measuring time. Both options lead to difficulties in the reconstruction of a marginal signal with large expansion over the galactic sky as it would be the case for charged cosmic particles. We developed a method to construct reference maps based on fundamental detector characteristics such as the livetime and the geometric acceptance. Using this, we are able to reconstruct the isotropic sky as it would be seen by the detector. We demonstrate the performance of the method using AMS-02 data.

T 7.10 Mo 18:20 Philo-HS7

Large Acceptance Analysis of Electrons and Positrons with AMS-02 — •Fabian Machate — RWTH Aachen, Aachen, Germany

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station performs precision measurements of cosmic rays in the GeV to TeV energy range. The published analyses of the electron and positron fluxes rely on the electromagnetic calorimeter (ECAL) for energy measurements and background rejection. The geometrical acceptance for the conventional analyses is restricted by the weight limitations for the calorimeter.

A new method to reject background with a Multivariate Analysis (MVA) using information from the Transition Radiation Detector (TRD) will be presented. This analysis has a significantly larger geometrical acceptance and can increase the statistics by a factor of up to ~ 4.

T 8: Neutrinophysik V

Zeit: Montag 16:00–18:25 Raum: Z6 - HS 0.001

Gruppenbericht T 8.1 Mo 16:00 Z6 - HS 0.001

The Electron Capture in ^{163}Ho experiment — •Clemens Hassel for the ECHo-Collaboration — Kirchhoff-Institute of Physics, Heidelberg University, Germany.

Direct determination of the electron neutrino (m_{ν_e}) and anti-neutrino mass ($m_{\bar{\nu}_e}$) can be obtained by the analysis of electron capture and beta spectra respectively. In the last years experiments analysing the ^{3}H beta spectrum reached a limit on $m_{\bar{\nu}_e}$ of 2 eV. The upper limit on m_{ν_e} is still two orders of magnitudes higher at about 225 eV. The Electron Capture in ^{163}Ho experiment, ECHo, is designed to investigate m_{ν_e} in the sub-eV region and reach the same sensitivity as foreseen for $m_{\bar{\nu}_e}$ in new ^{3}H-based experiments. In ECHo, high sensitivity on a finite m_{ν_e} will be reached by the analysis of the endpoint region in high statistics and high resolution calorimetrically measured ^{163}Ho spectra. To perform this experiment, high purity ^{163}Ho source will be enclosed in a large number of low temperature metallic magnetic micro-calorimeters which are readout using the microwave multiplexing technique. This approach allows for a very good energy resolution of below $\Delta E_{\mathrm{FWHM}} < 5$ eV and for a fast time resolution well below 1 μs. Thanks to the modular approach, the ECHo experiment is designed to be stepwise up-graded. The first on-going phase, ECHo-1k, is characterized by a ^{163}Ho activity of about 1 kBq enclosed in about 100 pixels. The statistics of 10^{10} events in the ^{163}Ho spectrum will allow to improve the limit on m_{ν_e} by more than one order of magnitude. In this talk, the present status of the ECHo-1k experiment will be discussed as well as the plans for the next phase, ECHo-100k.

T 8.2 Mo 16:20 Z6 - HS 0.001

Optimization of metallic magnetic calorimeter arrays with embedded ^{163}Ho for the ECHo experiment — •Federica Mantegazzini for the ECHo-Collaboration — Kirchhoff-Institute for Physics, Heidelberg University, Germany

The ECHo experiment aims to determine the electron neutrino mass via the analysis of the calorimetrically measured electron capture spectrum of ^{163}Ho. The detector technology is based on metallic magnetic calorimeters (MMC) and the implantation of ^{163}Ho has been selected as method to enclose the source in the detectors, showing already good performances for activity values up to 1 Bq. Since the sensitivity of the ECHo experiment strongly depends on the total acquired statistics, the activity per pixel needs to be increased, taking into account two constraints: the resulting unresolved pile-up events fraction and the supplementary heat capacity due to the implanted ions. We have developed a novel experimental technique for the determination of the specific heat per ^{163}Ho ion, based on the simultaneous measurement of two MMC pixels with identical geometry which differ only because of the ^{163}Ho ions implanted in one of the two. At an operational temperature of 20 mK for an activity of about 1 Bq, the heat capacity increases of less than 3%. Therefore, a total activity of the order of 10 Bq per pixel - as required in order to keep the unresolved pile-up fraction under control - can be implanted without strongly affecting the detector performance. In this contribution, the development and the characterisation of the new microfabricated detector arrays is presented.

T 8.3 Mo 16:35 Z6 - HS 0.001

Production, Separation and Implantation of ^{163}Ho for Neutrino Mass Measurements — •Klaus Wendt[1], Holger Dorrer[1], Christoph Düllmann[1,2], Klaus Eberhardt[1], Lisa Gamer[3], Christian Enss[3], Loredana Gastaldo[3], Clemens Hassel[3], Ulli Köster[4], Christoph Mokry[1], Jörg Runke[1,2], and Andreas Türler[5,6] — [1]JGU, Mainz, Germany — [2]GSI, Darmstadt, Germany — [3]Heidelberg University, Heidelberg, Germany — [4]ILL, Grenoble, France — [5]PSI, Villigen, Bern, Switzerland — [6]University of Bern, Bern, Switzerland

The ECHo collaboration aims at measuring the electron neutrino mass by recording the spectrum following electron capture of ^{163}Ho. For this purpose dedicated metallic magnetic calorimeters (MMCs) are used. The radioisotope ^{163}Ho is produced from enriched ^{162}Er in the ILL high flux nuclear reactor, separated and purified by chemical and laser mass spectrometric means for final embedding within the 180x180 μm^2 Au-absorber of the ECHo MMCs. Multi-step resonance ionization at the RISIKO mass separator ensures full elemental and isotopic selectivity for ultra-pure ^{163}Ho ion implantation with a well-controlled sub millimeter beam spot size. Performance of the laser ion source and the implantation process was improved to minimize sample losses. On-line in-situ deposition of Au by pulsed laser deposition (PLD) ensures homogeneous ^{163}Ho/Au layer formation during the implantation process. The quality of the ECHo source material is verified from production up to implantation and data taking using different analytical techniques, which include γ-ray spectrometry, NAA, ICP-MS and RIMS.

T 8.4 Mo 16:50 Z6 - HS 0.001

The ^{163}Ho electron capture spectrum — •Loredana Gastaldo for the ECHo-Collaboration — Kirchhoff-Institut fuer Physik, Universitaet Heidelberg

The analysis of high statistics and high resolution calorimetrically measured ^{163}Ho electron capture spectra, obtained within the ECHo experiment, clearly indicated that a theory based on first order excited states could not describe the data at the few percent level. Several theoretical models have been developed by different groups in order to improve the agreement with the experimental results.In this talk, we discuss the proposed theories and compare them to the available data.

In experiments as ECHo, designed to investigate the electron neutrino mass in the sub-eV region by the analysis of the ^{163}Ho electron capture spectrum, the precise knowledge of the processes involved in the decay, and therefore, in turn, of the spectral shape, is extremely important for the reduction of systematic uncertainties. We present new experimental approaches addressed to gain more information on the electron capture process in ^{163}Ho as well as in other nuclides undergoing electron capture, characterized by a low energy available for the process, Q_{EC}. Our aim is to provide high resolution and high statistics electron capture spectra to theorists to test new models.

Gruppenbericht T 8.5 Mo 17:05 Z6 - HS 0.001

TRISTAN: the search for keV-scale sterile neutrinos in the tritium beta decay with KATRIN — •Konrad Altenmüller for the KATRIN-Collaboration — Technische Universität München

The TRISTAN project is an extension of the KATRIN experiment to search for the signature of keV-scale sterile neutrinos in the tritium beta decay spectrum. To investigate the effective neutrino mass KATRIN does an integral measurement of the tritium spectrum close to the end point of 18.6 keV. For this purpose an electromagnetic filter is used that allows only electrons above a certain energy threshold, i.e. a tiny fraction of all electrons emerged from the tritium, to reach the detector, where they are counted. This talk will give an overview on TRISTAN, which will measure the entire tritium spectrum and is thus confronted with much higher count rates than KATRIN. For a first measurement in 2018 – TRISTAN phase-0 – the tritium spectrum will be scanned down to low electron energies without any hardware change, but with a lowered source strength to not exceed the detector's rate constraints. For TRISTAN phase-1 the KATRIN setup will be modified after the neutrino mass measurements are finished to conduct a differential and integral measurement of the entire tritium spectrum. The current detector will be replaced by a novel 4000-pixel silicon drift detector system that has an outstanding energy resolution of a few hundred eV and can handle rates up to 10^9 counts per second as they occur when the filter is turned off. Prototype detectors were successfully tested and first tritium data was taken at the Troitsk ν-mass spectrometer to study systematics and develop analysis methods.

T 8.6 Mo 17:25 Z6 - HS 0.001

Search for keV-scale sterile Neutrinos with the first Light of KATRIN — •Anton Huber[1], Guido Drexlin[1], Susanne Mertens[2,4], and Thierry Lasserrre[3] for the KATRIN-Collaboration — [1]Karlsruhe Institut für Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe — [2]Max-Planck-Institut für Physik, München — [3]Technische Universität München — [4]Centre CEA de Saclay, Paris

Sterile neutrinos in the keV-mass regime are a viable dark matter candidate. A sterile neutrino with a mass up to 18.6 keV would be visible in the beta-decay spectrum of tritium as a minuscule kink-like signature and distortion. The KATRIN experiment is designed to determine the absolute neutrinos mass by measuring the beta-decay spectrum of gaseous tritium close to its endpoint. Beyond that, it's unprecedented

tritium source luminosity and spectroscopic quality could be used to measure the entire beta-spectrum to search for a kink-like signature of a sterile neutrino. The idea discussed in this talk is a so-called Phase-0 measurement, where the first light data of KATRIN would be used to scan the entire tritium beta-decay spectrum to search for sterile neutrinos. A measurement of only one week with KATRIN has the potential to improve the current laboratory limits for keV-scale sterile neutrinos. This work presents the expected sensitivity, important systematic effects and the experimental realization of this experiment. This work was supported by GRK1694, BMBF (05A17VK2), KSETA, the HGF and the Friedrich-Ebert-Stiftung.

T 8.7 Mo 17:40 Z6 - HS 0.001

TRISTAN measurements at Troitsk nu-mass experiment — •Tim Brunst for the KATRIN-Collaboration — Max-Planck-Institut für Physik, München

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV (90% C.L.) after an effective data taking time of three years.

The TRISTAN (tritium beta-decay to search for sterile neutrinos) project aims at detecting a keV-scale sterile neutrino signature by measuring the entire tritium beta-decay spectrum with an upgraded KATRIN system. One of the greatest challenges is to handle the high signal rates generated by the strong activity of the KATRIN tritium source. Therefore, a novel multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 Mcps with an excellent energy resolution of 200 eV (FWHM) at 10 keV.

First seven-pixel prototype detectors were successfully installed and operated at the Troitsk nu-mass experiment, one of KATRIN's technological predecessors. This talk presents the results of these measurement campaigns.

T 8.8 Mo 17:55 Z6 - HS 0.001

Modifications of the KATRIN Simulation Software for Sterile Neutrino Search — •Madlen Steven for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical University of Munich

The Karlsruhe Tritium Neutrino (KATRIN) experiment is designed to improve the ν-mass sensitivity to about 0.2 eV/c^2 (90% C.L.) by measuring the shape of the endpoint of the tritium β-decay spectrum. By extending the measurement interval to the whole spectrum it will also be possible to search for so called sterile neutrinos. This hypothetical fourth neutrino flavour eigenstate does not interact via the weak, strong and electromagnetic force. A corresponding mass eigenstate of order keV could be observed as a kink in the β-decay spectrum.
As the current modelling software and in particular the Source and Spectrum Computation (SSC) package of the KATRIN experiment considers only the endpoint of the tritium spectrum, it has to be extended for the sterile neutrino search.
This talk will present the basic idea of this new simulation software and in particular focus on detector-related effects. First results for the detector response to monoenergetic electrons obtained by using the KATRIN simulation software Kassiopeia will be shown.

T 8.9 Mo 18:10 Z6 - HS 0.001

Precise modeling of KATRIN beta spectrum of tritium for keV sterile neutrino search — •Federico Roccati for the KATRIN-Collaboration — Max-Planck-Institute for Physics, Munich, Germany

The KATRIN experiment major task is to probe the effective electron anti-neutrino mass with a sensitivity of 200 meV at 90% confidence level. The KATRIN setup, along with an upgraded detector and readout system, is suitable for keV-scale sterile neutrino search. The signature of a sterile neutrino in the tritium beta decay spectrum is a minuscule kink-like distortion. To enable a sensitive search for this characteristic feature, an ultra-precise modeling of the entire tritium beta spectrum is necessary. For this reason, a novel semi-analytical, multi-dimensional convolution technique has been developed. It tracks both the energy and angular distribution of the electrons as they leave the windowless gaseous tritium source of KATRIN.

In this talk the basic idea and first results obtained with this new technique will be presented. Furthermore, we will present the concept of how to integrate the results in a more general simulation framework for a keV-scale sterile neutrino search with KATRIN.

T 9: Neutrinophysik IX

Zeit: Montag 16:00–18:30 Raum: Z6 - HS 0.002

T 9.1 Mo 16:00 Z6 - HS 0.002

First Measurements of Lifetime and Formation Probablility of Orthopositronium in the Linear Alkylbenzene Based Scintillator of JUNO — •Mario Schwarz, Sabrina Franke, Marc Tippmann, Hans Steiger, Lothar Oberauer, Philipp Landgraf, Konstantin Schweizer, and Julia Sawatzki — Technische Universität München, Physik Department, Lehrstuhl für experimentelle Astroteilchenphysik, James-Franck-Str. 1, 85748 Garching bei München

The planned JUNO (Jinangmen Underground Neutrino Observatory) detector will use 20 kt of liquid scintillator (LS) based on LAB (Linear AlkylBenzene) as neutrino target. Reactor antineutrino interactions will be detected by means of inverse beta decay with the emission of a positron and analysis of the resulting luminescent light. An experimental setup for a lifetime determination of orthopositronium formed by positrons in the LS has been developed in Munich. In this talk an overview of the setup is presented as well as data obtained by detailed Monte-Carlo simulations and final measurement results. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the Maier-Leibniz-Laboratorium.

T 9.2 Mo 16:15 Z6 - HS 0.002

Monitoring Systems for the Filling of the Central Detector of JUNO — •Hans Th. J. Steiger, Mathias Walter, Philipp Landgraf, Lothar Oberauer, Andreas Ulrich, Sabrina Franke, Julia Sawatzki, Mario Schwarz, Konstantin Schweizer, and Marc Tippmann — Technische Universität München, Physik Department, James-Franck-Straße 1, 85748 Garching bei München

In the planned JUNO (Jinangmen Underground Neutrino Observatory) Detector 20 kt of liquid scintillator (LS) will be used as neutrino target. A 120 mm thin highly transparent acrylic hollow sphere stores the target in a water tank. Slightly different filling levels in the tank and the sphere during the filling of these volumes could cause fatal damage of the detector. Therefore precise monitoring of the hydrostatic and gas pressure in both volumes as well as controling the mechanical stress on the acrylic is necessary. Also the filling levels in the water tank and the sphere has to be monitored. For this tasks first concepts and developements carried out in Munich are presented in this talk. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the Maier-Leibniz-Laboratorium.

T 9.3 Mo 16:30 Z6 - HS 0.002

Status update on the laser system for monitoring the liquid scintillator transparency in JUNO — •Wilfried Depnering for the JUNO-Collaboration — Institute for Physics, JGU Mainz, Germany

In the last years, large-volume liquid scintillator (LS) detectors have made important contributions to low-energy neutrino physics. A future neutrino detector scaling this technology to 20 kt is the Jiangmen Underground Neutrino Observatory (JUNO). Its primary goal is to determine the neutrino mass hierarchy with at least 3σ significance. To reach that goal, an energy resolution of 3% @ 1 MeV is required. Therefore, the transparency of the LS has to be sufficiently high and stable during the whole operation time (attenuation length $\geq$ 20 m @ 430 nm).
One device for in-situ monitoring of the optical LS quality is a laser system inside the central detector of JUNO. It allows to detect potential aging effects of the liquid and a gradient in its refractive index. The latter can be caused by a temperature gradient and would lead to curved light propagation, which would need to be taken into account during the event reconstruction.

This talk presents the current status of the laser system. The development is funded by the DFG research unit "JUNO".

T 9.4 Mo 16:45 Z6 - HS 0.002

Cavity enhanced long light path attenuation length measurement — •Tobias Heinz, Tobias Lachenmaier, David Blum, Alexander Tietzsch, Axel Müller, Tobias Sterr, and Marc Breisch — Physikalisches Institut, Universität Tübingen

In large liquid scintillator detectors like the JUNO detector a high optical transparency for the produced scintillation light is one of the key requirements for the detector material. To quantify the optical transparency a measurement of the attenuation length is crucial.

The required attenuation length for the liquid scintillator used in the JUNO detector should be greater than 22 m @ 430 nm. The measurement of such a high value is difficult with commercial UV-VIS spectrometers due to the shortness of commonly used absorption cells and the corresponding small decrease in light intensity. This talk will present an alternative method to measure the attenuation length of liquid scintillators using an optical cavity to extend the effective light path through the medium and therefore increases the precision of the attenuation measurement. The current status of the experimental setup and some first results will be presented.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.5 Mo 17:00 Z6 - HS 0.002

Status Update of the PALM Setup — •Sabrina Franke[1], Julia Sawatzki[1], Lothar Oberauer[1], and Andreas Ulrich[2] for the JUNO-Collaboration — [1]Technical University of Munich, Physics Department, E15, James-Franck-Str 1, 85748 Garching — [2]Technical University of Munich, Physics Department, E12, James-Franck-Str 1, 85748 Garching

Status update of the Precision Attenuation Length Measurement Setup (PALM) in the framework of the JUNO collaboration. The Jiangmen Underground Neutrino Observatory is a 20 kt liquid scintillator neutrino detector. Its primary goal is the determination of the neutrino mass hierarchy. To achieve this, precision measurements of the reactor antineutrino survival probability will be done. Due to the detector's diameter of approx. 40 m, the attenuation length is a crucial parameter for the energy resolution an can not be measured with commercially available spectrometers in the needed order of magnitude (10 cm vs. meter range). Therefore, the PALM setup was developed, which make it possible to measure light paths through the medium up to approx. 2.9 m and to determine the attenuation length very precisely. In this talk, a status update on measurements with the PALM experiment will be given. This work is sponsored by the DFG - JUNO funding.

T 9.6 Mo 17:15 Z6 - HS 0.002

Radon Monitoring in gaseous Nitrogen used for the Filling of the Central Detector of JUNO — •Hans Th. J. Steiger, Philipp Landgraf, Lothar Oberauer, Mathias Walter, Hermann Hagn, Sabrina Franke, Julia Sawatzki, Mario Schwarz, Konstantin Schweizer, and Marc Tippmann — Technische Universität München, Physik Department, James-Franck-Straße 1, 85748 Garching bei München

The planned JUNO (Jinangmen Underground Neutrino Observatory) Detector will use 20 kt of liquid scintillator (LS) based on LAB (Linear AlkylBenzene) as neutrino target within an acrylic sphere with a diameter of 35.4 m. For the filling of this sphere with LS pressurized gaseous nitrogen will be used. To avoid a contamination of the LS with ^{222}Rn, it's content in the nitrogen gas will be monitored. In this talk the status of a prototype radon monitoring system based on a proportional chamber as well as a setup for nitrogen scintillation counting, developed at Technische Universität München, are presented. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the Maier-Leibnitz-Laboratorium.

T 9.7 Mo 17:30 Z6 - HS 0.002

The OSIRIS pre-detector - A radioactivity monitor for the JUNO liquid scintillator — •Paul Christian Hackspacher[1], Michael Wurm[1], Sebastian Lorenz[1], and Christoph Genster[2] for the JUNO-Collaboration — [1]Johannes Gutenberg Universität Mainz — [2]Forschungszentrum Jülich

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator reactor neutrino experiment currently being built in the Guangdong province in southern China. In order to reliably reconstruct neutrino-induced inverse beta decay events from photomultiplier signals, scintillator purity is imperative. Potential air leaks in the filling and cycling lines or failures of the purification plants are risks that endanger the high radiopurity necessary to obtain clean signals within such a large active target volume. The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) is being developed as a failsafe monitor to assess the quality of the scintillator batches before filling them into the central detector. A Monte Carlo simulation serves as a feasibility study and is used to investigate the sensitivity limits of such a system. This talk will present the current status, estimated sensitivity and future plans for the OSIRIS pre-detector.

T 9.8 Mo 17:45 Z6 - HS 0.002

First results from the PMT Mass Testing System for JUNO — •Alexander Tietzsch[1], Björn Wonsak[2], Tobias Lachenmaier[1], Caren Hagner[2], Tobias Sterr[1], Malte Stender[2], Henning Rebber[2], David Meyhöfer[2], David Blum[1], Tobias Heinz[1], Axel Müller[1], and Marc Breisch[1] for the JUNO-Collaboration — [1]Physikalisches Institut, Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

To reach the goal of determining the neutrino mass hierarchy, all parts of the JUNO experiment need to hit certain quality criteria, especially those which are related to the final energy resolution of the detector. This is relevant in particular for the 20'000 20-inch photomultiplier tubes (PMTs) intended to be used in JUNO. Therefore, all PMTs will be checked and characterized with a PMT mass testing facility before being mounted into the JUNO detector. With this PMT mass testing system, several key characteristics like dark rate, peak-to-valley ratio, photon detection efficiency and timing resolution are targeted to be measured in a stable and comparable way and compared to the requirements of JUNO.

In this talk, we will focus on the data taking with the PMT mass testing facility for JUNO, the current status of the data acquisition methods, the progress in the PMT testing and some preliminary results from the first batch of PMTs will be presented.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.9 Mo 18:00 Z6 - HS 0.002

The PMT Mass Testing System for the JUNO Experiment using commercial shipping containers — Caren Hagner[1], David Meyhöfer[1], Henning Rebber[1], •Malte Stender[1], Björn Wonsak[1], David Blum[2], Marc Breisch[2], Tobias Heinz[2], Tobias Lachenmaier[2], Axel Müller[2], Tobias Sterr[2], and Alexander Tietzsch[2] for the JUNO-Collaboration — [1]Institut für Experimentalphysik, Universität Hamburg — [2]Physikalisches Institut, Eberhard Karls Universität Tübingen

JUNO is a 20 kt liquid scintillator detector, which observes reactor antineutrinos. To reach its goal of determining the neutrino mass hierarchy, an energy resolution of 3 % @ 1 MeV or better is one of the key requirements of the upcoming JUNO experiment, which is currently under construction in China. Therefore, an optical coverage greater than 75 % and a photon detection efficiency greater than 27 % are needed. This will be realized by about 20000 20-inch-PMTs and up to 25000 3-inch-PMTs used in the experiment.

Further, it is indispensable that every PMT used in JUNO is tested and characterised with respect to e.g. quantum efficiency, dark noise rate and time resolution. The testing takes place in commercial shipping containers equipped with a PMT mass testing facility setup.

In this talk, we present the concept of the test facility, give details about the used structure and electronics and report about the commissioning of the first system in southern China during the last year.

This work is supported by the Deutsche Forschungsgemeinschaft.

T 9.10 Mo 18:15 Z6 - HS 0.002

Studies on trigger configuration for the JUNO experiment — •Rikhav Shah[1], Yaping Cheng[1], Christoph Genster[1], Philipp Kampmann[1], Livia Ludhova[1], Michaela Schever[1], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1] — [1]IKP-2 Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator neutrino detector under construction in China, aiming to determine the neutrino mass hierarchy, one among other open questions in neutrino physics. The measurement of the oscillation pattern of reactor electron anti-neutrinos reaching the detector is expected to lead to a 3-4 σ sensitivity on the mass hierarchy within 6 years of data taking. The detector is designed to achieve an energy resolution

of 3% at 1 MeV. In addition, the effect of the dark rate of the 18,000 20-inch PMTs must be carefully considered. A study of the realistic dark-noise and other background hits in the PMTs and their effect on the detection of low-energy events will be presented.

T 10: Higgs: Erweiterte Modelle I

Zeit: Montag 16:00–18:30 Raum: Z6 - HS 0.004

T 10.1 Mo 16:00 Z6 - HS 0.004

Absorbing corrections due to supersymmetric particles to Higgs couplings in effective parameters in the decay $H \to hh$ — •Max Stadelmaier[1], Margarete Mühlleitner[1], Michael Spira[2], and Stefan Liebler[1] — [1]Institut für Theoretische Physik (ITP), KIT, Karlsruhe, Deutschland — [2]Labor für Teilchenphsik (LTP), PSI, Villigen, Schweiz

Since the Large Hadron Collider (LHC) has not discovered any supersymmetric (SUSY) partners to Standard Model (SM) particles yet, they are likely to exist at higher mass scales. The SUSY particles also contribute indirectly in higher-order corrections to the Higgs boson observables of the extended Higgs sector of the minimal supersymmetric extension of the SM (MSSM), namely to the partial decay widths of Higgs-to-Higgs decays. We compute the higher order corrections to the decay $H \to hh$ of the heavier of the two CP-even Higgs bosons, H, into a pair of lighter SM-like Higgs bosons, h. Assuming the SUSY particles to be very heavy we use an effective 2-Higgs-doublet model. We thoroughly investigate the correct matching conditions to the underlying full theory of the MSSM with heavy superpartners and compare the effective 2HDM-like calculation with the full MSSM result. We delineate the parameter regions where this approximation is valid.

T 10.2 Mo 16:15 Z6 - HS 0.004

Searching for new light higgs bosons at the ILC — •Yan Wang[1,2] and Jenny List[1] — [1]DESY, Hamburg, Germany — [2]IHEP, Beijing, China

In many new physics models with additional Higgs sectors, e.g. 2HDM, NMSSM, there exist one or more light scalars h. Thereby, the coupling of such scalars to the Z boson can be small, as expected if the 125 GeV Higgs boson remains Standard-Model-like as measurements of uncertainties shrink. Light higgs bosons with suppressed couplings to the Z boson would in turn have escaped from the detection at LEP, due to LEP's limited luminosity. With a factor 1000 higher luminosity and polarized beams, the International Linear Collider (ILC) is expected to have substantial discovery potential for such states. Furthermore, searching additional scalars at LEP and LHC are usually dependent on the model details, such as decay channels, so it is necessary to have a more general analysis with model-independent assumptions.

In this work, we perform a search for light scalars produced in association with the Z boson at the ILC with a center-of-mass energy of 250 GeV, using the full Geant4-based simulation of the ILD detector concept. For a model-independent consideration, the analysis is performed using the recoil technique, in particular with the Z boson decaying into a pair of muons. As a preliminary result, the ILC's discovery and exclusion potential will be shown for different higgs masses between 10 and 115 GeV.

T 10.3 Mo 16:30 Z6 - HS 0.004

Search for heavy Higgs bosons in the $H \to \tau_{\mathrm{had}}\tau_{\mathrm{had}}$ channel with the ATLAS detector — •Lino Gerlach, Michel Janus, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

In 2012, a scalar boson was found at CERN that is consistent with the properties of the Higgs boson predicted by the Standard Model of particle physics. Some theories, in particular supersymmetric models, also predict the existence of additional heavier neutral Higgs bosons. The decays of these heavy Higgs bosons to a pair of τ leptons can be siginificant because of the high mass of the τ lepton and additional effects of two-Higgs-doublet models that can enhance the coupling to down-type fermions.

In this talk, details of the search for $H \to \tau\tau$ in the fully hadronic channel using 36.1 fb^{-1} of proton-proton collision data taken with the ATLAS experiment at a centre-of-mass energy of $\sqrt{s} = 13$ TeV will be presented. Special emphasis will be placed on the background estimation of jets that are falsely identified as hadronically decaying τ leptons, which play an important role in many different analyses. This universal approach in determining the misidentification probability will also be presented.

T 10.4 Mo 16:45 Z6 - HS 0.004

Search for additional Higgs bosons in WW final states with CMS — David Brunner, Jordy Degens, Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, •Dennis Roy, Hale Sert, Achim Stahl, and Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

One of the most promising models beyond the Standard Model is the Minimal Supersymmetric extension to the Standard Model (MSSM). Setting limits on the parameter space of the MSSM is mandatory in order to provide constraints for further experimental and theoretical studies. As with any 2HDM, five different Higgs bosons are predicted. In various scenarios of the MSSM the decay of the heavy scalar Higgs boson H into two W bosons provides sensitivity on two important parameters in the Higgs sector, $\tan\beta$ and m_A, in a region where analyses of other final states are less sensitive.
In this talk the results of this BSM $H \to WW$ analysis are presented, which show limits in the parameter space of a general 2HDM, as well as model dependent limits of MSSM scenarios. The data used was recorded in 2016 by CMS at a center-of-mass energy of 13 TeV, which corresponds to an intergrated luminosity of 35.9 fb^{-1}.

T 10.5 Mo 17:00 Z6 - HS 0.004

Search for Higgs boson pair production in the $\gamma\gamma WW^*$ final state with a boosted topology using ATLAS data — •Kira Abeling, Joshua Beirer, Jason Veatch, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

Since the discovery of the Higgs boson in 2012, many studies have been performed to compare its properties with Standard Model (SM) predictions. In particular, a direct measurement of the Higgs self-coupling is important to characterise the Higgs potential.

Furthermore, it is known that there must be physics beyond the SM. One set of extensions, known as two Higgs doublet models (2HDMs), predicts five Higgs bosons in total, of which two are CP-even and neutrally charged differing by their mass. The heavy Higgs boson, H, can decay in two light Higgs bosons, h, which have the properties of the discovered Higgs boson. The mass of the heavy Higgs is a free parameter and can exist within a large range.

In this talk, a search for di-Higgs production in the $\gamma\gamma WW^*$ decay channel using $\sqrt{s} = 13$ TeV pp collision data collected by the ATLAS experiment in 2015 and 2016 is discussed. This channel combines the clean signal of the di-photon system and the high branching ratio of $h \to WW^*$. Since only large resonant masses are considered, the jets from the W boson decay cannot be resolved completely. This yields a boosted topology and the W boson decay products are collected in a single large-R jet. This talk covers analyses in both the fully hadronic and the 1-lepton final states.

T 10.6 Mo 17:15 Z6 - HS 0.004

Interference modelling of the heavy Higgs boson decaying into $t\bar{t}$ final states at the ATLAS experiment — Katharina Behr[1], •Yu-Heng Chen[1], Klaus Mönig[1], and Jike Wang[2] — [1]DESY, Hamburg, Germany — [2]Heidelberg PI, Heidelberg, Germany

The first search for heavy (pseudo)scalar Higgs bosons A/H decaying into a top-antitop-quark pair ($t\bar{t}$) including interference effects at the Large Hadron Collider (LHC) has been performed by the ATLAS collaboration on 20.3 fb^{-1} of $\sqrt{s} = 8$ TeV proton-proton collision data. The interference between the signal and the dominant background from standard model $t\bar{t}$ production significantly distorts the signal shape from a simple Breit-Wigner peak to a peak-dip structure; hence, the potential to observe such a signal relies on a precise understanding and modelling of the lineshape of both the signal and the background.

The contribution introduces the major challenges and techniques including model implementation, fitting and efficient MC signal sample

production/recycling via reweighting used at the ATLAS experiment. The results are interpreted in terms of the framework of the Type-II two-Higgs-doublet models (2HDM) as well as an extension to dark matter models.

T 10.7 Mo 17:30 Z6 - HS 0.004

Combination of di-Higgs searches using 13 TeV data collected by the ATLAS detector — •Florian Beisiegel, Alessandra Betti, Jochen Dingfelder, Tatjana Lenz, Alexander Melzer, and Norbert Wermes — University of Bonn

The discovery of the SM Higgs boson in 2012 was a great success of modern particle physics since it served as a proof of the Higgs mechanism introduced in 1964.
One focus of the current particle physics experiments at the LHC is the measurement of the Higgs properties, such as its coupling strengths to fundamental particles. In addition to the coupling of the Higgs boson to fermions and gauge bosons, the Higgs mechanism also predicts a coupling to itself. In the SM, there exist 3-Higgs couplings, leading to di-Higgs production. Searches for Higgs boson pair-production are thus a promising way to measure the triple Higgs boson coupling strength. Another important part of di-Higgs analyses is the search for new physics by looking for resonances where a new particle X decays into two Higgs bosons. For these, upper limits on the cross section times branching ratio of the considered processes can be calculated. In addition, the results can be interpreted in various BSM models to determine constraints on the model parameters.
By combining di-Higgs searches with different final states like $b\bar{b}b\bar{b}$, $b\bar{b}\tau\tau$ and $b\bar{b}\gamma\gamma$, the upper limits can be further improved. This talk presents such a combination of different di-Higgs analyses using $36.5\,\mathrm{fb}^{-1}$ of $\sqrt{s} = 13\,\mathrm{TeV}$ data collected with the ATLAS detector.

T 10.8 Mo 17:45 Z6 - HS 0.004

Extension of searches for additional MSSM Higgs boson with the CMS experiment towards the NMSSM — Roger Wolf, René Caspart, •Irina Fateeva, and Günter Quast — Karlsruhe Institute of Technology, Karlsruhe

The MSSM predicts the existence of five Higgs bosons, two charged ($H^{\pm}$) and three neutral (h, H, A). In the Next to Minimal Supersymmetric Standard Model (NMSSM), additionally to the Higgs boson fields of the MSSM, one complex SU(2) singlet field $\hat{S}$ is added, which leads to overall 7 Higgs bosons. For the work presented in this talk the results of the search for additional neutral MSSM Higgs bosons in the di-τ final state by CMS are re-interpreted in an NMSSM scenario, which allows for high values of $tan\beta$. The studies are based on the most recent publication of the search for additional neutral MSSM Higgs bosons with CMS.

T 10.9 Mo 18:00 Z6 - HS 0.004

Search for heavy Higgs resonances in the boosted $H \to hh \to WW\tau\tau$ $\to$1 lepton + jets channel — •Nils Gillwald, Jason Veatch, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

With the discovery of the Higgs boson in 2012, the final elementary particle of the Standard Model was discovered. The observation of Higgs boson pair production would allow a direct measurement of the Higgs potential, which is an important parameter to understand the nature of the Higgs field. Additionally, several BSM models such as two Higgs doublet models and Kaluza-Klein theories predict heavy resonances that can decay into a pair of Higgs bosons.

With a branching ratio of 1.3%, the hh to $WW\tau\tau$ channel is the sixth largest di-Higgs decay channel and has never been investigated before. This talk covers an analysis-in-progress on the prospects for searching for boosted di-Higgs events produced via a heavy BSM Higgs resonance in the $H \to hh \to WW\tau\tau \to 1$ lepton + jets channel with the current ATLAS data. The boosted topology is sensitive to high heavy higgs masses and provides excellent suppression of QCD jet background, compensating the small branching ratio of the channel.

T 10.10 Mo 18:15 Z6 - HS 0.004

Probing CP Properties of the Higgs boson with Higgs signal rates from Tevatron and LHC data — •Tobias Klingl[1], Philip Bechtle[1], Tim Stefaniak[2], Sven Heinemeyer[4], Georg Weiglein[2], and Daniel Dercks[3] — [1]Universität Bonn — [2]Deutsches Elektronen-Synchrotron Hamburg — [3]Universität Hamburg — [4]Instituto de Física Teórica Madrid

The Higgs boson found at the LHC is experimentally in agreement with the SM prediction. However, it is still a possibility that it consists of an admixture of a CP-even Higgs-like scalar h and a CP-odd pseudoscalar A as described by the general parametrization $\phi = h\cos\alpha + A\sin\alpha$. Using the program `HiggsSignals` we investigate the scope of possible deviations of the mixing α from its SM prediction $\alpha = 0$. To this end, we consider Higgs coupling benchmark scenarios with scalar and pseudoscalar scale factors for the couplings to fermions and one common scale factor for the coupling of h to the SU(2) gauge bosons. The latter is assumed to be ≤ 1 as predicted in many models such as SUSY or 2HDM. Although there are no renormalizable couplings of A to the SM gauge bosons at tree level such couplings might be induced through loop corrections of new heavy fields. We investigate this possibility with an effective field theory formulation using higher-dimensional operators. We obtain constraints on α from χ^2 fits to the official signal rates from a combined ATLAS and CMS analysis.

T 11: QCD / Partonstruktur

Zeit: Montag 16:00–18:15 Raum: Z6 - SR 1.002

T 11.1 Mo 16:00 Z6 - SR 1.002

Messung des Wirkungsquerschnitts der Z+Jet-Produktion im myonischen Zerfallskanal mit dem CMS-Detektor bei $\sqrt{s} = 13$ TeV zur Verbesserung der Proton-PDFs — •Thomas Berger und Klaus Rabbertz — Institut für Experimentelle Teilchenphysik, KIT, Karlsruhe, Deutschland

Die Messung des Z+Jet-Wirkungsquerschnitts am LHC bietet aufgrund der klaren Signatur des Prozesses einen hervorragenden Test für die Vorhersagen des Standardmodells. Durch die präzise Rekonstruktion des Z-Bosons im myonischen Zerfallskanal können zusätzlich die Parameter der Partonverteilungsfunktion (PDF) des Protons weiter eingeschränkt werden.

Die präsentierte Analyse basiert auf dem vollständigen Datensatz, der vom CMS-Experment im Jahr 2016 aufgenommen wurde. Der Z+Jet-Wirkungsquerschnitt wird dreifach-differentiell in Abhängigkeit von Transversalimpuls p_T^Z des Z-Bosons, sowie Rapiditätsdifferenz y^* und Gesamtboost y_b des Z+Jet-Systems gemessen. Diese Herangehensweise erlaubt die Entkopplung der PDFs vom Matrixelement und ermöglicht damit eine genauere Bestimmung ebenjener Verteilungsfunktionen.

T 11.2 Mo 16:15 Z6 - SR 1.002

Measurements of Durham, anti-k_t and SIScone jet rates at LEP with the OPAL detector — •Andrii Verbytskyi — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

The jet production in e^+e^- annihilation to hadrons is studied with data recorded by the OPAL experiment at LEP at multiple centre-of-mass energies. The jet production rates were measured with Durham and for the first time with the anti-k_t and SISCone jet clustering algorithms and compared to predictions by modern Monte Carlo event generators.

T 11.3 Mo 16:30 Z6 - SR 1.002

Measurement of the diffractive cross sections with the CMS experiment at 13TeV — •Melike Akbiyik, Ralf Ulrich, and Sebastian Baur — KIT, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

The cross section for single and double diffractive processes is measured at the CERN LHC with the CMS experiment in proton-proton collisions at 13TeV. The CASTOR calorimeter is a crucial part of the analysis, since it is suited to distinguish between single and double diffraction. A multivariate classification with BDTs is employed for the core task. As input serve pixel tracks (with no magnetic field in CMS) combined with towers from all calorimeters, covering the enormous continuous acceptance from -6.6<eta<+5.2. The results are the first measurements of diffractive cross sections at 13TeV so far. The

data challenges some of the model predictions, and favors smaller values of single diffraction towards the highest energies.

T 11.4 Mo 16:45 Z6 - SR 1.002

Measurement of observables sensitive to the underlying event in inclusive Z boson production at a centre of mass energy of 13 TeV with the ATLAS detector — •Lennart Adam — Institut für Physik, Staudingerweg 7, 55128 Mainz

This talk will summarize a full measurement of observables sensitive to the underlying event in proton- proton collisions at a centre-of-mass energy of 13 TeV. It is based on a data set collected during 2015 with the ATLAS detector at the Large Hadron Collider. The underlying event refers to all processes of a single proton-proton interaction which are not attributed to the hard scattering process. It is a background to all hadron collider experiments. Thus, a precise modelling of the underlying event is crucial to precision measurements, such as of the W boson mass. The analysis presented here evaluates the accuracy of recent MC models in simulating the underlying event. In order to measure the overall activity of the underlying event, the charged particle multiplicity, the sum of transverse momenta and the general pt-spectra of cherged particles are investigated. The observables are measured as a function of the hard scatter process represented by the creation of a Z boson subsequently decaying into a muon pair. A dedicated discussion of systematic uncertainties, e.g. pile-up effects, is included.

T 11.5 Mo 17:00 Z6 - SR 1.002

Determination of $\alpha_s(M_Z)$ from energy-energy correlations in electron positron annihilation — •Andriii Verbytskyi[1], Adam Kardos[2], Stefan Kluth[1], Gabor Somogyi[2], and Zoltan Tulipant[2] — [1]Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München — [2]MTA-DE Particle Physics Research Group, University of Debrecen, 4010 Debrecen, PO Box 105, Hungary

A determination of the strong coupling constant from data collected in e^+e^- collisions is presented. The measurements of energy-energy correlation from multiple experiments confronted with perturbative and resummed QCD predictions. The nonperturbative effects are studied and incorporated in the analysis via Monte Carlo models that include modern shower algorithms and higher order corrections to QCD matrix elements.

T 11.6 Mo 17:15 Z6 - SR 1.002

Measurement of W/Z production in the high p_{T}, boosted region at CMS — •Jindrich Lidrych, Hannes Jung, and Paolo Gunnellini — DESY, Hamburg, Germany

Decay products of the W/Z boson with the very high transverse momentum (p_{T}) are collimated in the momentum direction of the mother particle and are merged into a fat jet with the characteristic substructure. Since the properties of the W and Z boson are precisely predicted by the Standard Model (SM), the measurements with the boosted W/Z boson can be in particular interesting for probing the SM at the extreme energies.

In this talk, we will present the Monte Carlo simulations on the detector level for the the measurement of W/Z production in the boosted region at CMS. This study will be used for the experimental reconstruction of boosted objects to measure the production of W/Z with the high p_{T} in proton-proton collisions at $\sqrt{s} = 13$ TeV collected by the CMS experiment at the LHC.

T 11.7 Mo 17:30 Z6 - SR 1.002

Determination of the total cross section and the ρ-parameter in proton–proton collisions at the LHC at $\sqrt{s} = 13$ TeV from elastic scattering using the ALFA sub-detector of ATLAS — •Christian Heinz, Hasko Stenzel, and Michael Düren — 2. Physikalisches Institut, Universtät Gießen

The ALFA (Absolute Luminosity for ATLAS) Roman Pot detector system is part of the forward instrumentation of ATLAS located about 240 m downstream of the interaction point in the LHC tunnel. ALFA consists of scintillating fibre trackers housed in vertical Roman Pots which enable the measurement of elastic proton-proton scattering at small scattering angles. In 2016, data were recorded at a centre-of-mass energy of $\sqrt{s} = 13$ TeV during several fills with special beam optics of the LHC with $\beta^* = 2.5$ km and parallel-to-point focusing.

The four-momentum transfer t is measured for elastically scattered protons and used to extract the differential elastic cross section including the Coulomb nuclear interference region. In this talk a progress report of the determination of the total cross section, the nuclear slope of the elastic cross section and of $\rho = \frac{\Re f_{el}(t\to 0)}{\Im f_{el}(t\to 0)}$ at small $|t|$ is given.

T 11.8 Mo 17:45 Z6 - SR 1.002

Studien zur PDF-Sensitivität anhand des dreifach-differentiellen Z+Jet-Wirkungsquerschnitts — •Miguel Santos Correa, Jakob Stark und Klaus Rabbertz — Institut für Experimentelle Teilchenphysik, KIT, Karlsruhe, Deutschland

Die Produktion von Jets in Assoziation mit einem Z-Boson bietet eine gute Möglichkeit für die präzise Bestimmung der Partonverteilungsfunktionen (PDFs) des Protons. Aufgrund des hohen Anteils von Quark-Gluon-Streuereignissen können Messungen des Z+Jet Wirkungsquerschnitts insbesondere Auskunft über die Gluon-PDF geben.

Für eine Studie der PDF-Sensitivität werden Messungen und Theorievorhersagen des dreifach-differentiellen Z+Jet Wirkungsquerschnitts untersucht. Dieser wird in Abhängigkeit vom Transversalimpuls des Z-Bosons und zweier geometrischer Variablen betrachtet: die Rapiditätsdifferenz y^* und der Gesamtboost y_b des Z+Jet-Systems. Diese Aufteilung bewirkt eine bessere Trennung von Matrixelement- und PDF-bezogenen Effekten, wodurch eine erhöhte Präzision der PDF-Bestimmung zu erwarten ist.

Die Theorievorhersagen werden als fastNLO-Interpolationstabellen bereitgestellt und in Vergleichen mit Daten vom CMS-Experiment am LHC für die Bestimmung der PDFs verwendet.

T 11.9 Mo 18:00 Z6 - SR 1.002

Measurement of Associated Production of W+c and Determination of the Strange-Quark Content of the Proton — •Svenja Pflitsch, Katerina Lipka, and Benoit Roland — DESY

The measurement the of W+c production cross-section provides an opportunity to directly access the strange quark content of the proton at the electroweak scale.

We focus on $W \to l\nu$ and $c \to D^*$ as probes of W+c since both, W-boson and D-Meson, can be measured with good accuracy by the CMS-detector. Further the fragmentation of charm quarks into D-mesons is well measured. The data taken by the CMS-experiment at the LHC in 2016 offers sufficient statistics for an analysis of the pseudorapidity-distribution of the muon coming from the decay of the W-boson. We present the results for the inclusive and differential cross section of W+charm, as well as comparisons to theoretical predictions at Next-to-Leading order (NLO).

The results from this analysis are used as input for a QCD analysis at NLO to determine the strange-quark distribution and extract the strangeness fraction of the proton.

T 12: Theorie: Flavourphysik / Neutrinophysik

Zeit: Montag 16:00–17:45 Raum: Z6 - SR 1.010

T 12.1 Mo 16:00 Z6 - SR 1.010

Manipulating flavour models with invariants — •Wolfgang G. Hollik[1] and Ulises J. Saldana-Salazar[2] — [1]DESY, Hamburg, Germany — [2]TTP KIT, Karlsruhe, Germany

Quark and lepton mass matrices are unphysical in their full generality. We present a simple interpretation of mass matrix elements based on the trace invariant to reduce the initial arbitrariness. In this parametrization, we can reproduce certain popular flavour textures from an aligmnent mechanism. Similarly, slight misaligment easily reproduces Froggatt–Nielsen-like suppression factors without the need of a large scale hierarchy.

T 12.2 Mo 16:15 Z6 - SR 1.010

$D^0 \to KK^*$ as a discovery mode for charm CP violation — •Ulrich Nierste[1] and Stefan Schacht[2] — [1]Inst. f. Theor. Teilchenphysik, KIT, Karlsruhe — [2]Dipartimento di Fisica, Università di Torino und INFN, Sezione di Torino, Turin, Italien

CP violation in the charm system has not been observed yet. We ar-

gue that the decay mode $D^0 \to KK^*$ is very promising for a discovery, because the Standard Model permits a large CP asymmetry and the measurement requires no flavour tagging.

T 12.3 Mo 16:30 Z6 - SR 1.010

New Physics in $\mathbf{B \longrightarrow D^{(*)}\ell\bar{\nu}_\ell}$ — •Kilian Lieret and Thomas Kuhr — LMU, Munich, Germany

Measurements of $B \longrightarrow D^{(*)}\ell\bar{\nu}_\ell$ branching fraction ratios currently challenge lepton universality and thus the Standard Model at a four sigma level. This talk focuses on how to discriminate between different kinds of possible new physics contributions. Based on the full angular distribution of the decay, several observables for different new physics scenarios are considered. Furthermore, we will reanalyze Belle I data in order to provide more specific distributions for phenomenological studies.

T 12.4 Mo 16:45 Z6 - SR 1.010

Pion light-cone distribution amplitude from data on pion form factors — •Aleksey Rusov, Alexander Khodjamirian, and Chan Cheng — University of Siegen

An accurate extraction of the pion light-cone distribution amplitude (LCDA) is important in the framework of different approaches such as Soft-Collinear Effective Theory (SCET), Light-Cone Sum Rules (LCSR), QCD factorization (QCDF).

We revisit the LCSRs for the spacelike electromagnetic pion and the $\pi\gamma^*\gamma$ form factors. The LCSR results are related with experimental data on these form factors at timelike region by means of a dispersion relation. This allows for extracting and constraining the Gegenbauer moments of the pion LCDA.

T 12.5 Mo 17:00 Z6 - SR 1.010

GUT Baryogenesis, Radiative Neutrino Mass and Scalar Dark Matter — •Sinan Zeissner — TU-Dortmund

We explore an interesting interplay between dark matter phenomenology, neutrino mass generation and baryogenesis in the context of the scotogenic model. In this model additional right-handed Majorana neutrinos can induce lepton number violating processes that can transform an original $B+L$ asymmetry into a $B-L$ asymmetry which later on is converted into a baryon asymmetry by sphaleron processes. The corresponding region in the parameter space also allows for the radiative generation of neutrino masses and dark matter production.

T 12.6 Mo 17:15 Z6 - SR 1.010

Type I Seesaw Neutrino Portal to Dark Matter — •Mathias Becker — TU Dortmund, Dortmund, Germany

The most popular model to explain the observed Dark Matter (DM) relic density assumes DM to couple to the SM via electroweak gauge interactions.

However, it is also possible that DM is an electroweak gauge singlet. In this case, to couple DM to the SM a mediator is required. One of the three renormalizable portal couplings is the neutrino portal, which also allows for the generation of the observed neutrino masses.

We explore neutrino portal DM, where the neutrino mass is generated by a type I seesaw mechanism and we investigate the case where the right handed neutrino is allowed to propagate in an extra dimension.

T 12.7 Mo 17:30 Z6 - SR 1.010

Neutrino oscillations in the presence of asymmetrically warped extra dimensions — •Dominik Döring — TU Dortmund, Dortmund, Germany

We study a brane model with a compactified and asymmetrically warped extra dimension. Two additional non-active neutrinos are introduced, one being responsible for neutrino mass generation, while the other is allowed to propagate in the extra dimension, leading to an alteration of the dispersion relation on the brane.

We discuss the shape of the Kaluza-Klein tower and explore the effects on active-sterile neutrino oscillations in this model, making a connection to previous semi-classical asymmetric warping models.

T 13: Theorie: QFT / Gittereichtheorie

Zeit: Montag 16:00–17:30 Raum: Z6 - SR 1.013

T 13.1 Mo 16:00 Z6 - SR 1.013

$\mathcal{N} = 1$ supersymmetric Yang-Mills theory and the gluino condensate from the gradient flow — Sajid Ali[1], Georg Bergner[2], Henning Gerber[1], Pietro Giudice[1], •Camilo Lopez[2], Istvan Montvay[4], Gernot Münster[1], Stefano Piemonte[3], and Philipp Scior[1] — [1]University of Münster — [2]University of Jena — [3]University of Regensburg — [4]Deutsches Elektronen-Synchrotron (DESY)

This talk summarises results from lattice simulations of $\mathcal{N} = 1$ supersymmetric Yang-Mills theory for the gauge groups SU(2) and SU(3). It is expected that this theory has a phase with broken chiral symmetry and non-vanishing gluino condensate. I will discuss the first exploratory studies of the gluino condensate with the gradient flow. If composite operators of bare fields are evolved along a trajectory on field space by means of the flow equations, they become renormalised up to a multiplicative renormalisation constant for the fermionic fields. This allows to calculate the topological charge, chiral condensate and energy density in terms of bare flowed fields on the lattice. We begin exploring this technique by measuring the finite temperature behaviour of the gluino condensate.

T 13.2 Mo 16:15 Z6 - SR 1.013

$\mathcal{N}$=1 supersymmetric SU(3) Yang-Mills theory on the lattice — •Marc Steinhauser, André Sternbeck, Björn Wellegehausen, and Andreas Wipf — Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität Jena, Germany

Supersymmetric gauge theories are an important building block for extensions of the standard model. As a first step towards Super-QCD we investigate the pure gauge sector, in particular the bound states: meson-like gluinoballs, gluino-glueballs and pure glueballs. The talk will focus on different strategies to improve discretization artifacts, in which the chiral symmetry and the supersymmetry provide important guidelines. The supersymmetric continuum limit and particle masses are discussed and compared to predictions from effective field theory.

T 13.3 Mo 16:30 Z6 - SR 1.013

Elements of non-perturbative quark mass renormalization in three-flavour lattice QCD — Jochen Heitger[1], •Fabian Joswig[1], Simon Kuberski[1], and Anastassios Vladikas[2] — [1]Westfälische Wilhelms-Universität Münster, Institut für Theoretische Physik, Wilhelm-Klemm-Straße 9, 48149 Münster, Germany — [2]INFN, Sezione di Tor Vergata, c/o Dipartimento di Fisica, Università di Roma Tor Vergata, Via della Ricerca Scientifica 1, 00133 Rome, Italy

We report on advances in the determination of the ratio Z_S/Z_P of the scalar to the pseudoscalar renormalization constants in three-flavour lattice QCD with Wilson-clover quarks and tree-level Symanzik improved gluons. The computations are based on the Ward identity approach, using Schrödinger functional boundary conditions. Our results for Z_S/Z_P cover a range of couplings along a line of constant physics with lattice spacings of about 0.09 fm and below, relevant for phenomenological applications such as the non-perturbative renormalization of quark masses. We also outline a strategy to determine the charm quark's mass from $N_f = 2 + 1$ lattice QCD.

T 13.4 Mo 16:45 Z6 - SR 1.013

Non-perturbative improvement of quark mass renormalization in the small lattice spacing region of three-flavor lattice QCD — Patrick Fritzsch[1], Jochen Heitger[2], and •Simon Kuberski[2] — [1]Theoretical Physics Department, CERN, 1211 Geneva 23, Switzerland — [2]Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Straße 9, D-48149 Münster, Germany

The use of Heavy Quark Effective Theory (HQET) on the lattice as an approach to B-physics phenomenology is based on a non-perturbative matching of HQET to QCD in finite volume. As a first step to apply the underlying strategy in the three-flavor ($N_f = 2 + 1$) theory, we determine the renormalization constant and improvement coefficients relating the renormalized current and subtracted quark mass

of (quenched) valence quarks in $\mathcal{O}(a)$ improved $N_f = 3$ lattice QCD. We present first results of our calculation for the relevant parameter region towards weak couplings along a line of constant physics, which corresponds to lattice resolutions $a \lesssim 0.02\,\text{fm}$ and fixes the physical extent of the matching volume to $L \approx 0.5\,\text{fm}$.

T 13.5 Mo 17:00 Z6 - SR 1.013

Asymptotic freedom in Higgs-top-QCD model — •Alessandro Ugolotti, Holger Gies, Luca Zambelli, and René Sondenheimer — TPI, FSU Jena

We investigate the existence of asymptotically free trajectories for Higgs-top-QCD models by exploiting generalized boundary conditions. We construct quasi-fixed points for the scalar Higgs potential within different approximation schemes. We substantiate our findings first in standard perturbation theory for renormalizable couplings, then refine these results within an effective-field-theory approach, and obtain a comprehensive picture using the functional renormalization group. We infer the existence of scaling solutions also by means of a weak-Yukawa-coupling expansion in the far ultraviolet. In the same regime we discuss the stability of the quasi-fixed point solutions for large field. We provide further evidence for such asymptotically free theories by numerical studies using pseudo-spectral and shooting methods.

T 13.6 Mo 17:15 Z6 - SR 1.013

Trans-cutoff scattering in theory of a Goldstone boson — •Lukas Eisemann — LMU, Muenchen, Deutschland

In a model of a Nambu-Goldstone-type scalar, we consider $2 \to n$ scattering processes with the CM-energy E distributed equally over the n final quanta. We work out the scaling with n of the tree-level cross sections for these processes. At trans-cutoff energies, perturbative unitarity is violated for $2 \to \textit{few}$, while for n sufficiently large, the theory behaves perturbatively. The turning point n_t, which sets the boundary between in- and decreasing behaviour of the cross section with n, can be found in terms of the CM-energy E.

We then investigate whether the existence of the turning point n_t may indicate that, in trans-cutoff scattering, non-perturbative states, which correspond to certain classical solutions, play a role. We do so by checking whether the spatial extension of those classical solutions $R(E)$ scales in the same way with E as does the wavelength $\lambda(E) = n_t(E)/E$ of the final quanta in the scattering processes $2 \to n_t$.

T 14: Gasgefüllte Detektoren I

Zeit: Montag 16:00–18:20 Raum: Z6 - SR 2.002

Gruppenbericht T 14.1 Mo 16:00 Z6 - SR 2.002

High Resolution Neutron Detection — •Markus Köhli, Markus Gruber, Fabian Schmidt, Jochen Kaminski, and Klaus Desch — Physikalisches Institut, University of Bonn, Bonn, Germany

Over decades the quasi-standard for thermal neutron detection has been set by helium-3, which acts as a converter as well as counting gas. Fueled by the helium crisis and the demand of large scale research infrastructures like the European Spallation Source the run for substitutional technologies using boron layers started - most of them adopted from particle physics. The MediPix platform - CMOS based chips with $55\,\mu m$ sized pixels operated at clock speeds up to 80 MHz - has been successfully evaluated in various detectors. This contribution presents the technological capabilities of a highly granular CMOS readout for neutron detection and discusses the system developed in Bonn aiming to realize a neutron time projection chamber. In a detector with 8 TimePix chips equipped with InGrid meshes as a gas amplification stage, the track topology with this unrivaled high resolution has been studied. By reconstructing the origin of the conversion ions from a boron layer, arranged in parallel to the readout, a time resolution below 50 ns and a spatial resolution of $100\,\mu m$ has been achieved.

T 14.2 Mo 16:20 Z6 - SR 2.002

Study of gas amplification and ionization processes in GridPix detectors — Klaus Desch, •Markus Gruber, and Jochen Kaminski — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

GridPix detectors are gaseous detectors, which are based on a combination of a Timepix ASIC with a MicroMegas gas amplification stage. The MicroMegas is produced by photolithographic postprocessing techniques and can be aligned with the pixel structure so that one grid hole is directly above each pixel. This results in a low capacitance and thus low noise setup allowing for detection of low energetic events. Thus, the high resolution of the Timepix ASIC with its $55\,\mu\text{m} \cdot 55\,\mu\text{m}$ pixel pitch allows for high resolution detection of single primary electrons and gives very detailed event pictures.

These features can be used to study primary processes of photons or charged particles in the detector gas. In this talk I will present measurements of the gas amplification and ionization processes in such a GridPix based detector using the X-ray fluorescence of aluminum as photon source.

T 14.3 Mo 16:35 Z6 - SR 2.002

Einsichten in die Spurfindung an der Belle II-Driftkammer mithilfe von kosmischen Strahlen — Florian Bernlochner, Nils Braun, •Michael Eliachevitch, Thomas Hauth und Martin Heck — Karlsruher Institut für Technologie, ETP

Das Belle II-Experiment strebt an, die Zerfälle der am SuperKEKB-Beschleuniger produzierten B-Mesonen mit hoher Präzision zu messen. Die dafür notwendige Spurfindung basiert neben einem Vertexdetektor auf einer Driftkammer, die im Vergleich zum Vorgängerexperiment vergrößert wurde und eine von Grund auf neu entwickelte Rekonstruktionssoftware verwendet.

Im Sommer 2017 wurde mit dem Belle II-Experiment in einer dedizierten Datennahme kosmische Strahlung aufgezeichnet. In diesem Vortrag werden erste Studien aus dieser Datennahme vorgestellt, welche es erlauben Erkenntnisse über die Effizienz der Spurfindung in der Driftkammer zu gewinnen und deren Einsatzfähigkeit demonstrieren.

T 14.4 Mo 16:50 Z6 - SR 2.002

Set up of a new X-ray detector for CAST — •Tobias Schiffer, Klaus Desch, Jochen Kaminski, Christoph Krieger, and Sebastian Schmidt — Physikalisches Institut, Universität Bonn

The search for solar axions and chameleons with helioscopes like the CERN Axion Solar Telescope (CAST) requires detectors with very low background rates and high detection efficiency, since the expected rates are in the order of one per week and cm^2 or less in the region of 2 to 7 keV. For this, multipattern gaseous detectors like MicroMegas are a convenient solution. Due to their high granularity they achieve a very high spatial resolution, thus allowing eventshape reconstruction. An appropriate way to maximise the useage of the granularity is a pixelised readout chip, like the Timepix ASIC, with a perfectly aligned gas amplification stage on top. This so called GridPix is also able to detect single primary electrons giving a good energy reconstruction for X-rays.

The measurement of particles like axions or chameleons is done via conversion X-rays, so also the transmission for low energy X-rays has to be kept in mind. Taking these two major aspects into account a low background X-ray detector based on the GridPix technology has been developed and built, including subcomponents like a 300 nm thick vacuum tight entrance window, closed loop water cooling, FADC trigger recording the analogue signal induced on the grid and veto scintillators.

The challenges of the developement and construction will be discussed, also some first results will be presented.

T 14.5 Mo 17:05 Z6 - SR 2.002

Konzeption eines Systems zur Messung von Gasverstärkungsprozessen in Micromegas-Detektoren bei variablem Druck — •Robin Boshuis, Raimund Ströhmer, Deb Sankar Bhattacharya und Thorben Swirski — Universität Würzburg

Das Verhalten der Gasverstärkung eines Micromegas-Detektors hängt von der Stärke des elektrischen Feldes, der Höhe der Verstärkungsregion sowie des Gasdrucks ab. Die Elektronen werden im el. Feld beschleunigt und können bei ihren Stößen mit den Gasmolekülen weitere Elektronen auslösen. Während man durch die Variation des Feldes den Energiegewinn - und dadurch die Ionisationswahrscheinlichkeit - zwischen zwei Stößen verändern kann, hat die Variation des Abstandes von Anode zu Gitter eine Auswirkung auf die Gesamtanzahl der Stöße bis zum Ende der Kaskade. Da eine systematische Variation der Höhe des Verstärkungsbereichs komplex in der Umsetzung

ist, wird ein alternativer Ansatz gewählt, in dem der Druck variiert wird, was ebenfalls die Gesamtanzahl der Stöße ändert. Die Spannung kann so gewählt werden, dass sich der mittlere Energiegewinn zwischen zwei Stößen nicht ändert. Dazu wurde der vorhandene Höhenstrahlungsteststand durch eine Druckkammer erweitert, in der der Absolutdruck zwischen 500mbar und 1500mbar verändert werden kann. In diesem Vortrag werden die Konzeption der Druckkammer und die damit einhergehenden notwendigen Änderungen am Messaufbau beschrieben. Außerdem werden erste Messungen der Gasverstärkung an Bulk-Micromegas-Detektoren bei variablem Druck vorgestellt und mit Simulationen, die mit Garfield++ angefertigt wurden, verglichen.

T 14.6 Mo 17:20 Z6 - SR 2.002

Results of a Testbeam Campaign with a Micromegas Quadruplet — •Philipp Lösel[1], Otmar Biebel[1], Robin Boshuis[3], Andreas Düdder[2], Bernhard Flierl[1], Maximilian Herrmann[1], Ralf Hertenberger[1], Felix Klitzner[1], Ralph Müller[1], Friedemann Neuhaus[2], and Andre Zibell[3] — [1]LMU München — [2]JGU Mainz — [3]Uni Würzburg

In a testbeam campaign at the H8 beamline at SPS/CERN the first SM2 Micromegas quadruplet for the NSW upgrade of the ATLAS Muon Spectrometer at CERN was investigated using pions and muons. The two square meter sized Micromegas quadruplet consist of two eta layers, which will give position information of the traversing muons in radial direction of the ATLAS experiment, and two stereo layers. The combination of the stereo layers, where the strips are rotated by $\pm 1.5°$ with respect to the eta strips, will give position information in both radial direction as well as along the strips.
We will present results on the spatial resolution in the precise radial direction as well as along the strips. The spatial resolution is determined for perpendicular traversing charged particles as well as for the tilted SM2 quadruplet. The track reconstruction of the quadruplet compared to the reference track reconstructed by a telescope consisting of two-dimensional GEM and Micromegas detectors will be discussed. Additionally on the homogeneity in gas gain and efficiency will be reported.

T 14.7 Mo 17:35 Z6 - SR 2.002

Two-Dimensional Floating Strip Micromegas Detectors — •Felix Klitzner[1], Otmar Biebel[1], Jonathan Bortfeldt[2], Bernhard Flierl[1], Phillipp Lösel[1], Ralph Müller[1], Maximilian Herrmann[1], Ralf Hertenberger[1], and Chrysostomos Valderanis[1] — [1]Ludwig-Maximilans-Universität München — [2]CERN

Floating strip Micromegas detectors are high-rate capable particle detectors with excellent spatial and temporal resolution, allowing single particle tracking for particle fluxes up to $7\,\mathrm{MHz/cm^2}$. A floating strip Micromegas detector collects the amplified ionization charge on copper anode strips with high ohmic contact to high voltage, so called floating strips. The charge signal is read out by readout strips, separated by a thin Kapton layer from the anode strips. This scheme makes the detector robust against discharges between the micro-mesh and the floating anode strips, induced by strongly ionizing particles. Different two-dimensional anode designs have been realized with two readout strip layers, parallel and perpendicular to the floating strips. Simulations have been set up to understand the signal formation and propagation to the front-end electronics, as different pulse shapes are observed on both strip layers. Measurements have been carried out with 20 MeV protons at beam intensities up to $\mathcal{O}$(MHz). Position sensitive triggers were derived from a thin triple GEM detector placed in front of the Micromegas. We present results with respect to cluster reconstruction, efficiency and μTPC angle reconstruction of both layers for three different designs, recorded with APV25 front-end boards.

T 14.8 Mo 17:50 Z6 - SR 2.002

Design and commissioning of a Gas Monitoring Chamber for High Pressure Applications — •Philip Hamacher-Baumann, Lukas Koch, William Ma, Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University

Currently, High Pressure Time Projection Chambers (HP-TPC) are intensely discussed in the neutrino detector community as active targets. Increased pressure results in likewise increased probability for gas interactions, but retains a low momentum detection threshold, compared to e.g. liquid gas detectors, for final state particles. The CERN Neutrino Platform has formed a working group to investigate new technologies needed for the operation of HP-TPCs. One of the adressed aspects for long term operation at high pressures is the monitoring of gas properties. This can be done by building a gas monitioring chamber capable of measuring drift and gain properties up to 10 bar.

T 14.9 Mo 18:05 Z6 - SR 2.002

Field Programmable Gate Array for drift velocity measurement — •William Ma, Thomas Radermacher, Stefan Roth, Jochen Steinmann, and Philip Hamacher-Baumann — III. Physikalisches Institut B, RWTH Aachen University

The usage of a field programmable gate array (FPGA), which was configured to perform a drift velocity measurement of electrons in a gas monitoring drift chamber, will be demonstrated. The fully customizable FPGA augmented with a discriminator mezzanine board allows an efficient registration of the start and stop trigger signals required for the drift velocity measurment. Fewer components are needed compared to the usual setup since the logic is completely implemented in the FPGA. Additional filtering or measurement of specific quantities, like the drift time, can be performed directly on the board, which reduces the data volume to be transfered for further data processing. A further advantage is the possibility to perform multiple measurements simultaneously inside one FPGA.

T 15: Outreach I

Zeit: Montag 16:00–18:30 Raum: Z6 - SR 2.005

T 15.1 Mo 16:00 Z6 - SR 2.005

Build Your Own Particle Detector. Öffentlichkeitsarbeit mit LEGO-Modellen und -Veranstaltungen. — •Sascha Mehlhase — LMU München, München, Deutschland — Build Your Own Particle Detector (byopd.org)

Um ATLAS-Institute bei der Öffentlichkeitsarbeit zu unterstützen und die Aufmerksamkeit der Besucher von Wissenschaftsausstellungen und bei öffentlichen Veranstaltungen zu erregen, wurde ein sehr detailliertes Modell des Experiments aus LEGO-Steinen sowie ein Veranstaltungsprogramm unter Verwendung von LEGO-Steinen entwickelt. Beides eignet sich außerdem hervorragend um Besucher in ein Gespräch über Detektoren und Teilchenphysik zu verwickeln.

Ein großes LEGO-Modell, bestehend aus etwa 9500 Teilchen und ideal um Besuchern den Aufbau sowie die Größenverhältnisse heutiger Experimente zu vermitteln, wurde bisher an etwa 60 ATLAS-Institute exportiert und in zahlreichen Ausstellungen verwendet.

Im Rahmen des Build-Your-Own-Particle-Detector-Programms (http://byopd.org) wurden bisher mehr als 20 Veranstaltungen mit insgesamt etwa 1000 aktiven Teilnehmern durchgeführt. Dies geschieht z.B. in Form eines Wettbewerbs um den besten, aus einem zufälligen Haufen LEGO-Teile, entworfenen Teichendetektor, oder in Form einer 'geschlossenen' Veranstaltung bei der eine Besuchergruppe gemeinsam und unter Anleitung ein großes LEGO-Modell baut und währenddessen etwas über Teilchenphysik und Detektoren lernt.

T 15.2 Mo 16:15 Z6 - SR 2.005

Virtuelle Realität bei Belle II — •Michael Bender und Thomas Kuhr — Ludwig-Maximilians-Universität München

Das sich im Aufbau befindliche Belle II Experiment ist zur präzisen Vermessung von B-Mesonen konzipiert und soll einen wichtigen Beitrag zur Suche nach Physik jenseits des Standardmodells leisten. Die hierfür benötigten B-Mesonenpaare werden bei einer Schwerpunktsenergie von 10.58 GeV in Elektron-Positron Kollisionen erzeugt.
Um die gesammelten Daten zu visualisieren, nutzt man bei Belle II unter anderem die virtuelle Realität (VR). Die Verwendung von VR ist hierbei nicht nur auf den internen Gebrauch innerhalb des Experiments beschränkt, sondern erstreckt sich auch auf Lehre und Outreach. Hierfür kommen sowohl kommerziell erhältliche VR Brillen als auch die sogenannte CAVE (CAVE Audio Visual Environment), bei dem Benutzer sich in einem von außen von Projektoren bestrahlten Raum aufhalten, zum Einsatz.

In diesem Vortrag wird deren Verwendung bei Belle II vorgestellt.

T 15.3 Mo 16:30 Z6 - SR 2.005

Dark Matter: when art met science — •Barbara Warmbein and Christian Schwanenberger — DESY, Notkestr. 85, 22607 Hamburg

We report on creative collisions on the DESY campus: fifteen artists from all across Germany got together with dark matter hunting scientists from DESY for the research centre's first art-meets-science event "Dark Matter". Their works, ranging from a walk-in dark matter experience, a sound installation in the HERA tunnel, photography, installations, paintings and 3-D objects to a real collision, were shown from 13 October to 9 November in test halls, shafts and on campus. They were combined with presentations about science and art and the short film programme "Dark Matters" for the first international Dark Matter Day. The exhibition was a resounding success because it cracked a new target audience (the art crowd) and there are plans for follow-up projects.

T 15.4 Mo 16:45 Z6 - SR 2.005

Café & Kosmos: Das Universum in der Kneipe — Barbara Wankerl und •Stefan Knirck — Max-Planck-Institut für Physik, München, Deutschland

Seit Mai 2010 gibt es das Café & Kosmos in München. Die monatliche Veranstaltung geht bewusst weg von traditionellen Orten der Wissensvermittlung wie Schulen oder Unis. Stattdessen trifft man sich im Café oder in der Kneipe, um mit Wissenschaftlern zu diskutieren. Das Setting ist denkbar einfach: Ein Kurzvortrag mit Flipchart und ein paar Stiften, dann wird die Fragerunde mit dem Publikum eröffnet. Die Resonanz ist auch nach sieben Jahren ungebrochen gut, die Teilnehmerzahlen steigen weiter. Wir berichten, wie Café & Kosmos entstand, was es ausmacht und wie es zu einer Erfolgsgeschichte wurde.

T 15.5 Mo 17:00 Z6 - SR 2.005

CosMO-Experiment und Kamiokanne mit neuer Auslese — Günter Quast und •Lars Vielsack — Karlsruher Institut für Technologie, Karlsruhe

Das Cosmo-Experiment und die Kamiokanne des Netzwerks Teilchenwelt ermöglichen Schülern und Studenten schon seit vielen Jahren den Einstieg in die Untersuchung kosmischer Strahlung. Bisher wird zur Auslese eine speziell entwickelte DAQ-Karte bzw. ein Betriebsgerät verwendet. Alternativ dazu wird im Vortrag gezeigt, dass man auch ein preisgünstiges USB-Oszilloskop einsetzen kann, um für Schüler schwer zu durchschauende Hardwarebausteine durch ein bereits von anderer Stelle bekanntes Messverfahren zu ersetzen. Die üblichen Messungen, also die Rate oder Lebensdauer kosmischer Myonen, werden über eine Analyse-Software realisiert, die die Ozsilloskopdaten auswertet. Die in python geschriebene Analyseroutine ist einfach zugänglich und kann modifiziert werden, um durch direkte Einflussnahme auf die Signalselektion und die Koinzidenzbedingungen eigene Analysen mit speziellen Fragestellungen z. B. zur Bestimmung von Detektoreffizienzen durchzuführen. Damit wird der Fokus weg vom Hardwareaufbau stärker auf die physikalischen Inhalte des Experiments gelenkt.

T 15.6 Mo 17:15 Z6 - SR 2.005

The Bonn Particle Physics Show — •Herbert Dreiner — Physikalisches Inst., Universität Bonn

Starting in 2004 (50 years CERN) we have been developing particle physics shows in Bonn. The show was strongly improved in 2008 and presented at the BMBF Weltmaschine exhibition. In 2014 we then developed a brand new 2h show with a time-travel story line. The involves 25 live experiments which are also described in arXiv:1607.07478 in detail. In the past 3.5 yrs we have performed the show in Bonn, Oxford, London, Padua, Trieste, Copenhagen, Odense, Valencia and Barcelona.

T 15.7 Mo 17:30 Z6 - SR 2.005

Higgs to 4 lepton mass spectrum using CMS Open Data — •Nur Zulaiha Jomhari and Achim Geiser — DESY, Hamburg, Germany

This talk covers a Higgs to 4 lepton analysis that approximately reproduces part of the published CMS Higgs discovery paper at 7 and 8 TeV.

CMS Open Data are data taken by the CMS detector that are released to the public via the CERN Open Data portal (http://opendata.web.cern.ch/). The purpose is to encourage people (public or external researchers) to conduct their own analysis using original preserved data. CMS Open Data can not only be used for research but also for educational purposes.

Rebuilding part of the original Higgs discovery, a simplified analysis of the Higgs to 4 lepton mass spectrum using CMS Open Data is introduced based on original CMS datasets. The analysis and some of its simplifications are explained. The corresponding example code is being publicly released together with CMS primary dataset for 2012.

T 15.8 Mo 17:45 Z6 - SR 2.005

Forschung trifft Schule - Lehrerfortbildungen zum Standardmodell der Teilchenphysik mit innovativem Ansatz — •Philipp Lindenau[1] und Michael Kobel[2] für die Netzwerk Teilchenwelt-Kollaboration — [1]IKTP und Professur für Didaktik der Physik, Technische Universität Dresden — [2]IKTP, Technische Universität Dresden

Netzwerk Teilchenwelt veranstaltet in Kooperation mit der Dr. Hans Riegel-Stiftung seit 2017 unter dem Motto "Forschung trifft Schule" bundesweit Lehrerfortbildungen zur Teilchenphysik in unterschiedlichen Formaten. Grundlage für diese Fortbildungen bildet das seit 2013 von Netzwerk Teilchenwelt in Zusammenarbeit mit der Joachim Herz Stiftung und engagierten Lehrkräften entwickelte "Unterrichtsmaterial Teilchenphysik", insbesondere der Band "Ladungen, Wechselwirkungen und Teilchen".

Das Unterrichtskonzept beinhaltet eine einheitliche, konsistente sowie anschlussfähige Begriffsbildung und ist daher die ideale Grundlage für einen zukünftigen schulunterrichtlichen Standard. Darüber hinaus knüpft es an etablierte Lehrplaninhalte und Aspekte aus anderen Teilbereichen der Physik an. Im Zentrum des Konzeptes stehen die fundamentalen Wechselwirkungen der Natur, welche im Standardmodell der Teilchenphysik beschrieben und durch Ladungen hervorgerufen werden. Das Spektrum der existierenden Materieteilchen nimmt im Vergleich zu den meisten anderen und üblichen Herangehensweisen eine untergeordnete Rolle ein. Die grundlegenden Mechanismen der Elementarteilchenphysik werden anhand weniger, exemplarisch ausgewählter Materieteilchen diskutiert und veranschaulicht.

T 15.9 Mo 18:00 Z6 - SR 2.005

Teilchenphysik Akademie an der Universität Mainz — •Matthias Schott und Christian Schneider — Universität Mainz

Seit 2016 veranstaltet die Universität Mainz eine 1-2 wöchige Teilchenphysik-Akademie für Schüler aus ganz Deutschland in den letzten Jahren vor dem Abitur . Nach einem anspruchsvollen Bewerbungsverfahren werden 20 Teilnehmer aus ganz Deutschland nach Mainz eingeladen, um dort ein Experiment am MAMI Beschleuniger zu entwickeln und durchzuführen. Begleitend erhalten die Schüler Vorlesungen über Mathematik, Teilchenphysik und Teilchendetektoren sowie eine Einführung in die Datenanalyse und Programmierung. Im Vortrag wird das Konzept der Teilchenphysik Akademie erläutert sowie über die bisherigen Erfahrungen berichtet.

T 15.10 Mo 18:15 Z6 - SR 2.005

Weltmaschine: one site to cover them all — •Barbara Warmbein and Thomas Zoufal — DESY, Notkestr. 85, 22607 Hamburg

Weltmaschine.de is the central and official website for news and background info about the world of particle physics and Germany's role in it. Aimed at the general public, it makes the link between big science news and the researcher next door. Several series including the "Teilchenjäger" portraits or a new one on "fundamental questions" present a unique opportunity for researchers to reach out. Originally conceived as a hub for news from and about the LHC, it is envisaged to widen the scope to other projects as well. Weltmaschine also offers media trainings for scientists and a travelling exhibition.

T 16: GRID Computing / Experimentelle Methoden I

Zeit: Montag 16:00–18:30 Raum: Z6 - SR 2.006

T 16.1 Mo 16:00 Z6 - SR 2.006

Dynamic Integration and Scheduling of Opportunistic Resources — •Matthias Jochen Schnepf, Christoph Heidecker, Manuel Giffels, and Günter Quast — Karlsruhe Institute of Technology

The demand for computing resources in high energy physics (HEP) varies over time due to conferences and periods of data taking. To cover such peak loads the integration of opportunistic resources on-demand can be used. However, HEP software needs a specific software environment which is usually not provided by opportunistic resources. This makes it necessary to use container or virtualization technologies which provide the HEP software environment on opportunistic resources.

The CMS group at the Karlsruhe Institute of Technology developed the ROCED cloud scheduler to dynamically provision, integrate and manage opportunistic resources in combination with the HTCondor batch system and modern virtualization and container technologies. The transparent integration of opportunistic resources into a single batch system allows users to access thousands of additional CPU cores without resource specific customizations. However, it turned out that network limitations in conjunction with I/O intensive tasks can cause CPU inefficiencies on opportunistic sites. In order to reduce these inefficiencies, we currently working on a resource scheduling based on the available network bandwidth and the I/O demands of individual jobs. In this presentation, an overview of developed technologies, integrated resources and the status of I/O based job scheduling will be given.

T 16.2 Mo 16:15 Z6 - SR 2.006

VISPA: Multi-user access to deep learning infrastructure for physics research — •Ralf Florian von Cube, Martin Erdmann, Benjamin Fischer, Robert Fischer, Erik Geiser, Christian Glaser, Thorben Quast, Marcel Rieger, Felix Schlüter, and Martin Urban — III. Physikalisches Institut A, RWTH Aachen University

The VISPA (Visual Physics Analysis) platform enables access to remote resources for performing physics analyses through a modern web-browser. A set of common tools to meet the demands of most physics data analysts is provided such that local software installations by users are not needed.

Recently, the VISPA cluster was extended by GeForce GTX 1080 cards and software to develop deep neural networks was installed. This enables users to explore modern methods of machine learning in their data analyses.

Access to resources is managed by a permission system, and allows experiment specific permission on dedicated resources.

The setup was successfully used in university Bachelor and Master courses and workshops with 100 participants.

T 16.3 Mo 16:30 Z6 - SR 2.006

Systematic Uncertainties In Machine Learning Based Analyses — Raphael Friese, Günter Quast, Roger Wolf, Sebastian Wozniewski, and •Stefan Wunsch — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

During the last years, the field of machine learning became more and more important, also in high-level data analyses in particle physics. In the next years the published results of the LHC experiments will more and more rely on these methods. An essential part of such analyses is the proper estimation of the contributing uncertainties. On the other hand, up to date, profound studies of the effects of systematic uncertainties in the usage of modern machine learning methods are still missing. This talk proposes possible approaches to identify and propagate systematic uncertainties to the final result in machine learning based analyses.

T 16.4 Mo 16:45 Z6 - SR 2.006

Advantages of caching concepts for HEP analysis work-flows — •Christoph Heidecker, Matthias Schnepf, Max Fischer, Manuel Giffels, and Günter Quast — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Current experiments in High Energy Physics deliver tremendous amounts of data waiting for further processing. This leads to enormous challenges for the storing systems, but also for data distribution to end-users for further analyses. The situation is even compounded by the fact that HEP trends to utilize opportunistic resources as extension to common HEP computing facilities. For an efficient utilization of these resources an adequate data throughput of I/O intensive analyzes is essential. Data locality concepts that direct job to a processing unit holding necessary data in its local cache promise to solve those throughput limitations.

At KIT, two different caching concepts have been studied to enable short turn around cycles of I/O intensive analyses. Both concepts have been transparently integrated into the batch system HTCondor. The first approach utilizes coordinated caches on SSDs in the worker nodes and an HTCondor batch system that schedules jobs taking into account data locality. Another approach utilizes CEPH as a distributed file system acting as a system-wide cache. In combination with XRootD caching and data locality plug-ins, this approach is very well suited to tackle bandwidth limitations on opportunistic resources like HPC centers offering parallel file systems. In this talk, both caching concepts and the current development status are presented.

T 16.5 Mo 17:00 Z6 - SR 2.006

Integration of a heterogeneous compute resource in the ATLAS workflow — •Felix Bührer, Anton Gamel, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg, Physikalisches Institut

High-Performance Computing (HPC) and other research cluster computing resources provided by universities can be useful supplements to the collaboration's own WLCG computing resources for data analysis and production of simulated event samples. The shared HPC cluster "NEMO" at the University of Freiburg has been made available to local ATLAS users through the provisioning of virtual machines incorporating the ATLAS software environment analogously to a WLCG center. In addition to the provisioning of the virtual enviroment, the talk describes the on-demand integration of these opportunistic resource into the Tier-3 scheduler in a dynamic way. Resources are scheduled using an intermediate layer monitoring requirements and requesting the needed resources.

The performance of the virtualized environment is evaluated. Recent developments on monitoring and work towards a more flexible scheduling of opportunistic resources, which are required due to the different requirements needed for various data analysis tasks are discussed.

T 16.6 Mo 17:15 Z6 - SR 2.006

Study of breakdown voltage from current-voltage characteristic of SiPM — •Ayesha Ali, Reimund Bayerlien, Ivor Fleck, Waleed Khalid, and Ulrich Werthenbach — University Siegen

Silicon photomultipliers (SiPM) have proven to be very attractive photon- detection devices with high detection efficiency down to single-photon resolution. The SiPM features high gain, low-voltage operation, insensitivity to magnetic field and excellent timing resolution. The SiPM has acquired a proven performance in medical imaging and high energy physics. One of the basic characteristic of a SiPM is the breakdown voltage. Its calculation allows us to set the over-voltage which is the key parameter controlling the operation and opto-electronic characteristics of the detector. Other important parameters for the characterization of SiPMs are gain, dark count rate, the recovery time of the pixels, the rise and fall times of the pulses and photon detection efficiency. They all are a function of the over-voltage. The current-voltage curve and breakdown voltage of a 4x4 channel SiPM array have been studied as a function of temperature. Thermal movement of lattice atoms and electrons causes the dark count rate. Cooling the material reduces the thermal movement. Therefore, the dark count rate declines with lower temperatures and the breakdown voltage shifts towards lower values. The results of these measurements will be presented in this talk.

T 16.7 Mo 17:30 Z6 - SR 2.006

Parameterization-based Tracking for the P2 experiment. — •Iurii Sorokin — Institut für Kernphysik Uni Mainz / PRISMA Cluster of Excellence

The P2 experiment in Mainz aims to determine the weak mixing angle θ_W at low momentum transfer by measuring the parity-violating asymmetry of elastic electronproton scattering. In order to achieve

the intended precision of $\Delta \sin^2(\theta_W)/\sin^2(\theta_W) = 0.13\%$ within the planned 10 000 hours of running the experiment has to operate at the rate of 10^{11} detected electrons per second. Although it is not required to measure the kinematic parameters of each individual electron, every attempt is made to achieve the highest possible throughput in the track reconstruction chain.

In the present work a parameterization-based track reconstruction method is described. It is a variation of track following, where the results of the computation-heavy steps, namely the propagation of a track to the further detector plane, and the fitting, are pre-calculated, and expressed in terms of parametric analytic functions. This makes the algorithm extremely fast, and well-suited for an implementation on an FPGA.

The method also takes implicitly into account the actual phase space distribution of the tracks already at the stage of candidate construction. Compared to a simple algorithm, that does not use such information, this allows reducing the combinatorial background by many orders of magnitude, down to $O(1)$ background candidate per one signal track.

T 16.8 Mo 17:45 Z6 - SR 2.006

Bestimmung von Ausschlussgrenzen mit GammaCombo — Johannes Albrecht[1], Alexander Battig[1], Matthew W. Kenzie[2], •Titus Mombächer[1] und Stefanie Reichert[1] — [1]TU Dortmund — [2]University of Cambridge

Oft werden bei experimentellen Suchen nach seltenen Zerfällen keine Signalkandidaten beobachtet. Um dennoch Aussagen über die Vereinbarkeit der Messung mit theoretischen Modellen treffen zu können, müssen Ausschlussgrenzen bestimmt werden. Die verschiedenen dazu entwickelten statistischen Methoden sind für den Anwender oft kompliziert zu implementieren.

In diesem Vortrag wird die Verwendung verschiedener Methoden mithilfe des GammaCombo-Frameworks vorgestellt und anhand der Suchen nach den Zerfällen $B^0_{(s)} \to e^+e^-$ und $B^+ \to K^+e^\pm\mu^\mp$ mit dem LHCb-Experiment diskutiert und verglichen.

T 16.9 Mo 18:00 Z6 - SR 2.006

Momentum transfer reconstruction for the P2 Experiment — •Alexey Tyukin for the P2-Collaboration — Institute for nuclear physics, PRISMA, Johann-Joachim-Becher-Weg 45, 55128 Mainz

The P2 experiment at the future MESA accelerator in Mainz is designed to determine the weak mixing angle, a core parameter of the Standard Model, with great precision. It will require measuring the parity violating asymmetry of elastic electron-proton scattering. The asymmetry depends on the momentum transfer Q^2. Therefore a reconstruction of the electron tracks in the inhomogeneous magnetic field of the P2 detector is essential. For this, the detector will have four tracking planes of thin high voltage monolithic active pixel sensors (HV-MAPS).

This talk will cover the performance of the Q^2 reconstruction. A Geant4 simulation is used to produce realistic detector hit distributions. For track reconstruction the General Broken Lines fit is used, which requires particle track propagation in an inhomogeneous magnetic field using a Runge-Kutta method. During the stepwise propagation also the track parameter error matrix is calculated by the Bugge-Myrheim method. Systematical effects producing offsets in the resulting values have to be understood for proper Q^2 reconstruction. The average Q^2 value of $0.006\,\mathrm{GeV}^2/c^2$ can be reconstructed with about 4% uncertainty for a single event, leading to a high overall precision due to large electron rates of the experiment.

T 16.10 Mo 18:15 Z6 - SR 2.006

In-situ calibration of the single photo-electron charge distributions of the PMTs in IceCube — •Martin Rongen and Martin Leuermann for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory instruments about 1 km^3 of deep, glacial ice at the geographic South Pole with 5160 photomultipliers (PMTs) to detect Cherenkov light of passing particles. As the arrival times and amplitudes of light at the PMTs are the only observables, a precise calibration of the PMTs characteristics is needed. Currently, one averaged single photo-electron (SPE) charge-distribution template obtained in the lab is used to describe the gain characteristic of all PMTs in the detector simulation. Having observed a median deviation of in-situ data from this template, as well as strong PMT-to-PMT fluctuations, the per-PMT charge distributions are now being calibrated. This is especially challenging due to the absence of a well-known, low-occupancy light source. In this talk, we present a convolution method to measure precise SPE charge distributions in the presence of high charge contamination.

T 17: CP-Verletzung / Mischungswinkel

Zeit: Montag 16:00–18:30 Raum: Z6 - SR 2.007

T 17.1 Mo 16:00 Z6 - SR 2.007

Messung der *CP*-Verletzung in $B^0 \to D^\pm\pi^\mp$ Zerfällen mit neuen Daten des LHCb-Experiments — Alex Birnkraut, Ulrich Eitschberger, •Mario Fröböse und Philipp Ibis — Experimentelle Physik 5, TU Dortmund

Um den CKM-Winkel γ zu bestimmen, wird am LHCb-Experiment die Verletzung der *CP*-Symmetrie im Kanal $B^0 \to D^\pm\pi^\mp$ untersucht. Diese *CP*-Asymmetrie wird bestimmt durch die zeitaufgelöste Messung der Interferenz von direktem Zerfall und dem Zerfall nach B^0-$\overline{B}^0$-Mischung. Die B^0- und $\overline{B}^0$-Mesonen zerfallen dabei in die jeweils gleichen Endzustände $D^+\pi^-$ un $D^-\pi^+$. Da der Zerfall $B^0 \to D^-\pi^+$ gegenüber $\overline{B}^0 \to D^-\pi^+$ Cabbibo-unterdrückt ist, ist die erwartete Interferenz klein.

In einer vorherigen Analyse wurde diese Messung bereits mit Daten aus den Jahren 2011 und 2012 durchgeführt, welche bei einer Schwerpunktsenergie $\sqrt{s}$ von 7 bzw. 8 TeV aufgenommen wurden. Mit Daten aus 2015 und 2016, aufgenommen bei $\sqrt{s} = 13\,\mathrm{TeV}$, soll die statistische Unsicherheit auf den CKM-Winkel γ weiter verringert werden. Herausfordernd ist hierbei die hohe Anzahl an Signalkandidaten, wodurch kleinste Unterschiede zwischen Signal- und Kontrollkanälen die Messung signifikant beeinflussen. In diesem Vortrag werden erste Ergebnisse der Analyse vorgestellt.

T 17.2 Mo 16:15 Z6 - SR 2.007

Zerfallszeitabhängige Messungen von γ am LHCb-Experiment — Alex Birnkraut, Ulrich Eitschberger, Kevin Heinicke und •Philipp Ibis — Experimentelle Physik 5, TU Dortmund

In den Zerfällen $B^0_s \to D^\mp_s K^\pm$ und $B^0 \to D^\mp\pi^\pm$ tritt *CP*-Verletzung in der Interferenz zwischen direktem Zerfall und Zerfall nach Mischung der B-Mesonen auf. Durch zeitaufgelöste Messungen von Zerfällen initialer $B^0_{(s)}$- und $\overline{B}^0_{(s)}$-Mesonen in den jeweils gleichen Endzustand kann diese *CP*-Verletzung bestimmt werden. Da beide Zerfallskänale von tree-level Übergängen dominiert werden, kann somit der CKM-Winkel γ mit geringen theoretischen Unsicherheiten bestimmt werden.

In diesem Vortrag werden die Ergebnisse der Messung von γ in den Kanälen $B^0_s \to D^\mp_s K^\pm$ und $B^0 \to D^\mp\pi^\pm$ auf dem Run I Datensatz des LHCb-Experiments, der einer integrierten Luminosität von 3 fb^{-1} entspricht, vorgestellt.

T 17.3 Mo 16:30 Z6 - SR 2.007

Messung des *CP*-Parameters $\sin(2\beta)$ in den Zerfällen $B^0 \to J/\psi K^0_S$ und $B^0 \to \psi(2S) K^0_S$ mit dem LHCb-Experiment — Vukan Jevtic, Patrick Mackowiak, •Vanessa Müller, Ramon Niet und Alex Seuthe — Experimentelle Physik 5, TU Dortmund

Die Untersuchung der *CP*-Verletzung in der Interferenz von direktem $b \to c\bar{c}s$-Zerfall und Zerfall nach B^0–$\overline{B}^0$-Mischung ermöglicht eine theoretisch saubere Bestimmung des CKM-Winkels β. Um eine zeitaufgelöste Messung der *CP*-Verletzung durchzuführen, eignet sich der Kanal $B^0 \to J/\psi K^0_S$ besonders gut, weil Beiträge höherer Ordnung, die weitere starke und schwache Phasen einführen könnten, erwartungsgemäß klein sind. Bisher wurde bei LHCb der Kanal betratchtet in dem das J/ψ-Meson aus zwei Myonen rekonstruiert wird.

In diesem Vortrag werden die Ergebnisse der kürzlich veröffentlichten Analyse der Zerfallskanäle $B^0 \to J/\psi K^0_S$ und $B^0 \to \psi(2S) K^0_S$ vorgestellt. Hier wird der Endzustand des J/ψ-Mesons in zwei Elektronen und der des $\psi(2S)$-Mesons in zwei Myonen betrachtet. Die Hinzunahme dieser zusätzlichen Zerfallskanäle führt zu einer Steigerung der Sensit-

vität in der Bestimmung von $\sin(2\beta)$ um 20%. Außerdem stellt die vorgestellte Analyse die erste zerfallszeitabhängige Messung mit Elektronen im Endzustand an einem hadronischen Teilchenbeschleuniger dar.

T 17.4 Mo 16:45 Z6 - SR 2.007

Performance study of a novel time-dependent CP analysis of $B \to \pi^0\pi^0$ and projection of the measurement of the unitarity angle ϕ_2/α at the Belle II Experiment — •Fernando Abudinén — Max-Planck-Institut für Physik

The measurement of the time-dependent CP violation parameters of the decay channel $B \to \pi^0\pi^0$ is crucial for the determination of the unitarity angle ϕ_2. At former B-factories, only the direct CP violation parameter $\mathcal{A}_{CP}$ could be measured in time-integrated studies. For the mixing-induced CP violation parameter S_{CP}, a time-dependent analysis is required, a highly challenging task. This analysis requires a precise determination of the B^0-decay vertex, which cannot be achieved in the dominant four-photons final state. Only rare events with a so-called Dalitz decay $\pi^0 \to e^+e^-\gamma$ or with converted photons provide information for the B^0 vertex reconstruction. Thus, large samples of $B^0 \to \pi^0\pi^0$ decays are needed and, at present, the size of the current B-factories data samples is insufficient.

Exploiting the capabilities of the new Belle II pixel vertex detector and the full Belle II data sample at 50 ab $^{-1}$, the presented study shows that the expected uncertainty on the first measurement of $S_{\pi^0\pi^0}$ is estimated to be $\Delta S_{\pi^0\pi^0} = 0.29$. This results in a reduction of the current 8-fold ϕ_2/α-ambiguity to a 2-fold considering $B \to \pi\pi$ decays. Considering also $B \to \rho\rho$ decays, the final uncertainty on ϕ_2/α is projected to be about five times smaller than the current world average.

T 17.5 Mo 17:00 Z6 - SR 2.007

Messung der zeitabhängigen *CP*-Asymmetrie im Zerfall $B^0 \to D^{*\pm}D^{\mp}$ mit dem LHCb-Experiment — Philipp Ibis, Antje Mödden und •Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

Ein wichtiges Ziel des LHCb-Experiments ist die präzise Vermessung von *CP*-Verletzung in Zerfällen neutraler B-Mesonen. Durch die Analyse des Zerfalls $B^0 \to D^{*\pm}D^{\mp}$ lässt sich eine zerfallszeitabhängige *CP*-Asymmetrie messen, die in der Interferenz zwischen dem direkten Zerfall und dem Zerfall nach B^0–$\overline{B}^0$-Mischung auftritt. Bei $b \to c\bar{c}d$-Übergängen, wie im Zerfall $B^0 \to D^{*\pm}D^{\mp}$, ist der Beitrag von Schleifenprozessen zur Übergangsamplitude gegenüber dem Tree-Diagramm nicht zusätzlich unterdrückt. Somit wird bei der Analyse der *CP*-Verletzung in Zerfällen wie $B^0 \to D^{*\pm}D^{\mp}$ ein effektiver Winkel β_{eff} gemessen, welcher eine Phasenverschiebung gegenüber dem CKM-Winkel β beinhaltet. Durch eine Kombination der Messungen von β_{eff} und β aus $b \to c\bar{c}s$-Zerfällen kann diese Phasenverschiebung bestimmt werden.
Der Vortrag stellt den bisherigen Stand der Analyse vor, welche auf dem Datensatz des LHCb-Experiments der Jahre 2011 bis 2016 entsprechend einer Luminosität von 5 fb^{-1} basiert.

T 17.6 Mo 17:15 Z6 - SR 2.007

Studien zur zeitabhängigen *CP*-Verletzung im Zerfall $B_s^0 \to D_s^{\mp}K^{\pm}$ mit neuen Daten des LHCb-Experiments — •Robin Eichhorn, Ulrich Eitschberger, Kevin Heinecke und Philipp Ibis — Experimentelle Physik 5, TU Dortmund

Das LHCb-Experiment ist spezialisiert auf Präzisionsmessungen, insbesondere im Sektor der B-Mesonen. Teil dieser Messungen ist die Analyse von *CP*-verletzenden Prozessen als Beitrag zur indirekten Suche nach Physik jenseits des Standardmodells.

Im Zerfallskanal $B_s^0 \to D_s^{\mp}K^{\pm}$ kann *CP*-Verletzung in der Interferenz von Zerfall und Zerfall nach Mischung gemessen werden. Die in dem Zerfallskanal extrahierten *CP*-Parameter ermöglichen die Bestimmung des CKM-Winkels γ.

Der erste Schritt der Analyse umfasst die Selektion von Signalkandidaten des Zerfalls. Aufgrund der ähnlichen Topologie bei gleichzeitig deutlich größerer Zerfallsbreite wird der flavour-spezifische Zerfall $B_s^0 \to D_s^+\pi^-$ zur Entwicklung der Selektion verwendet. In der vorangegangenen Run I $B_s^0 \to D_s^{\mp}K^{\pm}$ Analyse basierte die Selektion auf einem multivariaten Algorithmus, welcher mit $B_s^0 \to D_s^+\pi^-$ Zerfällen trainiert wurde. Für die Run II Daten der Jahre 2015 und 2016 wird das Training und die Optimierung des Algorithmus neu durchgeführt. In diesem Vortrag wird der aktuelle Stand der Analyse präsentiert.

T 17.7 Mo 17:30 Z6 - SR 2.007

CP asymmetry measurements in charm and tau decay at Belle — •Daniel Greenwald — TU Muenchen, Physik Department

CP violation is expected to be tiny or non-existent in the decays of charmed mesons and the tau lepton. Measurement of a CP asymmetry significantly larger than zero is a sign of physics beyond the standard model. The CLEO experiment measured a CP asymmetry of the decay of D^+ to $\pi^+\pi^0$ consistent with zero but with a large uncertainty. The BaBar experiment measured a CP asymmetry of the decay of the tau to $\nu_\tau K_S\pi^0$ inconsistent with the standard-model expectation (which stems from CP asymmetry in the kaon sector) at 2.8σ. We present studies of these variables using data from the Belle experiment at KEK, in Tsukuba, Japan: a new measurement of the CP asymmetry for the charm decay and an ongoing study for the measurement of the CP asymmetry for the tau decay.

T 17.8 Mo 17:45 Z6 - SR 2.007

Messung der CKM-Phase γ in $\Lambda_b \to \Lambda D^0$ am LHCb-Experiment — •Nis Meinert — Institut für Physik, Rostock, Deutschland

Bisher wurden für Analysen der CP Verletzung zumeist Meson- und nur wenige Baryon-Zerfälle verwendet. Letztere lieferten bis jetzt lediglich Asymmetriewerte zwischen Teilchen und Antiteilchen und wurden nicht zur Berechnung von CKM-Phasen benutzt.

In unserer Analyse suchen wir daher nach dem Baryonen-Zerfall $\Lambda_b \to \Lambda D^0/\overline{D}^0$. Die Analyse der Subzerfälle $D^0 \to K\pi$ und $D^0 \to KK/\pi\pi$ erlaubt die Anwendung der ADS- und GLW-Methoden, welche jeweils Zugang zu der CKM-Phase γ gewähren. Diese Messung ist damit sensitiv auf einen eventuell existierenden Unterschied in γ für Mesonen und Baryonen, welcher nicht im Rahmen des Standardmodells erklärbar ist und kann somit zum Verständnis der CP-Asymmetrie unseres Universums beitragen.

Die Rekonstruktion dieser Zerfälle ist auf Grund der langlebigen Λ-Teilchen und der starken Unterdrückung ($\propto \lambda^3$ in der Wolfenstein-Parametrisierung) herausfordernd. Die einzigartige Produktionsrate von Λ_b-Baryonen und die besonders effiziente Λ_b-Rekonstruktion am LHCb kompensieren diese Nachteile jedoch.

Präsentiert wird der aktuellen Stand der Analyse mit Daten aus Run 1 und Teilen von Run 2.

T 17.9 Mo 18:00 Z6 - SR 2.007

Messung der CKM-Phase γ in $\Lambda_b \to D^0pK$ am LHCb-Experiment — •Harald Viemann — Institut für Physik - Uni Rostock, Rostock, Deutschland

Im Augenblick dominieren Mesonen-Zerfälle die Messungen zur CP Verletzung und solche mit Baryonen sind lediglich Asymmetrie-Messungen. Die Messung der CKM-Phasen bei Baryonen gibt es bis jetzt noch nicht, sie ist daher äußerst interessant und würde bei Unterschieden das Standardmodell herausfordern.

Der baryonische Zerfall $\Lambda_b \to D^0/\overline{D^0}pK$ erlaubt über die Subzerfälle $D^0 \to K\pi$ und $D^0 \to KK/\pi\pi$ die Anwendung der ADS- bzw. der GLW-Methode. Somit ist hier ein Zugang zu der CKM-Phase γ gegeben.

Präsentiert wird der aktuelle Stand der Analyse.

T 17.10 Mo 18:15 Z6 - SR 2.007

Perspektiven der Messung von $\sin(2\beta)$ in $B^0 \to J/\psi K_S^0$ mit dem Run II Datensatz des LHCb-Experiments — •Vukan Jevtic, Patrick Mackowiak, Vanessa Müller und Ramon Niet — Technische Universität Dortmund, Experimentelle Physik 5

Die präzise Messung des CKM-Winkels β in der Interferenz des direkten Zerfalls und des Zerfalls nach Mischung neutraler B-Mesonen bleibt ein unverzichtbarer Präzisionstest des Standardmodells. Die Analyse der *CP*-Verletzung in $B^0 \to J/\psi K_S^0$-Zerfällen mit den Run I Daten des LHCb-Experiments resultierte in einer Sensitivität des Parameters $\sin(2\beta)$ auf dem Niveau von Belle I und BaBar. Die auf 13 TeV erhöhte Schwerpunktsenergie im Run II des LHCs macht es möglich größere Datenmengen in kürzerer Zeit aufzunehmen und so die statistischen Unsicherheiten in Messungen zu verkleinern. Dies stellt physikalische Analysen aber auch vor neue Herausforderungen, beispielsweise in der Rekonstruktion von Teilchenspuren vor dem Hintergrund erhöhter Spurmultiplizitäten.

In diesem Vortrag wird der aktuelle Stand von Studien in dem Zerfallskanal $B^0 \to J/\psi K_S^0$ mit Run II Daten des LHCb-Experiments in besonderer Hinsicht auf verschiedene Rekonstruktionsmöglichkeiten des K_S^0-Mesons präsentiert.

T 18: DAQ / Trigger I

Zeit: Montag 16:00–18:30 Raum: Z6 - SR 2.010

T 18.1 Mo 16:00 Z6 - SR 2.010

Auslesekonzept des ATLAS ITk Detektors für das Phase II Upgrade — Jonathan Debus, •Carsten Dülsen, Tobias Flick, Wolfgang Wagner und Marius Wensing — Bergische Universität Wuppertal

Im Jahr 2026 wird in den ATLAS Detektor ein neuer innerster Spurdetektor (Inner Tracker, ITk) eingebaut. Die Datenauslese des ITk wird mit dem neuartigen, netzwerkbasierten FELIX System ausgestattet sein, welches die Eventdaten vom Detektor ausliest und zur Verarbeitung an eine Serverfarm weiterreicht. Auf Grund der Größe (mehr als 12.000 Daten-Links) und Komplexität (Modularitäten, Trigger-Typen, Kalibration, ..) stellt der ITk sehr hohe Anforderungen an dieses. Es soll das FELIX-Konzept sowie die notwendigen Anpassungen von FELIX an den ITk vorgestellt werden.

T 18.2 Mo 16:15 Z6 - SR 2.010

YARR und ATLAS ITk DAQ Software — •Jonathan Debus, Carsten Dülsen, Tobias Flick, Wolfgang Wagner und Marius Wensing — Bergische Universität Wuppertal

Im Jahr 2026 wird in den ATLAS Detektor ein neuer innerster Spurdetektor (Inner Tracker, ITk) eingebaut. Dieser stellt deutlich erhöhte Anforderungen an Modularität und Performanz der Auslesesoftware. Es wird die YARR Software, die als Basis für die ITk DAQ Software dient, vorgestellt und auf Integration von Netzwerkkommunikation in diese eingegangen.

T 18.3 Mo 16:30 Z6 - SR 2.010

CMS hadron outer calorimeter — •Ashraf Mohamed[1,2], Dirk Kruecker[1], Kerstin Borras[1,2], and Soham Bhattacharya[3] — [1]Deutsches Elektronen-Synchrotron, Hamburg (Germany) — [2]RWTH Aachen University, Aachen (Germany) — [3]Tata Institute of Fundamental Research, Mumbai (India)

The Outer Hadron Calorimeter (HO) is the outermost component of the hadronic calorimeter of the CMS experiment. It consists of additional scintillator layers just outside the magnetic cryostat originally designed to improve the measurement of high energetic jets. Due to its radial position just in front of the barrel Muon system it can able to support the Muon trigger. After an upgrade during the years 2013 to 2015 the necessary trigger signals are available at the Muon L1 trigger. We study the possible improvements for the Muon trigger with respect to efficiencies and rates. The HO allows to mitigate the efficiency drop in some gap regions of the Muon system and it can improve the estimation of the muon transverse momentum within the L1 trigger. Furthermore, we study it usefulness as a fallback system for the Muon Drift Tubes based trigger and we give an outlook for the planned upgrade of the HO electronics from the present VME to the new microTCA standard.

T 18.4 Mo 16:45 Z6 - SR 2.010

$Z \to \tau\tau$ Tag-and-Probe Measurement of the ATLAS Tau Trigger Efficiency — •Serhat Ördek, Michel Janus, and Stanley Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

The Large Hadron Collider was designed to be operated at instantaneous luminosities of up to 10^{34} cm^{-2} s^{-1}, but in 2017, more than twice this value was reached. Therefore, more data than expected can be recorded, but this implies that the trigger system needs to be retuned in order to take the increased instantaneous luminosity into account.
Many measurements with the ATLAS detector which have final states with tau leptons rely on a tau trigger system for the online selection. This talk presents the $Z \to \tau\tau$ tag-and-probe analysis used to determine the tau trigger efficiency. Events are tagged by requiring the presence of a single muon. Hadronic tau decay candidates are then investigated to see what fraction of them pass the tau trigger. The dependency of the trigger efficiency on the transverse momentum and the pseudorapidity of the probe as well as the average number of interactions per bunch-crossing in the event will be shown. Moreover, the challenges and possible improvements of the method will be discussed.

T 18.5 Mo 17:00 Z6 - SR 2.010

Background Suppression with the Belle II Neural Network Trigger — •Sebastian Skambraks, Christian Kiesling, and Sara Pohl — Max-Planck-Institut für Physik, München

Neural networks are going to be used in the pipelined first level trigger of the upgraded flavor physics experiment Belle II at the high luminosity B factory SuperKEKB in Tsukuba, Japan. An instantaneous luminosity of $\mathcal{L} = 8 \times 10^{35}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ is anticipated, 40 times larger than the world record reached with the predecessor KEKB. Background tracks, with vertices displaced along the beamline (z-axis), are expected to be severely increased due to the high luminosity. Using hit and drift time information from the central drift chamber, the online neural network trigger provides 3D track reconstruction of single tracks. In particular, the robust estimation of the z-vertices significantly improves the suppression of background tracks with vertices outside of the interaction region. This allows to relax the track trigger conditions and thus enhances the efficiency for events with a low track multiplicity. Based on Monte Carlo events and background, the high event rate faced by the first level trigger is analyzed and the benefits of the neural network trigger are evaluated.

T 18.6 Mo 17:15 Z6 - SR 2.010

Analyse zur Funktionalität des zukünftigen Kalorimeter-Triggersystems von ATLAS anhand des LAr-Demonstrationsaufbaus — •Anne-Sophie Reimer — IKTP TU Dresden

Im Jahr 2020 soll sich die Luminosität des LHC im Vergleich zur Design-Luminosität mehr als verdoppeln. Da das Triggersystem in seiner Bandbreite jedoch beschränkt ist, erfordert dies eine Verbesserung insbesondere des Level-1-Triggers. Um physikalisch interessante Ereignisse auch mit niedriger Transversalenergieschwelle aufzeichnen zu können, sollen in den LAr-Kalorimetern sogenannte Superzellen ausgelesen werden, die im Vergleich zur bisherigen Auslese eine feinere Segmentierung besitzen. Dadurch wird die Messung der Schauerform eines Teilchens in longitudinaler sowie transversaler Richtung möglich. Parallel zur regulären ATLAS-Datennahme im Jahr 2017 wurden in einem Demonstrationsaufbau Superzellen-Signale aufgezeichnet. Durch die Analyse der aufgezeichneten Daten können Untersuchungen zu den in Zukunft verwendeten Schauerprofilvariablen und zu deren Funktionalität bei der Unterscheidung zwischen Elektronen und hadronischen Jets gemacht werden. Die aktuellen Ergebnisse werden im Vortrag präsentiert.

T 18.7 Mo 17:30 Z6 - SR 2.010

Auslese des ATLAS ITk Pixel Barrel Demonstrators mit RCE GBT — •Eric Buschmann, Jörn Grosse-Knetter und Arnulf Quadt — II. Physikalisches Institut, Georg-August-Universität Göttingen

Die erhöhte Luminosität des Large Hadron Colliders (LHC) nach dem geplanten Upgrade zum High Luminosity LHC (HL-LHC) stellt hohe Anforderungen an die Detektor- und Auslesesysteme. Für den ATLAS Detektor am LHC ist hierfür ein vollständiges Ersetzen des jetzigen Spurdetektors (Inner Detector) durch einen vollständig halbleiterbasierten Inner Tracker (ITk) bestehend aus Pixel- und Streifensensoren geplant. Besonders die Auslese der innersten Pixellagen stellt eine Herausforderung dar und benötigt eine Übertragungsrate von einigen Gb/s pro Modul.

Der ITk Pixel Barrel Demonstrator ist ein Stave-Prototyp im ITk-Layout, aber bestückt mit der momentan verfügbaren Frontend-Generation. Ein Auslesesystem für den Demonstrator basiert auf der RCE (Reconfigurable Cluster Element) Plattform, welche ARM Prozessoren mit FPGAs integriert und als Test- und Entwicklungsplattform für das ATLAS Upgrade Verwendung findet. Der aktuelle Stand der Entwicklungen wird vorgestellt.

T 18.8 Mo 17:45 Z6 - SR 2.010

Readout system for the P2 tracking detector — •Carsten Grzesik for the P2-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University, Mainz — PRISMA Cluster of Excellence

The P2 experiment at the Institute for Nuclear Physics in Mainz is designed to measure the weak mixing angle at low momentum transfer. Therefore the parity violating asymmetry in electron-proton scattering needs to be determined with very high precision. This will be possi-

ble at the new Mainz Energy Recovering Superconducting Accelerator (MESA) with its 150 μA beam of polarized electrons.

Integrating Cherenkov detectors are used for measuring the asymmetry and the scattering kinematics are monitored by a tracking system based on silicon pixel detectors. For the tracking detector High Monolithic Active Pixel Sensors (HV-MAPS) are used, which provide a zero-suppressed, full digital readout. The high rate of particles passing the detector and the fine granularity of the tracking detector results in a high data rate in the triggerless readout system.

In this talk a first readout concept for the P2 tracking detector, which is based on field-programmable gate arrays (FPGAs) for merging, sorting and filtering the data of the multiple detector parts and networked by multiple Gbit/s optical links, is presented.

T 18.9 Mo 18:00 Z6 - SR 2.010

Online Datenreduktion für das Belle II-Experiment mit dem FPGA-basierten DATCON System — •Christian Wessel[1], Bruno Deschamps[1], Jochen Dingfelder[1], Carlos Marinas[1] und Florian Bernlochner[2] — [1]Universität Bonn, Physikalisches Institut — [2]KIT Karlsruhe

Das Belle II-Experiment in Japan ist für eine instantane Luminosität von $8 \cdot 10^{35}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ ausgelegt. Für präzise Messungen von zeitabhängigen Effekten ist Belle II mit einem Pixel Detektor (PXD) mit 8 Millionen Pixeln auf DEPFET-Basis ausgestattet. Durch die Kollisionsrate von 509 MHz wird im PXD eine hohe Datenrate erzeugt, die zu großen Teilen aus Strahluntergründen besteht, welche online aus dem Datenstrom entfernt werden müssen, um so die Datenmenge zu reduzieren. Diese Online-Datenreduktion soll mit dem FPGA-basierten „Data Acquisition Tracking Concentrator Online Node“ (DATCON) System bewerkstelligt werden. Der DATCON sucht im den PXD umgebenden Streifendetektor nach Spursegmenten. Diese werden in den PXD extrapoliert, um dort „Regions of Interest“ (ROI) zu definieren. Nur die Daten der Pixel innerhalb einer ROI werden offline gespeichert. Auf diesem Weg soll eine Reduktion der Daten des PXD um einen Faktor von 10 erfolgen. In vorläufigen Simulationsstudien mit $\Upsilon(4S)$-Ereignissen und Strahluntergründen liegen sowohl die Spurrekonstruktionseffizienz als auch die Effizienz der ROI-Berechnung bei über 96%.

In diesem Vortrag werde ich den aktuellen Status der Entwicklung des DATCON darlegen mit Fokus auf die Simulationsergebnisse.

T 18.10 Mo 18:15 Z6 - SR 2.010

Triplet Track Trigger based on HV-CMOS technology — Adrian Herkert, •Tamasi Kar, André Schöning, and Jike Wang — Physikalisches Institut, Universität Heidelberg, Germany

The High Luminosity upgrade of the LHC (HL-LHC) aims to increase the luminosity of the proton - proton beams to seven times the Run 1 luminosity. In addition to HL-LHC, a future circular collider (FCC-hh) with even higher centre of mass energy ($\sim$ 100 TeV) and luminosity ($\sim 30 * 10^{34} cm^{-2} s^{-1}$) is being studied to explore new physics at the high energy and precision frontier. Of the several challenges that will be posed to the detectors in such a radiation dense environment, very high pileup ($\sim$ 200 for HL-LHC and $\sim$ 1000 for FCC-hh) is one of the most critical. It will result in very high data rate and affect the resolution of trigger objects (e.g. jets, E_{tmiss}) tremendously. This demands smart ideas to increase the selectivity and pileup suppression in the trigger at the earliest possible stage. One such idea is that of a triplet track trigger based on HV-CMOS technology.

Recent advancements in HV-CMOS technology have given birth to thin and radiation hard pixel sensors that are cheap and easy to fabricate compared to the traditional hybrid ones, so that large areas can be instrumented. In this talk, the concept of a triplet track trigger using High Voltage Monolithic Active Pixel Sensor (HV-MAPS) will be presented. It comprises three closely spaced HV-MAPS detector layers at a large radius which allows for full readout of all hits in all bunch crossings. This will be followed by simulation results indicating improved track parameter resolution and efficiency.

T 19: Top-Quarks: Produktion II

Zeit: Montag 16:00–18:15 Raum: Z6 - SR 2.011

T 19.1 Mo 16:00 Z6 - SR 2.011

Measurements of cross-sections of $t\bar{t}$ production with additional heavy-flavour jets in the eμ channel in proton-proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector — •Akanksha Vishwakarma — DESY

Measurements of normalized cross-sections of top quark pair production in association with additional b-jets in proton-proton collisions at a centre-of-mass energy of 13 TeV collected by the ATLAS experiment are presented. The analysis is performed in dilepton channel by requiring an opposite-charge $e\mu$ pair using 36.1 fb^{-1} of pp collision data. Normalised differential cross-sections of top-quark pair production are presented as functions of additional b-jet multiplicity, transverse momentum p_T , the scalar sum of transverse momenta of leptons and jets H_T, and scalar sum of p_T of all jets H_{had}^T. All measurements are corrected for detector effects and presented as particle-level distributions compared to predictions with different theoretical approaches for QCD radiation.

T 19.2 Mo 16:15 Z6 - SR 2.011

Measurement of the differential top pair production cross section in dilepton events with large missing transverse momentum at CMS — •Marius Teroerde, Christian Schomakers, Christian Autermann, and Lutz Feld — I. Physikalisches Institut B, RWTH Aachen, Aachen, Germany

Top pair production is an important background in many measurements and searches for new physics at the LHC. Since top pair decays to dileptonic final states contain significant missing transverse momentum (p_T^{miss}) and at least two jets, they have a similar signature as many potential models for physics beyond the standard model, especially those that could explain dark matter.

The presented analysis is based on a search for supersymmetry in dileptonic final states and focuses on the measurement of the differential cross section of top pair production as a function of different global event variables, such as p_T^{miss}. The result can serve both as a standard model measurement and as a model-independent upper limit on physics beyond the standard model, as it can be compared to theoretical predictions. In the talk, the current state of the analysis is presented.

T 19.3 Mo 16:30 Z6 - SR 2.011

Differential cross section measurement of top quark pair production with associated bottom quarks in the dilepton channel at 13 TeV — Maria Aldaya Martin, Carmen Diez Pardos, and •Andrej Saibel — DESY, Notkestraße 85, 22607 Hamburg

Good experimental knowledge of top quark pair production with additional jets ($t\bar{t}$+jets) is essential to pave the way to the observation of top quark pair production in association with a Higgs boson ($t\bar{t}$H) which allows direct measurement of the top-Higgs Yukawa coupling. In particular, $t\bar{t}$+b($\bar{\mathrm{b}}$), with bottom quarks originating from gluon splitting, constitutes an irreducible, non-resonant background for the $t\bar{t}$H process, where the Higgs boson decays into a bottom quark pair $t\bar{t}$H(b$\bar{\mathrm{b}}$). Moreover, the state-of-the-art of QCD calculations for $t\bar{t}$+b($\bar{\mathrm{b}}$) production have significant uncertainties from missing higher-order terms, making direct experimental measurements of this process desirable.

In this talk, a differential cross section measurement of the $t\bar{t}$+b($\bar{\mathrm{b}}$) process in the dileptonic final state at 13 TeV is presented. The main focus is to study the behavior of additional jets, those that do not originate from the decay of top quarks. The differential cross sections of the additional jets are then compared to several different particle level predictions.

T 19.4 Mo 16:45 Z6 - SR 2.011

Studies on the measurement of the $t\bar{t}Z$ production cross section in the dilepton channel — Otmar Biebel[1], •Florian Fischer[1], Thomas McCarthy[2], and Jeannine Wagner-Kuhr[1] — [1]Ludwig-Maximilians-Universität, München — [2]Max-Planck-Institut für Physik, München

In top quark physics, the associated production of top-antitop quark pairs with a Z boson plays an important role as this process is sensitive to the coupling of the Z boson to the top quark. This value

can vary significantly in many models including physics beyond the Standard Model. Additionally, $t\bar{t}Z$ has a quite similar signature to e.g. the production of top-antitop quark pairs in association with a Higgs boson.

For the studies presented in this talk Monte Carlo simulations, normalised to an integrated luminosity of 120 fb^{-1}, are used. This is equal to the expected amount of proton-proton collisions taken at a centre-of-mass energy of 13 TeV by the ATLAS experiment during the entire LHC Run-2. The $t\bar{t}Z$ system with an electron-positron or muon-antimuon pair in the final state will be kinematically reconstructed under the assumption, that the charged leptons originate from the decay of the Z boson and the top quark pair decays fully hadronically. In order to separate the signal from the two most dominant background processes, $t\bar{t}$ and Z+jets, a multivariate technique will be applied.

T 19.5 Mo 17:00 Z6 - SR 2.011

Monte-Carlo generators for top-quark pair production in the ATLAS experiment — •Timothée Theveneaux-Pelzer — DESY, Zeuthen, Germany

To study top-quark pair production ($t\bar{t}$) in proton-proton data at the LHC, Monte-Carlo (MC) generators are needed to model this process accurately. This is the case either when $t\bar{t}$ is the signal - in order to model the detector acceptance and response in high-precision measurements - or when $t\bar{t}$ is one of the backgrounds - in order to model several event variables in various regions of phase-space.

MC generators are in general made of several components, each with many parameters which values can't be deduced by first principles. Therefore, a MC generator have to be wisely optimised (or *tuned*) in order to provide an accurate description of the desired process. This optimisation can take advantage of inputs from both theoretical predictions and experimental measurements.

The ATLAS collaboration performed several studies on $t\bar{t}$ MC generators since run-1. The latest model is based on the Powheg-Box Next-to-Leading Order matrix element generator, in association with Pythia8 for parton shower and hadronisation. In this talk, the optimisation of this model and the associated uncertainties will be described, and a brief overview of possible future improvements will also be given.

T 19.6 Mo 17:15 Z6 - SR 2.011

Preliminary studies on top quark+Higgs boson production through flavour-changing neutral currents — •Nicolas Lang, Wolfgang Wagner, Geoffrey Gilles, and Arunika Sahu — Bergische Universität Wuppertal

Various theories of new physics and extensions of the standard model predict the existence of flavour-changing neutral currents (FCNC), which are prohibited by the standard model on tree level and strongly suppressed on 1-loop level. Thus the observation of a process involving FCNC would hint at new physics. Preliminary studies investigate single top quark and associated Higgs boson production from a light quark and a gluon through FCNC. More specifically, the $H \to b\bar{b}$ decay channel is examined. B-tagging in conjunction with multivariate techniques aid in the separation of the backgrounds, most notably $t\bar{t}$ and $t\bar{t} + b\bar{b}$ production.

T 19.7 Mo 17:30 Z6 - SR 2.011

Verbesserung des S/R-Verhältnisses im $t\bar{t}H$-Kanal durch Ausnutzung von Top-Quark Spin-Korrelationen — Arnulf Quadt, Clara Nellist, •Paul Konstantin Krug und Thomas Peiffer — II. Physikalisches Institut, Georg-August-Universität Göttingen

In diesem Vortrag werden die Auswirkungen von Top-Quark Spin-Korrelationen auf die $t\bar{t}$-Produktion in Assoziation mit einem Higgs-Boson und entsprechende Untergrundprozesse bei einer Schwerpunktsenergie von 13 TeV am LHC mit dem ATLAS-Experiment präsentiert. Wenn $t\bar{t}$-Paare zusammen mit einem Higgs-Boson produziert werden, erwartet man eine komplementäre $t\bar{t}$-Helizitätskonfiguration in Bezug auf das Szenario ohne zusätzliches Higgs-Boson. Grund hierfür ist die Chiralitäts-Umkehr des Top-Quarks, welche durch die Higgs-Emission verursacht wird. Obwohl dieses Verhalten nur in dem naiven Bild vom chiralen Grenzfall des Top-Quarks, bzw. einer sehr hohen invarianten Masse ($m_{t\bar{t}} \gg m_t$, $m_{\bar{t}}$) erwartet wird, was für LHC-Energien unrealistisch ist, wurde bereits gezeigt, dass sich trotzdem Observablen finden lassen, die nicht nur sensitiv auf $t\bar{t}$-Spinpolarisationseffekte reagieren, sondern auch bei der Trennung des $t\bar{t}H$-Signals von dem irreduziblen $t\bar{t}ff/VV$-Untergrund helfen können. Im Detail werden hierbei Studien zu Winkelverteilungen der Top-Quark-Zerfallsprodukte im $t\bar{t}H$-Kanal und in den Untergrundprozessen vorgestellt, mit Fokus auf den $H \to b\bar{b}$ Zerfallskanal des Higgs-Bosons. Ergebnisse der Analysen von Monte-Carlo-Simulationen für den Semi- und Dileptonischen Kanal werden präsentiert. Der Einfluss von verschiedenen Observablen und deren Sensitivität in unterschiedlichen Bezugssystemen werden diskutiert.

T 19.8 Mo 17:45 Z6 - SR 2.011

Kombinierte Elektronen- und Jet-Trigger für Top-Quark Analysen mit dem CMS-Experiment — Thorsten Chwalek, Nils Faltermann, Thomas Müller und •David Seith — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Die meisten Top-Quark-Analysen verlangen geladene Leptonen in ihrer Ereignisselektion. Hierzu werden unter anderem Einzel-Elektronen-Trigger benötigt. Aufgrund der gesteigerten instantanen Luminosität des LHCs im Jahr 2017 wurden die Schwellen für solche Trigger gesteigert. Dies führt zu einem Verlust an Signalereignissen, insbesondere in Prozessen mit einzelnen Top-Quarks. Alternativ können kombinierte Elektronen- und Jet-Trigger verwendet werden. Zwei solcher Trigger, die 2017 verwendet wurden, werden in diesem Vortrag vorgestellt.

T 19.9 Mo 18:00 Z6 - SR 2.011

Kalibration des ATLAS B-Taggers mittels $t\bar{t}$-Ereignissen im dileptonischen Kanal — •Jannik Geisen, Thomas Peiffer, Arnulf Quadt und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Das zuverlässige Identifizieren von Bottom-Quarks ist essenziell für die Experimente am LHC, denn diese Quarks spielen beim Zerfall sowohl von Top-Quarks als auch von Higgs-Bosonen und somit bei vielen aktuellen Analysen der LHC-Experimente eine signifikante Rolle. Insbesondere die Produktion eines Higgs-Bosons in Assoziation mit Top-Quark-Paaren, bei der das Higgs-Boson in ein Paar aus Bottom-Quarks zerfällt, weist vier Bottom-Jets im Endzustand auf und ist eine der großen Herausforderungen des LHC-Physikprogramms in Run II. Die Identifikation in ATLAS geschieht mithilfe von multivariaten Analyse-Techniken, die mit Informationen aus dem inneren Detektor gespeist werden, weshalb die Verbesserung des ATLAS-Detektors im Run II des LHC die Identifikation deutlich verbessert hat.
Vorgestellt wird die Kalibrationsmethode des ATLAS B-Taggers im dileptonischen $t\bar{t}$-Zerfallskanal mithilfe der Wahrscheinlichkeitsdichte-Methode. Ergebnisse dieser Kalibration mit aktuellen Monte-Carlo-Simulationen und mit den vom ATLAS-Experiment gesammelten Datensätzen des Run II werden für die verschiedenen ATLAS B-Tagger-Algorithmen gezeigt.

T 20: Neutrinophysik I

Zeit: Montag 16:00–18:05 Raum: Z6 - SR 2.012

Gruppenbericht T 20.1 Mo 16:00 Z6 - SR 2.012

The nEXO experiment — •Michael Wagenpfeil for the nEXO-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The nEXO experiment will be a multi-tonne LXe TPC to search for the neutrinoless double beta decay in Xe-136 with a target half-life sensitivity of approximately 10^{28} years. This improvement of two orders of magnitude over current experimental half-life limits is realised by using 5000 kg of isotopically enriched xenon, careful material selection and an improved design of the TPC. MC simulations derive a sensitivity to the effective Majorana neutrino mass between 5.7 and 17.7 meV on a 90 % C.L. depending on the nuclear matrix element calculation after 10 years live-time.

In order to realise this goal, it is crucial to achieve an excellent energy resolution which puts strong requirements on the performance of the TPC detector systems for both VUV scintillation photons and secondary charge carriers.

We give an overview of current sensitivity studies as well as the investigation of the charge-detecting anode tiles foreseen for nEXO.

We also discuss the progress of the characterisation efforts of VUV-sensitive SiPMs which are planned to be employed as photo detectors covering the inside wall of the TPC.

T 20.2 Mo 16:20 Z6 - SR 2.012

Investigation on the electron drift at the edges of the EXO-200 TPC — •Sebastian Schmidt, Gerrit Wrede, Tobias Ziegler, Jürgen Hössl, Gisela Anton, and Thilo Michel — Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg, 91058 Erlangen

The EXO-200 experiment searches for the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{136}Xe using a TPC filled with enriched liquid xenon. An event taking place within the detector leads to the ionization and excitation of Xe-atoms. The created electrons are drifting in an electric field until they either recombine with a Xe-ion or reach the charge detection unit of the system. Deexcitation, as well as recombination, causes the emission of scintillation light which is also detected. This information is combined in order to estimate the energies as well as the positions of the interactions of a primary particle.
In this contribution, the analysis of non-uniformities of the electric field close to the edges of the EXO-200 TPC is presented. This involves the investigation of the standoff distance, describing the shortest distance of a reconstructed interaction vertex to the inner boundary of the TPC. By using charge drift simulations in combination with optimization methods, an improvement of the agreement of MC and data is achieved.

T 20.3 Mo 16:35 Z6 - SR 2.012

Charge-only energy reconstruction with Convolutional Neural Networks for the EXO-200 experiment — •Tobias Ziegler[1], Michael Jewell[2], Sebastian Schmidt[1], Jürgen Hössl[1], Gisela Anton[1], and Thilo Michel[1] — [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP — [2]Stanford University, California, USA

The EXO-200 experiment searches for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{136}Xe with a single-phase liquid xenon (LXe) time projection chamber (TPC) filled with enriched LXe. The TPC provides the position (X,Y,Z) of events and the deposited energy in LXe by simultaneously detecting the xenon scintillation light and the amount of secondary electrons. For charge collection, electrons drift in the electric field towards the anode, where they induce currents in a first plane of wires and are collected by a second plane of wires. In this study, we investigate the energy reconstruction of events with single or multiple charge deposits using all available collection wires. We apply Deep Learning methods, esp. Convolutional Neural Networks, to reconstruct the charge-only energy deposition in the EXO-200 experiment and compare its performance to the conventional approach.

T 20.4 Mo 16:50 Z6 - SR 2.012

Multi-Pixel Photon Counters for the detection of liquid xenon scintillation light — •Katharina Witzmann[1], Michael Wagenpfeil[1], Tobias Ziegler[1], Judith Schneider[1], Ako Jamil[2], Jürgen Hössl[1], Gisela Anton[1], and Thilo Michel[1] — [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP — [2]Yale University, Connecticut, USA

The future nEXO experiment will search for neutrinoless double beta decay with a single-phase time projection chamber, filled with liquid xenon enriched in ^{136}Xe, by detecting scintillation light and secondary electrons. The vacuum ultraviolet (VUV) scintillation light of liquid xenon will be detected with Silicon Photomultipliers (SiPMs) which are also referred to as Multi-Pixel Photon Counters (MPPCs). Important criteria to achieve the desired energy resolution of 1 % at the Q-value (2457.8 keV) are a photon detection efficiency of at least 15 % for the liquid xenon scintillation light and a probability of less than 20 % to obtain correlated avalanches such as cross-talk or after-pulsing. In this contribution we will present results of characterization measurements with commercial MPPCs named VUV3 and VUV4 carried out by the nEXO-collaboration using differing experimental setups.

T 20.5 Mo 17:05 Z6 - SR 2.012

Characterisation of a VUV-sensitive Silicon Photomultiplier for the nEXO experiment — •Judith Schneider[1], Tobias Ziegler[1], Michael Wagenpfeil[1], Patrick Hufschmidt[1], Ako Jamil[2], Katharina Witzmann[1], Naomi Vogel[1], Jürgen Hössl[1], Gisela Anton[1], and Thilo Michel[1] — [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP — [2]Yale University

For the future nEXO experiment, about 4 m^2 of SiPMs will be used for the detection of the LXe VUV (vacuum ultraviolet) scintillation light at 178 nm in order to search for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{136}Xe. Most commercially available SiPMs are not sensitive to UV light. Besides that, SiPMs are suffering from correlated avalanches such as crosstalk and afterpulsing. In order to achieve an energy resolution of about 1 % (σ) at the Q-value of the $0\nu\beta\beta$ decay of ^{136}Xe at 2457.8 keV, a photon detection efficiency (PDE) of at least 15 % at 178 nm and a correlated avalanche probability of less than 20 % are required. We present the characterisation of a device capable of detecting VUV light. This includes measurements in the absence of light as well as using Xe scintillation light. We compare the results with the requirements of the nEXO experiment at −100 °C.

T 20.6 Mo 17:20 Z6 - SR 2.012

CONUS - A new experiment to measure COherent Neutrino nUcleus Scattering at reactor site — •Thomas Rink for the CONUS-Collaboration — Max-Planck-Institut für Kernphysik (MPIK), Heidelberg, Deutschland

The recent discovery of coherent elastic neutrino nucleus scattering (CEνNS) by the neutrino beam experiment COHERENT opened up a new and high statistics path in neutrino detection. The reaction's coherent nature allows a strong enhancement of the corresponding cross section and makes it the strongest among all known neutrino interactions. Nevertheless, its detection in the fully coherent regime with reactor antineutrinos has been impossible so far due to very low nuclear recoil energies and their corresponding quenching, i.e. energy dissipation in the conversion of nuclear recoils into detectable signals. With the latest generation of Germanium detectors exhibiting lowest detection thresholds, around 300 eV, such attempts become feasible. The CONUS experiment established at MPIK Heidelberg aims at detecting this interaction with a high signal-to-background ratio by combining ultra-low threshold and high-purity Germanium detectors, an advanced shield design and highest possible antineutrino fluxes on the Earth's surface. For this, CONUS uses four such low threshold detectors with a total mass up to 4 kg and is going to be operated at the nuclear power plant in Brokdorf, Germany. This talk introduces the design, realization and current status of the CONUS experiment and gives an overview of phenomenological and theoretical questions that can be addressed utilizing CEνNS.

T 20.7 Mo 17:35 Z6 - SR 2.012

Anti- and Coincidence Methods for CONUS — •Tobias Schierhuber for the CONUS-Collaboration — Max-Plank-Institut für Kernphysik, Heidelberg, Deutschland

The upcoming experiment CONUS is utilizing next generation Germanium detectors to measure coherent elastic neutrino nucleus scattering (CEνNS) and is located inside the commercial nuclear power plant in Brokdorf, Germany, at shallow depth (up to 45 m water equivalent). This means the muon flux from cosmic radiation is only reduced by a factor of $\sim$5. Therefore many steps are necessary to ensure low background results. One such step is active background suppression in order to remove unwanted components and obtain the best signal to background ratio possible.

This talk will give an introduction into two currently used background suppression methods: first, a cosmic-ray suppression system based on plastic scintillators to remove residual muon-induced signals and second, an anti-coincidence method applied between the four Germanium detectors, which are used in the CONUS experiment. Both systems are useful tools to study signal and background components by operating them in coincidence as well as anti-coincidence mode. Furthermore the underlying framework for the data acquisition, a custom solution using the Lynx DAQ will be presented.

T 20.8 Mo 17:50 Z6 - SR 2.012

Commissioning of the CONUS Experiment — •Janina Hakenmüller for the CONUS-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The CONUS experiment is looking for **CO**herent elastic **N**eutrino n**U**cleus **S**cattering with low-threshold high-purity Germanium (Ge) point contact detectors with a total mass of $\sim$4 kg. The experiment is set up at the nuclear power plant of Brokdorf, Germany, where a high antineutrino flux with energies within the coherent regime is provided. To measure a signal detectors with a sufficiently low energy threshold are required to be able to detect the tiny recoils of the nuclei hit by the antineutrinos. Moreover, the background has to be suppressed as much as possible to make the signal clearly visible. For CONUS, located at

the shallow depth of maximal 45 meters of water equivalent (m w.e.), this is achieved with a shell-like passive shield and an active muon veto system. During the commissioning in the underground laboratory at Heidelberg (15 m w.e.) the detectors and the shield have been characterized and thoroughly tested. In the talk, the achieved background level is discussed and the remaining background contributions are examined. Monte Carlo simulations with the Geant4-based framework MaGe are employed to disentangle the cosmic-ray muon-induced contributions, background from the shield and intrinsic contaminations of the detectors. Special attention is payed to the neutron-induced background, as fast neutrons can mimic the signal. Moreover, detector characteristics like the dead layer thickness, depletion voltage and longterm stability are presented.

T 21: Experimentelle Methoden der Astroteilchenphysik I

Zeit: Montag 16:00–18:20 Raum: Z6 - SR 2.013

Gruppenbericht T 21.1 Mo 16:00 Z6 - SR 2.013

Intensity interferometry with CTA - Experiments towards long-baseline interferometry — •Peter Deiml[1], Gisela Anton[1], Stefan Funk[1], Dmitry Malyshev[1], Thilo Michel[1], Felix Pfeifer[1], Raimund Schneider[2], Joachim von Zanthier[2], Adrian Zink[1], and Andreas Zmija[1] — [1]Erlangen Centre for Astroparticle Physics, Universität Erlangen-Nürnberg, 91058 Erlangen — [2]Institut für Optik, Information und Photonik, Universität Erlangen-Nürnberg, 91058 Erlangen

Intensity interferometry forms an image of a stellar source by correlating photon signals which are measured independently at different positions and different times. By use of kilometric arrays of air Cherenkov telescopes like the future Cherenkov Telescope Array (CTA) one may increase the spatial resolution by an order of magnitude. We review the theory of intensity interferometry and the new possibilities offered by such an array as well as the problems that arise. Moreover, we present the first correlations using IceAct telescopes which are originally part of the IceCube experiment at the south pole.

T 21.2 Mo 16:20 Z6 - SR 2.013

Experiments on intensity interferometry — •Andreas Zmija[1], Peter Deiml[1], Adrian Zink[1], Felix Pfeifer[1], Gisela Anton[1], Stefan Funk[1], Dmitry Malyshev[1], Thilo Michel[1], Raimund Schneider[2], and Joachim von Zanthier[2] — [1]Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP — [2]Institut für Optik, Information und Photonik, Universität Erlangen-Nürnberg, Staudtstr. 1, 91058 Erlangen, Germany

Intensity interferometry is a method that allows the measurement of the angular size of a star using at least two telescopes with varying baseline although each telescope cannot resolve the size of the star. The measurement principle is based on the correlation of the light intensities of a thermal source (e.g a star) received at two different positions on earth. Pioneering work has already been carried out several decades ago by Hanbury Brown and Twiss. The future Cherenkov-Telescope-Array CTA might be a good platform to exploit this Hanbury Brown-Twiss (HBT) effect for the investigation of the sizes of celestial objects. We have carried out laboratory experiments using a laser-illuminated ground glass disc and a narrow-bandwidth LED to test our measurement setup. In this contribution, we will briefly review the HBT effect and present our laboratory setup and the test results in detail.

T 21.3 Mo 16:35 Z6 - SR 2.013

Deep learning based Extraction of Radio Signals from Extensive Air Showers at the Pierre Auger Observatory — •Felix Schlueter, Martin Erdmann, and Radomir Smida — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

In the recent decade, radio measurements have become a very active field in detection of ultra-high energy cosmic rays. This technique enables a new perspective on the physics of extensive air showers, e.g. with measurements of the absolute energy of cosmic rays with a duty cycle close to 100%.
For every analysis of radio data, noise reduction is a challenge. Radio signals from extensive air showers are contaminated by environmental and human-made noise and can be significantly smaller than the measured noise. In this talk, an approach is presented to reduce noise based on the autoencoder concept used in deep learning techniques. This approach is evaluated using air shower simulations with realistic noise measured by the Auger Engineering Radio Array (AERA). An outlook to data application is given.

T 21.4 Mo 16:50 Z6 - SR 2.013

Substantial improvement in the MAGIC energy reconstruction through machine learning algorithms — •Kazuma Ishio[1], David Paneque[1], Abelardo Moralejo[2], and Julian Sitarek[3] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik — [2]Institut de Fisica d'Altes Energies (IFAE), The Barcelona Institute of Science and Technology, Bellaterra (Barcelona), Spain — [3]Division of Astrophysics, University of Lodz, Lodz, Poland

The MAGIC telescopes perform gamma-ray astronomy at energies above 50 GeV and extending to about 50 TeV. The energy of the detected gamma ray is estimated with a set of parameters extracted from the shower image on the cameras, and using Look-Up-Tables (LUTs) derived from Monte Carlo simulations. In this talk, I will show that a strategy using random forest (RF) can substantially improve (with respect to LUT) both the energy bias (30% improvement below 100 GeV) and the energy resolution (about 50% improvement above TeV energies). I will show that the choice of the image parameters and the procedure of nesting the RF process across the entire energy range play a crucial role in this improvement.

T 21.5 Mo 17:05 Z6 - SR 2.013

MC simulations of KATRIN's source on GPUs* — •Norman Haussmann for the KATRIN-Collaboration — Bergische Universität Wuppertal

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to measure the effective neutrino mass in a model-independent way with a sensitivity of 200 meV/c^2 (90 % C.L.).

The electrons in the Windowless Gaseous Tritium Source (WGTS), emanating from tritium decay, are emitted isotropically and guided magnetically. Thereby, the electrons undergo different effects, changing their kinetic energy, and angle to the guiding field. The major influence herein is elastic and inelastic scattering.

The differential electron spectrum, emitted at the source, needs to be well-understood in order to monitor the source parameters, to look for sterile neutrinos, and to fit the neutrino mass.

Monte-Carlo simulations of the source need high computational power. So far, KATRIN's own software package KASSIOPEIA was used to perfom these simulations. In order to improve the simulation speed by at least two orders of magnitude the code has been rewritten to run on GPUs aiming at a full MC simulation of the experiment.

Solutions for the obstacles of MC simulations on GPUs, optimizations, and speed comparisons are presented in this talk.

** Gefördert durch das BMBF.*

T 21.6 Mo 17:20 Z6 - SR 2.013

Models of the signal response from SiPMs and PMTs — •Oleg Kalekin — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

New model of the single photoelectron charge distribution from PMTs is presented. This model features the asymmetrical shape of the distribution with a high tail towards small amplitudes in contrast to the simple Gaussian distribution frequently used. New model of the SiPM signal response with cross-talk is presented. Influence of the cross talk is modelled with a multinomial distribution. This model demonstrates good results when fitting the SiPM signal charge distribution.

T 21.7 Mo 17:35 Z6 - SR 2.013

Cascade reconstruction in an IceCube-Gen2 detector equipped with multi-PMT Optical Modules — •Cristian Jesus Lozano Mariscal, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

In addition to an enlarged instrumented volume of 5-10 km^3, a further

increase in sensitivity of the planned successor of the IceCube neutrino observatory at the South Pole, IceCube-Gen2, is anticipated from new optical sensor concepts. One of these concepts is the multi-PMT optical module (mDOM), which, in contrast to the conventional IceCube module with its single 10-inch PMT, features 24 3-inch PMTs facing in all directions. In particular, the added information on the arrival direction of the photons obtained through this segmentation of the photosensitive area, is expected to improve the directional reconstruction of events. The contribution presents first results of studies on the performance of an IceCube-Gen2 detector equipped with mDOMs in the reconstruction of cascade events.

T 21.8 Mo 17:50 Z6 - SR 2.013

A new end-to-end calibration of the Fluorescence Detector of the Pierre Auger Observatory * — •Eric Mayotte for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

The Fluorescence Telescopes are crucial to the science goals of the Pierre Auger Observatory. Currently, to ensure the accuracy of their measurements, a relative calibration of each telescope is performed nightly. To improve upon this established calibration, as well as to improve the time-dependent end-to-end calibration of each telescope's optics and camera, a new absolute calibration process has been developed. The core of the technique consists of scanning a calibrated Lambert-sphere UV light source across the aperture of the outermost component of each of the telescope's optics and reading out the response of the PMT camera. The camera response is then compared to the known light source characteristics and simulated end-to-end optical performance of the instrumentation in order to provide a real-world absolute calibration of each telescope. This talk will give a brief overview of the method as well as the absolute calibration of the Lambert-sphere light source. Preliminary measurements on the light source output intensity, uniformity, and time-stability will also be presented.
* Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1 und 05A17VK1)

T 21.9 Mo 18:05 Z6 - SR 2.013

Search for Cosmic Particles on the ZeV Scale with the Moon and LOFAR — •Tobias Winchen[1], A. Bonardi[2], S. Buitink[1], A. Corstanje[2], H. Falcke[2,3,5], B. Hare[4], J. R. Hörandel[2,3], P. Mitra[1], K. Mulrey[1], A. Nelles[2,3,7], J. P. Rachen[2], L. Rossetto[2], P. Schellart[2,8], O. Scholten[4,6], S. ter Veen[5], S. Thoudam[2], and T.N.G. Trinh[4,6] — [1]Vrije Universiteit Brussel (Belgium) — [2]Radboud University Nijmegen (The Netherlands) — [3]NIKHEF (The Netherlands) — [4]KVI-CART (The Netherlands) — [5]ASTRON (The Netherlands) — [6]University of Groningen (The Netherlands) — [7]Now at University of California Irvine (USA) — [8]Now at Princeton University (USA)

A significant challenge to answer the long standing question about the origin and nature of ultra-high energy cosmic rays (UHECR) is given by their extremely low flux. Even lower fluxes of neutrinos with energies beyond the ZeV (10^{21} eV) scale are predicted in certain Grand-Unifying-Theories (GUTs) and e.g. models for super-heavy dark matter (SHDM). The significant increase in detector volume required to detect these particles can be achieved by employing Earth's moon as detector and search for radio pulses that are emitted when a particle interacts in the lunar rock with a radio telescope. Here, we give an overview on the design and status of a corresponding search with the LOFAR radio telescope.

T 22: Poster

Zeit: Montag 16:00–18:30 Raum: Z6 - Foyer

T 22.1 Mo 16:00 Z6 - Foyer

Der Mechanismus der Trägheit: Masse — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Die kleinsten Teile der Materie sind so aneinander gebunden, dass sie einen Abstand einhalten. Ansonsten hätten physikalische Objekte keine Ausdehnung.

Diese Bindung auf Abstand führt unweigerlich zu Trägheit. Die Bindungskräfte breiten sich mit (endlicher) Lichtgeschwindigkeit 'c' aus. Dadurch werden in einem Verbund bei Änderung der Bewegung die elementaren Objekte vom Bindungsfeld zunächst an ihrem ältenÖrt festgehalten, so dass vorübergehend eine Kraft der Bewegungsänderung entgegensteht.

Dieser Effekt ist nicht nur eine qualitative Idee, sondern lässt die Berechnung der Masse realer Teilchen zu. Die Masse des Elektrons z.B. folgt aus seiner Ausdehnung mit der Präzision von fast 10^{-6}. - Im Gegensatz dazu liefert die Higgs-Theorie keine quantitativen Ergebnisse. Wobei auch das notwendige Higgs-Feld nach Feststellung der Astronomie nicht existiert.

Weitere Info: www.ag-physics.org/rmass

T 22.2 Mo 16:00 Z6 - Foyer

TARGET, An Integrated Readout Electronics for Cherenkov Telescopes — David Jankowsky[1], Adrian Zink[1], Manuel Kraus[1], •Jacky Catalano[1], Manuel Loos[1], Johannes Schäfer[1], Stefan Funk[1], Luigi Tibaldo[2], Gary Varner[3], and and the CTA Consortium[4] — [1]ECAP, Erlangen, Germany — [2]MPIK, Heidelberg, Germany — [3]University of Hawaii, Hawaii, USA — [4]Full consortium author list at: http://cta-observatory.org

he next generation ground based Gamma Ray Telescope, the Cherenkov Telescope Array (CTA), will have a large number of telescopes at two sites and is expected to be sensitive to γ rays in the range between 10 GeV and 300 TeV. γ rays produce air showers in the atmosphere whose particles emit short flashes of Cherenkov light. Fast cameras with special read-out electronics have been developed to allow for very short (nanosecond) exposure. The TARGET ASICs, with its high sampling rate (1 GSample/s) and 12 bit precision, are supposed to fulfill the scientific goals of CTA Furthermore, it provides Level 0 trigger information, small package sizes, high integration (16 channels/ASIC), deep buffer for trigger latency (16k samples) and low costs per channel. This makes it a perfect canditate to be implemented in the compact small size cameras of CTA. For a first camera prototype 54 electronics modules featuring TARGET with 16x54 channels in total where produced. The results of the commissioning tests will be presented.

T 22.3 Mo 16:00 Z6 - Foyer

A Modified Gravity solves the problem of Dark Matter — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Dark matter is one of the great mysteries in today's physics.

There are fundamentally two solutions possible: (1) there may exist a type of presently undetected particles which provides the missing contribution to the gravitational field; (2) the theory of gravity of Newton and of Einstein which related gravitation to mass and energy may be erroneous.

For the second alternative there is a working ansatz. If one extends the Lorentzian interpretation of relativity to the field of general relativity, so to gravitation, there follows a different causality for gravity. Gravity is no longer caused by mass but it is a side effect of other forces. So every elementary particle contributes to the field independently of its mass. And in this case photons and neutrinos are playing a particular role.

If the thoroughly investigated rotating galaxy NGC 3198 is taken as an example for this approach, it can be shown that the result for the amount of the field as well as its spatial distribution fits quite precisely to the measurement.

On the other hand the search for specific particles as an explanation of this phenomenon has up to now not yielded any hints for their existence.

T 22.4 Mo 16:00 Z6 - Foyer

GEANT 4 simulation of the Kiel Electron Telescope on board Ulysses — •M. Köberle, B. Heber, P. Kühl, and J. Marquardt — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Germany

Ulysses was the first mission to explore the space environment above the poles of the sun. The mission launched in 1990, made three "fast latitude scans" of the Sun in 1994/1995, 2000/2001, and 2007/2008 providing a wealth of data. The COsmic and Solar Particle INvestigation Kiel Electron Telescope (COSPIN/KET) measures protons and

alpha-particles in the energy range from about 4 to above 2000 MeV/n and electrons in the range from 2 to above 300 MeV in distinguished energy channels. The telescope consists of two parts: an entrance telescope of two semiconductors comprising a silica-aerogel Cherenkov detector with a refractive index of 1.066, selecting particles with speeds $v/c = b > 0.938$, which also determines the magnitude of the particle charge. Secondly the calorimeter, a lead-fluoride Cherenkov detector followed by a scintillation detector measuring escaping particles. In order to describe the instrument response function we setup a GEANT 4 model and validated it against calibration measurements performed prior to the launch of the spacecraft. Here we present the model and the corresponding calculations that are in excellent agreement with measurements obtained at different accelerators.

T 22.5 Mo 16:00 Z6 - Foyer

A cryogenic detector characterization facility in the shallow underground laboratory at the Technical University of Munich — •Alexander Langenkämper[1], N. Ferreiro Iachellini[2], A. Kinast[1], E. Lindner[1], M. Mancuso[2], E. Mondragon[1], A. Münster[1], T. Ortmann[1], W. Potzel[1], S. Schönert[1], R. Strauss[2], S. Wawoczny[1], and M. Willers[1] — [1]Physikdepartment E15 and Excellence Cluster Universe, Technische Universität München, D-85748 Garching — [2]Max-Planck-Institut für Physik, D-80805 München

The Physics Department of the TUM operates a shallow underground detector laboratory (UGL) in Garching, Germany. It provides $\sim 160\,m^2$ of laboratory space which is shielded from cosmic radiation by ~ 6 m of gravel and soil, corresponding to ~ 15 m.w.e.. The laboratory houses a cleanroom (class ISO 7) equipped for fabrication and assembly of cryogenic detectors. Furthermore, the UGL runs a ^{3}He-^{4}He dilution refrigerator. The infrastructure is particularly relevant for the characterization of $CaWO_4$ target crystals for the CRESST-III experiment, detector fabrication and detector assembly for rare event searches. Future applications include detector development in the framework of coherent neutrino nucleus scattering experiments (ν-cleus) and studying its potential as a site to search for MeV-scale Dark Matter with gram-scale cryogenic detectors. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the BMBF Verbundprojekt 05A2017 - CRESST-XENON and by the SFB1258.

T 22.6 Mo 16:00 Z6 - Foyer

Status of the Dortmund Low Background Facility — •Marcel Gerhardt, Claus Gössling, Kevin Kröninger, and Christian Nitsch — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4a, 44227 Dortmund

The Dortmund Low Background Facility (DLB) is a low-background gamma-ray spectrometry system built at ground level on the campus of the Technische Universität Dortmund. It uses a high-purity germanium detector with a relative efficiency of 60 %. The detector is set up within a massive artificial overburden, corresponding to ten meters of water equivalent. This overburden consists of barite concrete and cast iron. It houses a multi-layer lead castle that features borated polyethylene as a neutron moderator and absorber. Additionally, an active muon veto is installed to reduce the cosmic-induced muon contributions to the spectrum.

The remarkably low background level of the DLB allows radio-purity screening measurements for material preselection and the detection of radionuclides with short halflifes for activation analysis, with sensitivities well below the Bq/kg-level, which is comparable to laboratories with shallow depths.

An overview of the current status of the DLB with the recently completed muon veto, which results into an approved background level, is given. Also, first developments in the digitization of the data acquisition system are presented.

T 22.7 Mo 16:00 Z6 - Foyer

Cryogenic detector and sensor production for rare event searches at the Technical University of Munich — •Elizabeth Mondragon, A. Kinast, A. Langenkaemper, A. Muenster, T. Ortmann, W. Potzel, S. Schoenert, S. Wawoczny, and M. Willers for the CRESST-Collaboration — Physikdepartment E15 and Excellence Cluster Universe, Technische Universität München, D-85748 Garching

For rare event searches, such as the direct dark matter search experiment CRESST (Cryogenic Rare Event Search with Superconducting Thermometers), highly sensitive temperature sensors and cryogenic detectors are indispensable. A very low energy threshold ($\ll 100$ eV) and good energy resolution is required to increase the experimental sensitivity particularly for low mass dark matter particles ($m_{DM} < 5\,GeV/c^2$) and to differentiate between these rare events and other particle interactions such as, e.g., radioactive backgrounds. In this contribution we present an overview of the various facilities and techniques available at TUM which are necessary for the production, development and improvement of low temperature detectors and temperature sensors. We also explain the methods we employ for the study and characterization of such technology and the potential applications. In addition, we discuss the quality requirements imposed on the developed systems. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the BMBF Verbundprojekt 05A2017 - CRESST-XENON and by the SFB1258.

T 22.8 Mo 16:00 Z6 - Foyer

Characterization of the XENON1T liquid xenon dual-phase time projection chamber using Kr-83m — •Michael Wigard — Institut für Kernphysik, WWU Münster

The XENON1T experiment aims to detect the interactions of weakly interacting massive particles (WIMPs) and xenon nuclei. With a projected sensitivity of $1.6 \cdot 10^{-47} cm^2$ at 50 GeV after 2 ton-years exposure, it is the most sensitive dark matter direct detection experiment in the world, using the largest liquid xenon dual-phase time projection chamber in the world. The first dark matter search result with 34.2 live days has already been published, and the next run with >300 days is currently in progress. To understand the properties of this detector calibration measurements with sources of known energy are needed. Due to the large size of the detector, external sources are insufficient for this purpose: to characterize the inner, active target volume internal calibrations must be used. This poster presents an overview of the methods, advantages and challenges associated with using Kr-83m as an internal calibration source. Among the detector properties that can be investigated with Kr-83m are the lifetime of drift electrons, light- and charge-yield uniformity in the detector volume and stability over time, and the effects of localized detector features on event position reconstruction. This work is supported by BMBF under contract 05A17PM2.

T 23: Hauptvorträge I

Zeit: Dienstag 11:00–12:10 Raum: Z6 - HS 0.004

Hauptvortrag T 23.1 Di 11:00 Z6 - HS 0.004

Faster, Finer, Stronger, Bigger: New Detector Technologies — •Frank Simon — Max-Planck-Institut für Physik, Munich, Germany

Progress in experimental high energy physics crucially depends on advances in detector technologies to cope with the conditions at the HL-LHC and to fully exploit the possibilities that will be offered by future facilities. This presentation will give an overview over recent developments and trends, from high precision timing and high granularity to radiation-hard detector elements and large instrumented volumes. The primary focus is on accelerator-based experiments, but selected applications in other fields will also be discussed.

Hauptvortrag T 23.2 Di 11:35 Z6 - HS 0.004

Deep learning concepts for particle physics — •Martin Erdmann — RWTH Aachen University, III. Physikalisches Institut A, 52056 Aachen

For two decades, physics analyses have benefited from machine learning using well-founded observables. With new deep learning technique, previously unexplored properties become accessible in data. Higher signal efficiency with identical detector hardware and event simulations with unprecedented speed are evidence of this progress. Various applications of deep learning developed for particle and astroparticle physics will be discussed as well as challenges arising with this new technology.

T 24: Neutrinoastronomie II

Zeit: Dienstag 16:30–19:00 Raum: Philo-HS1

T 24.1 Di 16:30 Philo-HS1

Laterally separated muons from cosmic ray air showers in IceCube — •Dennis Soldin for the IceCube-Collaboration — University of Delaware, Bartol Research Institute and Dept. of Physics and Astronomy, Newark, DE 19716, USA

Cosmic ray air showers with primary energies above $\gtrsim$ 10 TeV can produce high-energy muons with large transverse momentum ($p_T \gtrsim$ 2 GeV). These isolated muons can have large transverse separations from the shower core, up to several hundred meters. Together with the muon bundle they form a double track signature in km^3-scale neutrino telescopes such as IceCube. The separation from the core is a measure of the transverse momentum of the muon's parent particle. For $p_T \gtrsim 2$ GeV, particle interactions can be described in the context of perturbative quantum chromodynamics (pQCD). Hence, measurements of these muons may contribute to test pQCD predictions of high energy interactions involving intermediate nuclei.

We present a measurement of laterally separated muons using three years of IceCube data, taken between May 2012 and May 2015. The resulting lateral separation distributions of muons between 135 m and 450 m will be shown for various primary energies. These distributions are used to derive estimates of the transverse momenta of high-energy muons, which approximately correspond to the underlying hadron distributions. The resulting transverse momentum distributions are compared to Monte Carlo simulations and recent accelerator data of charged hadrons. In addition, we present studies of seasonal atmospheric effects on the production of muons at large altitudes.

T 24.2 Di 16:45 Philo-HS1

Improving the description of the astrophysical muon-neutrino spectrum with 9 years of IceCube data — •Jöran Stettner, Christian Haack, René Reimann, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory has observed a flux of high-energy astrophysical neutrinos compatible with an unbroken powerlaw energy spectrum. However, complementary analyses on different event topologies and hemispheres do not yield the same spectral index. Here, we focus on the muon-neutrino channel and explore models beyond an unbroken powerlaw to describe the high-energy spectrum. More flexible models, e.g. a broken powerlaw or a powerlaw with exponential cut-off, could both help to understand differences between the measured spectral indices and constrain the physics of cosmic-ray acceleration. The study is based on a high statistics sample of 9 years of muon-neutrinos from the Northern Hemisphere with very low background. We present sensitivities for different models and an approach to extract model-independent information on the flux of astrophysical neutrinos.

T 24.3 Di 17:00 Philo-HS1

Measurement of the Atmospheric Electron Neutrino Spectrum using Data from the IceCube Neutrino Detector — •Joshua Luckey, Felix Neubürger, Maximilian Meier, Jan Soedingrekso, Thobias Hoinka, and Thorben Menne for the IceCube-Collaboration — TU Dortmund, Dortmund, Deutschland

The aim of the work presented in this talk is to measure the atmospheric electron neutrino spectrum on data collected by the IceCube Detector. IceCube is a Cherenkov neutrino detector instrumenting 1 km^3 of ice at the South Pole. The Cherenkov light detected by IceCube is emitted by charged particles like atmospheric muons or the secondary particles of neutrino interactions passing through the detector. Events caused by neutrinos result in different event topologies, depending on the neutrino flavor and the kind of interaction. The events this analysis is interested in, the interaction of electron neutrinos, have a spherical topology in the detector. These events are referred to as cascade-like events. Muons, either atmospheric or from muon neutrino interactions, show an elongated event topology and are referred to as track-like events. The first part of this analysis is to build an event sample containing a high amount of cascade-like events with low amounts of track-like events, utilizing machine learning methods. Subsequently an unfolding approach will be used to obtain to the atmospheric electron neutrino spectrum. This analysis is currently planned to encompass one year of data from the year 2012, however a extension to multiple years may be possible in the near future. This talk will give an overview over the current status of this analysis and its prospects.

T 24.4 Di 17:15 Philo-HS1

IceCube Neutrino Meteorology: Correlation Between Atmospheric Neutrinos and Atmospheric Temperature — •Philipp Fürst, Pascal Backes, Jakob Böttcher, Christian Haack, Denise Hellwig, Jöran Stettner, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory, located at the Geographic South Pole, measures an all-sky atmospheric neutrino flux. These neutrinos are created in cosmic-ray-induced air showers and their production rate depends on local atmospheric conditions, causing neutrino rate changes throughout the local seasons.

Five years of neutrino data from IceCube and temperature data from NASA's atmosphere-observing Aqua-Satellite are used to measure the correlation coefficient of relative neutrino rate change and relative temperature change.

This correlation coefficient can be used to constrain neutrino production yields of pions and kaons.

We present method and results of calculating the neutrino-temperature correlation coefficient and further outlooks.

T 24.5 Di 17:30 Philo-HS1

Measuring the Flavor Ratio of High-Energy Neutrino Events in IceCube — •Juliana Stachurska — DESY Zeuthen

The IceCube Neutrino Observatory at the South Pole detects Cherenkov light from charged particles produced in neutrino interactions. At the highest energies, the neutrino flux is of cosmic origin, with an expected flavor ratio of ν_e:ν_μ:ν_τ of 1:1:1, but its astrophysical sources are yet unknown. A measurement of the flavor ratio on Earth can provide important information to constrain sources and production mechanisms. But as of today, no high energy tau neutrino interaction has been identified in the IceCube data, leaving the $\nu\tau$ fraction of the cosmic neutrino flux largely unconstrained. This work aims at identifying high-energy tau neutrino interactions creating tau leptons with a mean decay length of 50m per PeV neutrino energy. Above energies of $\sim$ 100 TeV they produce a unique and resolvable Double Cascade signature which together with the Single Cascade, and Track event topologies will be used to measure the flavor ratio of IceCube's high-energy events.

T 24.6 Di 17:45 Philo-HS1

New results from the search for steady point-like sources of astrophysical neutrinos with IceCube — •René Reimann, Christian Haack, Lisa Schumacher, Jöran Stettner, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

IceCube, a cubic-kilometer sized neutrino detector at the geographic South Pole, is measuring a flux of high-energy astrophysical neutrinos. However, their sources have not been identified yet. We present the results of a search for steady point-like sources based on an eight year sample of up-going muon-neutrinos optimized for good pointing and low background contamination. The signature of point-like sources is clustering of observed arrival directions with respect to the background from atmospheric neutrinos. To improve the sensitivity, the likelihood approach has been optimized on the properties of the measured astrophysical muon-neutrino flux. The analysis includes an all-sky search, testing a pre-defined source catalog and a search for a population of weak sources.

T 24.7 Di 18:00 Philo-HS1

Stacking point source search of a lower energy neutrino contribution at the HESE track positions using IceCube data — •Thorben Menne, Mathis Börner, Maximilian Meier, Tobias Hoinka, and Jan Soedingrekso for the IceCube-Collaboration — TU Dortmund

The IceCube detector is a cubic kilometer sized neutrino telescope located at the South Pole. One important goal is to observe neutrinos originating from a single or multiple sources in the sky. Despite the discovery of multiple neutrinos of astrophysical origin no significant source of these high energy events has been found yet. Also no significant clustering of lower energy neutrinos at a single point has been

found in a all sky search with 7 years of IceCube data. Nevertheless recently found correlations between a high energy IceCube neutrino and a flaring Blazar makes correlation searches in different messenger particles and energies even more promising. This analysis aims to find a signal from lower energy neutrinos originating from the positions of high energy starting track events measured in IceCube which have possible astrophysical origin. A stacking approach is used to collectively search for multiple weak emissions from the proposed source class. Both a time dependent and steady flux scenario are investigated using multiple years of IceCube neutrino data.

T 24.8 Di 18:15 Philo-HS1

Search for neutrino emission in the Galactic plane with IceCube using starting events — •Kai Krings for the IceCube-Collaboration — Technische Universität München, Physik-Department, James-Franck-Str. 1, D-85748 Garching

The IceCube Neutrino Telescope has observed a diffuse all-sky all-flavor astrophysical neutrino flux above 30 TeV; no sources have been identified yet. We want to challenge the question if the flux is partly of Galactic origin, by searching for neutrino emission in the Galactic plane. Complementary to the search with up-going muon neutrinos, which is constrained to the northern sky only, we use events from both hemispheres with energies above 1 TeV and interaction vertices inside the fiducial volume of the IceCube detector. Thus, the entire Galactic plane can be observed, including the Galactic Center. We present the sensitivity of a likelihood-based analysis to models that predict cosmic-ray induced neutrino emission in the Galactic plane, using seven years of data.

T 24.9 Di 18:30 Philo-HS1

Search for High Energy Astrophysical Tau Neutrinos using IceCube Data — •Maximilian Meier, Thorben Menne, Mathis Börner, Mirco Hünnefeld, Tobias Hoinka, Jan Soedingrekso, and Alexander Sandrock for the IceCube-Collaboration — TU Dortmund

The IceCube Neutrino Observatory at the South Pole is a Cherenkov detector designed to measure astrophysical neutrinos of all flavors. High energy tau neutrinos interacting inside the detector produce two cascades separated by the tau lepton decay length. At energies above 100 TeV the spatial separation can be resolved within the waveform of one IceCube optical module and identified as a double pulse signature. This work aims to select events with a cascade-like topology that contain at least one double pulse signature. This talk will give an overview over the current status of this analysis and its prospects.

T 24.10 Di 18:45 Philo-HS1

Constraints on the neutrino emission of short-lived transient sources from IceCube's follow-up program — •Nora Linn Strotjohann for the IceCube-Collaboration — Desy Zeuthen

IceCube's optical and X-ray follow-up program searches for short-lived transient neutrino sources by looking for several events that are consistent with a single source origin. Since the start of the program in 2008 only one neutrino triplet, i.e. three events within 100s and within 3.5 degrees of each other, was detected. This rate is consistent with the expected rate of chance coincidences of atmospheric events.

The lack of more such neutrino multiplets allows us to constrain the neutrino emission of short-lived transient neutrino source populations like gamma-ray bursts or choked-jet supernovae. This analysis does not rely on the detection of the sources via their electromagnetic emission which means that the limits also apply to photon-dark or unknown sources.

T 25: Silizium-Streifen-Detektoren II / Pixel-Detektoren

Zeit: Dienstag 16:30–18:45 Raum: Philo-HS2

T 25.1 Di 16:30 Philo-HS2

Konzipierung einer temperaturstabilisierten Teststation zur elektrischen Charakterisierung von Siliziumsensormodulen für das CMS-Experiment — Tobias Barvich, Felix Bögelspacher, Alexander Dierlamm, Ulrich Husemann, •Roland Koppenhöfer und Stefan Maier — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Im Rahmen des Phase-2-Upgrades des CMS-Experiments wird der gesamte CMS-Spurdetektor ausgetauscht. Der neue äußere CMS-Spurdetektor wird aus zwei verschiedenartigen Siliziumsensormodulen bestehen (PS- und 2S-Module). Um einen stabilen Betrieb der Module zu gewährleisten, werden die Sensoren mittels eines Kühlsystems bei einer Temperatur von ca. −20°C betrieben. Am Ende des Herstellungsprozesses der Detektormodule in den Produktionszentren muss die Funktionalität der Module unter den späteren Betriebsbedingungen im CMS-Detektor überprüft werden. Das Institut für Experimentelle Teilchenphysik am Karlsruher Institut für Technologie ist eines der Produktionszentren für 2S-Module und hat für die elektrische Charakterisierung der Module eine temperaturstabilisierte Teststation entwickelt. Der Vortrag stellt den Aufbau und die Funktionsweise der entwickelten Station vor.

T 25.2 Di 16:45 Philo-HS2

LYCORIS - Large Area Strip Telescope — Ties Behnke, •Uwe Krämer, Marcel Stanitzki, Dimitra Tsionou, and Mengqing Wu — DESY, Hamburg, Germany

The DESY II test beam facility provides an electron/positron beam with an energy of up to 6 GeV used for detector development. To meet the user requirements, a number of different devices are provided at the test beam facility such as the EUDET-type silicon telescopes based on the Mimosa26 chip and a large 1 T solenoid with a 85 cm usable inner diameter. While the EUDET-type telescopes have excellent performance, their comparably small active area of 1×2 cm^2 and large support structure, prevent their use with a large Device Under Test (DUT) within the solenoid.
As part of the AIDA2020 project, a new telescope, providing a large coverage area of 10×20 cm^2 with minimal support structure and able to be installed within the solenoid is being developed. The telescope consists of three sensitive layers on each side of the DUT. Each layer consists of two 10×10 cm^2 SiD silicon strip sensors that are read out via a KPiX readout chip bump bonded directly onto the sensor. In this talk, the current status of the project, including the readout and the sensors is presented.

T 25.3 Di 17:00 Philo-HS2

Investigation of the impact of mechanical stress on the properties of silicon strip sensors — •Martin Stegler, Luise Poley, and Ingo Bloch — DESY, Platanenallee 6, Zeuthen, Germany

Over the next few years the luminosity of the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN), will be increased to accumulate higher number of collisions to gain access to rare processes. It is planned to reach in 2023 an instantaneous luminosity at the LHC of $\mathcal{L} = 6 \cdot 10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$. Due to the resulting higher radiation level, the ATLAS Inner Detector is foreseen to be replaced with the ATLAS Inner tracker, consisting of a pixel tracker and a strip tracker. The upgraded strip tracker will consist of 18000 silicon strip detector modules, each consisting of silicon sensors, circuit boards and readout chips. Adhesives are used to connect the modular components thermally and mechanically. Due to different coefficients of thermal expansion of the various involved materials, temperature changes between construction (22 °C) and operation (-30 °C) lead to the exertion of mechanical stress on the sensor. This contribution shows measurements quantifying the impact of mechanical stress on sensors and investigating resulting sensor damages. A cooled module was tested in comparison with simulations of the thermal induced tensile stress near to the surface of a silicon sensor in a module. A four-point bending setup was used to measure the electrical properties for two versions of ATLAS strip sensors. In a setup with a beta source, the influence of the changes of the electrical properties on the silicon strip sensor module performance were measured.

T 25.4 Di 17:15 Philo-HS2

Rekonstruktion von Spuren und deren Qualitätsberwertung für den Siliziumstreifendetektor am Belle II-Experiment — Florian Bernlochner[1], Thomas Hauth[1], Martin Heck[1], Felix Metzner[1], Eugenio Paoloni[2] und •Sebastian Racs[1] — [1]ETP, KIT, Karlsruhe — [2]INFN, Pisa

Das bald in Betrieb gehende Belle II-Experiment in Tsukuba, Japan weist einen modernen Siliziumstreifendetektor auf. Dieser erlaubt eine Spurrekonstruktion, die eigenständig und in Kombination mit der Driftkammer und dem Pixeldetektor durchgeführt werden kann. Insbesondere wird auch die Vermessung niederenergetischer Teilchen möglich, die die Driftkammer nicht erreichen und durch Vielfachstreuung im Material beeinflusst werden. Die besondere Schwierigkeit bei der Spurfindung besteht darin, eine hohe Spurfindungseffizienz bei im Vergleich zum Vorgängerexperiment höheren Ereignis- und Untergrundraten zu garantieren. Vielfachstreuung und die komplexen Geometrie des vierlagigen Siliziumstreifendetektors ohne Symmetrien erschweren dies weiter.

In diesem Vortrag wird der Spurfindungsalgorithmus des Siliziumstreifendetektors kurz vorgestellt. Im Speziellen wird die Diskriminierung der rekonstruierten Spuren bezüglich Signalteilchenspuren und falsch rekonstruierter Spuren mittels Qualitätsberwertung besprochen.

T 25.5 Di 17:30 Philo-HS2

Beam induced background measurements with the semiconductor tracking detector at ATLAS — Saverio D'Auria[1], •Jihyun Jeong[2], and Christian Sander[2] — [1]University of Glasgow, UK — [2]DESY, Hamburg, Germany

The beam induced background is one of the important backgrounds in mono-jet analysis and searches for new particle with a disappearing track signature. Therefore, understanding the characteristics of beam induced background is crucial to estimate and reject this background.

In this talk, the analysis of the beam induced background of the data recorded in 2016 is presented. To enrich the events from beam induced background, the unpaired and isolated proton bunches are used. The events are selected by two different triggers: one is using the beam condition monitor which is a diamond detector close to the beam pipe, and another one is making a requirement on the minimum number of hits in the semiconductor tracking detector(SCT) end-cap disks. Furthermore, the triggered events are selected at analysis level by the asymmetric hit distribution in the SCT end-cap disks.

The trigger rates and the beam induced background selection rates are discussed, and additionally the interaction between collision debris and the detector material, so called afterglow, is presented.

T 25.6 Di 17:45 Philo-HS2

Simulation Studies on the Robustness of the ATLAS Pixel Detector for the HL-LHC — •Timo Dreyer, Stan Lai, and Jason Veatch — II. Physikalisches Institut, Georg-August-Universität Göttingen

In mid-2026, the LHC will start the high luminosity phase (HL-LHC), during which more than 3000 fb^{-1} of p-p collision data is expected. In addition to the physics benefits of the increased amount of data, new technical challenges will arise. These include an increased amount of pileup in the collison events and exposure of the detector components to larger radiation doses.

To face these challenges, the ATLAS experiment will undergo a major upgrade during the LHC shutdown period from 2024 to mid-2026, that will precede the HL-LHC phase. The current inner detector will be completely replaced by a new silicon based inner tracker (ITk) consisting of an inner pixel detector and an outer silicon strip detector.

This talk presents studies performed to evaluate the robustness of the planned ITk pixel detector under conditions where sub-components are defective. The methodology for masking pixel modules and channels is introduced and comparisons between the expected performance under different failure modes are presented.

T 25.7 Di 18:00 Philo-HS2

Auslesearchitektur-Simulation für Pixelsensoren in der Teilchenphysik — •Rudolf Schimassek, Ivan Perić und Felix Ehrler — IPE, Karlsruher Institut für Technologie, Baden-Württemberg

In der Teilchenphysik werden mit dem HL-LHC mit einer geplanten Luminosität, die fünf bis sieben mal der ursprünglichen Design-Luminosität entspricht, höhere Anforderungen bezüglich der Signalraten an die Detektoren gestellt als bisher. Um diese Raten verarbeiten zu können, müssen neue Konzepte für die Auslese entwickelt und getestet werden.

Zur Abschätzung der Einflüsse dieser Veränderungen wurde die Simulationsumgebung *ReadOut-Modelling-Environment (ROME)* entwickelt, die die Speicherstruktur und Ausleselogik der Sensoren abbildet. Diese Strukturen werden mit Daten aus Physik-Simulationen – wie aus der ATLAS ITk-Simulationskampagne – getestet, um Schwachstellen der Architektur zu finden oder Speicher zu dimensionieren. Neu an dieser Simulationsumgebung ist, dass sie nicht für einen einzelnen Detektor geschrieben ist, sondern allgemein gehalten wurde, um die Simulation möglichst vieler verschiedener Architekturen zu ermöglichen. Auf diese Weise ist auch ein direkter Vergleich verschiedener Architekturen möglich.

Die Detektorstruktur wird zusammen mit den Testdaten in einer Konfigurationsdatei definiert und diese an die Simulation übergeben, sodass keine Kenntnis des Quellcodes für die Nutzung notwendig ist.

Dieser Beitrag beschreibt das System an sich und dessen Möglichkeiten am Beispiel der CMOS-Sensoren für den ATLAS-Spurdetektor.

T 25.8 Di 18:15 Philo-HS2

Allpix Squared - A Generic Pixel Detector Simulation Framework — •Spannagel Simon — CERN, Geneva, Switzerland

Allpix Squared is a generic open-source simulation framework for the simulation of silicon pixel detectors. Its goal is to ease the implementation of detailed simulations for both single detectors and more complex setups such as beam telescopes. Predefined detector types can be automatically constructed from simple model files describing the detector parameters.

The simulation chain is arranged with the help of intuitive configuration files and an extensible system of modules, which implement the separate simulation steps such as realistic charge carrier deposition using the Geant4 toolkit or propagation of charge carriers in silicon using a drift-diffusion model. Detailed electric field maps imported from TCAD simulations can be used to precisely model the drift behaviour of charge carriers within the silicon, bringing a new level of realism to the simulation of particle detectors.

This contribution provides an overview of the framework and a selection of different simulation modules, and presents a first comparison with testbeam data.

T 25.9 Di 18:30 Philo-HS2

Towards a mobile and low-power platform for pixel detectors to be used in educational settings — Oliver Keller[1,2], Sascha Schmeling[1], •Andreas Müller[2], and Mathieu Benoit[2] — [1]CERN, Geneva, Switzerland — [2]University of Geneva, Switzerland

Pixel detector readout chips like the Timepix3 (developed within the Medipix collaboration hosted at CERN) offer numerous advantages for novel physics experiments also in educational settings. This contribution details ongoing development of data acquisition electronics and software geared towards learning environments. The Timepix3 chip is connected to an embedded multi-core processor which consumes considerably less power than the pixel detector itself enabling mobile applications. This novel processor-based approach allows faster development cycles and an overall simplified system design compared to a traditional FPGA-based solution. A compact bias supply circuit for silicon sensors is included which fulfils corresponding safety requirements for accessible parts like the sensor surface. Data output to computers or mobile devices is provided via wired and wireless ethernet. Software features of the platform are chosen to support guided experiments as well as inquiry-based learning in indoor and outdoor scenarios.

T 26: Suche nach Supersymmetrie I

Zeit: Dienstag 16:30–19:00 Raum: Philo-HS3

T 26.1 Di 16:30 Philo-HS3

Data-driven background estimatation and application of machine-learning techniques to the search for direct $\tilde{\tau}$-pair production with the ATLAS detector — •Johannes Junggeburth, Zinonas Zinonos, and Hubert Kroha — Max-Planck-Institut für Physik

One of the main goals of the ATLAS experiment at the LHC is the search for physics beyond the Standard Model, in particular for supersymmetric extensions. Searches for the pair production of $\tilde{\tau}$'s, the supersymmetric partners of the τ leptons, have not yet been performed

by ATLAS. The existing limits on the $\tilde{\tau}$ mass are still from the LEP experiments. The $\tilde{\tau}$ lepton can for instance decay into a τ-lepton and a $\tilde{\chi}_1^0$. In proton collisions, the identification of the τ leptons in the final-state is challenging due to the large QCD background. This makes it necessary to use multivariate analysis techniques. In this talk the strategy for a search for direct $\tilde{\tau}$ production in the Run-2 data recorded by ATLAS is outlined using data-driven background estimation and machine-learning algorithms to increase the sensitivity.

T 26.2 Di 16:45 Philo-HS3

Study on the expected sensitivity of Higgsino pair production at HL-LHC exploiting final states with missing transverse energy, soft leptons and monojet. — •Peter Tornambè — Albert Ludwigs Universität Freiburg

Supersymmetry (SUSY) is one of the most studied theories to extend the Standard Model (SM) beyond the electroweak scale. The ATLAS Collaboration published several SUSY searches with the 2015-2016 dataset which were able to exclude many different simplified models up to high masses. Supersymmetric particles like squarks and gluinos may be too heavy and not accessible by LHC with the current ongoing analysis. Naturalness arguments imply the existence of light electroweakino particles, when they have an high Higgsino component the mass splitting between them is expected to be really small. Due to this, the final products of the decay chain are very soft and the signals from electroweak Higgsino pair production is tipically overwhelmed by the Standard Model backgrounds. This talk will present the current upgrade study to estimate the exclusion power of High Luminosity LHC (HL-LHC), which will run at an energy in the center of mass of 14 TeV, for the natural mass range of a pure Higgsino scenario. Starting from theorethical proposals [arXiv:1409.7058], final states with two soft leptons, missing transverse energy and monojets from initial state radiation are considered in order to improve the ratio between signal and background.

T 26.3 Di 17:00 Philo-HS3

Search for charginos and neutralinos in events with one lepton, 2 b-jets and missing transverse momentum with the ATLAS detector — •Danijela Bogavac and Jeanette Miriam Lorenz — LMU München Am Coulombwall 1, DE-85748 Garching

This talk focuses on searches for supersymmetric particles in decay modes $\tilde{\chi}_1^{\pm} \to W^{\pm} + \tilde{\chi}_1^0$ and $\tilde{\chi}_2^0 \to h + \tilde{\chi}_1^0$. A final state of one lepton (electron or muon), 2 b-jets from the Higgs boson decay and missing transverse momentum is explored. The search is performed using 36.1 fb^{-1} of proton-proton collision data delivered by the Large Hadron Collider (LHC) and recorded by the ATLAS detector in 2015 and 2016. A significantly larger dataset in the LHC Run II and the increase of the LHC energy from 8 to 13 TeV allow this analysis to exceed the sensitivity of the LHC Run I.
Three statistically orthogonal signal regions are designed to target the wide range of kinematics that can be obtained from the decay of charginos and neutralinos. They are built using the Higgs boson invariant mass as a main discriminating variable between signal and backgrounds. Recent results will be shown and the analysis strategy will be discussed.

T 26.4 Di 17:15 Philo-HS3

Suche nach Topquarkpaarproduktion in Endzuständen mit einem Lepton am ATLAS-Experiment — •Julian Wollrath und Frederik Rühr — Physikalisches Institut, ALU Freiburg

Bei einer Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ wurde mit 36,1 fb^{-1} an Daten, aufgenommen mit dem ATLAS-Experiment, nach Topsquarkpaarproduktion in Endzuständen mit einem Lepton gesucht. Unter der Annahme eines hundertprozentigen Verzweigungsverhältnisses von $\tilde{t}_1 \to t^{(*)}\tilde{\chi}_1^0$ wurden für $\tilde{\chi}_1^0$-Massen unter 300 GeV Topsquarks mit Massen unterhalb 900 GeV größtenteils ausgeschlossen. In diesem Vortrag wird das Ergebnis kurz vorgestellt und über die Weiterführung dieser Suchen berichtet.

T 26.5 Di 17:30 Philo-HS3

Interpretation of Long-Lived Gluino and Neutralino Signals in the ATLAS 0L (2-6 jets + MET) SUSY Search — •Veronika Magerl, Fabio Cardillo, Simone Curcio, Peter Tornambe, and Zuzana Rurikova — Universität Freiburg

Many extensions of the Standard Model (SM) include heavy coloured particles, such as the gluinos $\widetilde{g}$ of supersymmetric (SUSY) theories, which could be accessible at the Large Hadron Collider (LHC). Depending on the underlying theoretical SUSY model, the gluinos are assumed to show different characteristics and decay modes.

Within the R-parity conserving (RPC) MSSM, gluinos may decay promptly into final states with multiple jets and missing transverse energy (MET) carried away by the undetected lightest supersymmetric particle (LSP). In Split SUSY models the $\widetilde{g}$ can be a long-lived massive particle which hadronises into R-hadrons before decaying into quarks and the LSP producing signatures very similar to the promptly decaying $\widetilde{g}$. Furthermore, refraining from RPC by increasing the R-parity violating (RPV) couplings, the $\widetilde{g}$ decays promptly but the LSP, typically the lightest neutralino $\widetilde{\chi}_1^0$ decays with finite lifetime, causing again similar multiple jet and MET signatures. Hence, the reinterpretation of long-lived $\widetilde{g}$ and $\widetilde{\chi}_1^0$ signals within the 0L (2-6 jets + MET) SUSY analysis, originally designed for the interpretation of prompt decaying $\widetilde{g}$ in the RPC MSSM is of particular interest.

This talk presents the latest results of these interpretations based on the $\sqrt{s} = 13\ TeV$ dataset corresponding to an integrated luminosity of 36.1 fb^{-1}.

T 26.6 Di 17:45 Philo-HS3

BDT and multi-bin analyses in the context of squark and gluino searches in the 0-lepton final state with the ATLAS experiment. — •Manuel Guth — Albert-Ludwigs Universität, Freiburg, DE

A search for supersymmetric phenomena in final states with multiple jets, missing transverse energy and without leptons, based on 2015+2016 data was presented by the ATLAS collaboration at the conference Moriond 2017. This analysis uses simple cut-and-count methods in the signal regions. In order to test a possible improvement, the use of sophisticated techniques, such as boosted decision trees (BDT) and multi-bin, is being investigated. For the multi-bin analysis, bins in jet multiplicity and effective mass are considered. The single bins are meant to replace the current signal regions and are optimised via a cut-and-count method or BDT. The focus of the study lies on squarks and gluino searches. The performance of these techniques is evaluated using Monte Carlo simulation. The goal is to find a new approach which is both simple but allows for improvement.

T 26.7 Di 18:00 Philo-HS3

Results of the Search for Strong Production of Supersymmetry involving Tau Leptons with the ATLAS Experiment — Philip Bechtle[1], Klaus Desch[1], •Oliver Ricken[1], and Steffen Schaepe[2] — [1]Physikalisches Institut, Universität Bonn — [2]CERN, Genf, Schweiz

The reliably running Large Hadron Collider (LHC) and the ATLAS experiment provide a new and unique discovery potential for physics beyond the Standard Model (SM). One of the most promising extensions to the successful yet incomplete SM is Supersymmetry (SUSY). Due to the quark-gluon composition of the colliding protons, production of new particles via the strong interaction is favoured at the LHC. This fact motivates searches for strongly produced decay chains of SUSY. In addition, it is natural in models of SUSY that tau leptons and their distinct detector signatures are expected to be rather abundant. This talk addresses the searches for hadronic tau final states in different models of strong production of SUSY. The analysis presented is based on 36.1 fb^{-1} of ATLAS data recorded at $\sqrt{s} = 13\,\text{TeV}$. In contrast to the early Run-II analyses, this study exploits the increased amount of data available in various ways: in addition to improved background estimation approaches, new fitting procedures are utilised to extract results more efficiently. This talk introduces the analysis pursued and presents the latest results available, focussing on the novelties with respect to the first studies of 13 TeV ATLAS data.

T 26.8 Di 18:15 Philo-HS3

Search for physics beyond the standard model with photons, missing transverse momentum and hadronic activity — •Maximilian Knut Kiesel, Christian Autermann, and Lutz Feld — I. Physikalisches Institut B, RWTH Aachen University

A search for physics beyond the standard model in proton-proton collisions with photons in the final state will be presented. Such final states are motivated by gauge mediated supersymmetry breaking models, in which a neutralino decays to an undetectable gravitino and a photon. If the neutralinos are produced through the strong interaction, the jets in the decay cascade lead to a large amount of hadronic activity. This search uses proton-proton collisions at a center-of-mass energy of 13 TeV recorded with the CMS detector in 2016, corresponding to an integrated luminosity of about 36 fb^{-1}. At least one high energetic

photon, hadronic activity and missing transverse momentum are required. The contribution of multijet production with real photons or jets identified as photons is estimated using a jet-enriched data control region. The contribution of electrons being reconstructed as photons is estimated using an electron-enriched data control, while the contribution of γW, γZ, and $\gamma t\bar{t}$ events is estimated using simulation. Simultaneous count experiments in several bins with high missing transverse momentum and high hadronic activity are performed to evaluate the presence of physics beyond the standard model. For low neutralino masses, this analysis provides the most stringent exclusion limits for gluino and squark pair production in general gauge mediated supersymmetry models.

T 26.9 Di 18:30 Philo-HS3

Suche nach elektroschwacher Produktion supersymmetrischer Teilchen in Ereignissen mit einem Lepton mit dem ATLAS Detektor am LHC — •Eric Schanet and Jeanette Lorenz — Ludwig-Maximilians-Universität München

Die vorgestellte Studie basiert auf einer publizierten Analyse zur Suche nach der Paarproduktion von Gluinos und Squarks in Ereignissen mit einem Lepton (Elektron oder Myon), hoher fehlender transversaler Energie, sowie Jets mit dem ATLAS Detektor am LHC.

Da bis zum Ende von Run-2 am LHC mindestens 120 fb^{-1} an Daten mit $\sqrt{s}$ = 13 TeV produziert werden sollen und bislang noch kein Hinweis auf Supersymmetrie gefunden werden konnte, werden auch Suchen nach elektroschwach produzierten Teilchen immer interessanter. Diese waren bislang aufgrund niedrigerer Wirkungsquerschnitte wegen fehlender Statistik nicht sensitiv auf supersymmetrische Prozesse.

Dieser Vortrag präsentiert eine Erweiterung der publizierten Analyse auf die elektroschwache Produktion. Mit Hilfe von Sensitivitätsstudien wird untersucht, inwiefern diese Analyse sensitiv auf elektroschwache supersymmetrische Signalmodelle ist. Es wird außerdem dargelegt, mit welchen Veränderungen die erreichte Sensitivität auf elektroschwache Signalmodelle erweitert werden kann.

T 26.10 Di 18:45 Philo-HS3

On History and Methodology of Supersymmetric Theories — •Alexander Unzicker — Pestalozzi-Gymnasium München

After about half a century of supersymmetric ideas in physics, it appears worthwhile to have a look at the history of this notable field of theoretical physics. Concrete key developments as well as some general methodological questions are discussed. These considerations should help to interpret future particle accelerator data with respect to fundamental questions.

T 27: Suche nach Physik jenseits des Standardmodels II

Zeit: Dienstag 16:30–19:00 Raum: Philo-HS4

T 27.1 Di 16:30 Philo-HS4

Triggerlose Analyse mit dem Level-1 topologischen Prozessor bei ATLAS — Sebastian Artz, Volker Büscher, •Johannes Frederic Damp und Christian Schmitt — Johannes Gutenberg-Universität Mainz

Viele Erweiterungen des Standardmodells sagen neue Teilchen mit hadronischen Endzuständen voraus, die zu Dijet-Ereignissen führen, zum Beispiel ein Z'-Modell für dunkle Materie. Aktuelle Analysen von ATLAS und CMS konzentrieren sich auf schwere Teilchen über 1 TeV, da die Region unter 1 TeV statistisch limitiert ist durch das Vorhandensein von hohen Triggerprescales: Aufgrund der begrenzten Bandbreite, die inklusiven Single-Jet-Triggern zugewiesen wird, muss ein großer Teil der Ereignisse mit Jet-Impulsen unter etwa 400 GeV verworfen werden. Es gibt verschiedene Lösungsansätze für dieses Problem, zum Beispiel eine Trigger-Level-Analyse mit High-Level-Trigger Jets welche invarianten Dijetmassen bis zu $\sim$ 450 GeV erreicht.

In diesem Vortrag wird ein neuer Ansatz zur Analyse von Regionen mit noch geringerer Masse vorgestellt, der den topologischen Prozessor der ersten Triggerstufe (L1Topo) von ATLAS nutzt. Durch das Ausführen der Analyse und Erzeugen von invarianten Massenhistogrammen direkt auf dem ersten Triggerlevel wird die eigentlich notwendige Triggerselektion vermieden. Dies ermöglicht im Gegensatz zur Offline-Analyse eine Analyse des gesamten Spektrums mit voller Statistik. Dieser Vortrag gibt einen Überblick über das allgemeine Konzept der Firmware-Implementierung, das Design der Auslesesoftware sowie den aktuellen Status der Offline-Analyse.

T 27.2 Di 16:45 Philo-HS4

Search for invisible particles produced in association with a single hadronically decaying top quark at $\sqrt{s}$ = 13 TeV with the ATLAS detector — •Tobias Kupfer, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4 a, 44227 Dortmund

The large center of mass energies available in proton-proton collisions at the LHC provide the opportunity to search for new physics phenomena beyond the Standard Model (SM). A vector-like top partner (VLT), which is predicted by many extensions to the SM, as well as resonant and non-resonant production of Dark Matter (DM) particles can lead to a final state including the top quark in addition to particles interacting scarcely or not at all with the detector. This specific signature, referred to as mono-top, is detected by the ATLAS experiment as a single reconstructed top quark in combination with large missing transverse momentum.
An analysis is presented designed to search for singly produced VLT resulting in a hadronically decaying top quark and a Z boson decaying into two neutrinos, which leads to the mono-top signature. The search is performed in a phase-space region optimized on the expected signal sensitivity and limits are set on the predicted mass and coupling of the VLT and of DM particles.

T 27.3 Di 17:00 Philo-HS4

Search for light resonances in b-quark jet pairs in association with a jet from initial state radiation using boosted topologies with the ATLAS detector — •Merve Sahinsoy and Oleg Brandt — KIRCHHOFF INSTITUTE FOR PHYSICS, HEIDELBERG

Many models of new physics predict new particles with significant couplings to b quarks, including resonances which also couple to dark matter particles. The resulting hadronic final states at low resonance masses represent a particular experimental challenge due to the large cross-section of standard model backgrounds and the resulting bandwidth limitations. This challenge can be overcome by searching for b quark pairs from the resonance decay reconstructed as a single large-radius jet which recoils against a jet from initial state radiation. This approach is also sensitive to standard model Higgs boson production at high transverse momenta. In this talk, the analysis strategy will be presented together with the recent optimisation studies on the identification of Higgs boson decays to a b-quark pair in the boosted regime using large-radius jets.

T 27.4 Di 17:15 Philo-HS4

Search for excited leptons decaying via contact-interaction with CMS — •Christoph Schuler, Jonas Roemer, Kerstin Hoepfner, and Thomas Hebbeker — RWTH Aachen University

The CMS experiment at CERN has recorded proton-proton collisions at a center-of-mass energy of 13 TeV in 2016. These data allow to search for physics beyond the Standard Model. One possibility is the existence of excited leptons. These excited leptons could be produced via contact interaction with an additional lepton of the same flavour, and subsequently decay via contact interaction.

We searched for the existence of excited electrons and muons with the full 2016 CMS dataset.

T 27.5 Di 17:30 Philo-HS4

Uncertainties on multijet background for searches with jets and missing transverse energy with the ATLAS detector — •Vincent Kitali, Christian Sander, and Krisztian Peters — DESY, Hamburg, Deutschland

The Higgs-Boson might be a portal to new physics. It may for example couple to massive particles not visible to the ATLAS detector, which are dark matter candidates. The Vector Boson Fusion (VBF) channel offers a clean final state with two jets and missing transverse energy.

One background are QCD events, in which missing transverse energy is reconstructed due to the imperfect reconstruction of the jet. The uncertainties on this background are large and need to be understood. To quantify, how many events with jets in the final state are misidentified as signal, jets are smeared using simulated jet transverse momentum response distributions. The main topic of this talk is the test of these simulations for their viability.

T 27.6 Di 17:45 Philo-HS4

Search for heavy charged long-lived particles with the ATLAS detector in a dataset of 36.1 fb^{-1} **p-p collisions** — •Michael Adersberger and Sascha Mehlhase — LMU, Munich, Germany

Heavy charged long-lived particles are an important target for searches at the LHC, as they are predicted in a large variety of theories beyond the Standard Model. A model-independent approach will be presented, where heavy charged long-lived particles are detector stable or reach at least the ATLAS hadronic calorimeters, from now on referred to as Stable Massive Particles (SMP).
The main observables to identify SMPs are time-of-flight and specific ionisation energy-loss measurements. Their velocity is significantly lower then the speed-of-light due to their high mass and the moderate kinetic energies available. They are expected to have a significantly higher specific ionisation energy-loss than Standard Model particles produced at the LHC. The main backgrounds are of instrumental nature and due to mis-measurements of various observables.
This search targets Chargino and Stau SMP models with two charged tracks in the final state and R-hadron SMP models (gluino, sbottom, stop) which have a significant fraction uncharged tracks after hadronisation or undergo a change of charge due to hadronic interactions with the detector material. Most recent public results will be presented.

T 27.7 Di 18:00 Philo-HS4

Analysis of changes in the ATLAS reconstruction algorithm for slow, muon-like particles — •Martin Habedank and Sascha Mehlhase — Ludwig-Maximilians Universität München

Many extensions of the Standard Model (SM) predict heavy, long-lived charged particles in reach of the LHC. These are called stable massive particles (SMPs) if they traverse large parts of the detector before decaying. Due to their long lifetime and little interaction with the calorimeters, they would leave tracks comparable to that of a muon in the ATLAS particle detector. In contrast to Standard Model muons, a velocity significantly lower than the speed of light is expected for SMPs. Their velocity β can be reconstructed by dE/dx and time-of-flight measurements and grants therefore a model-independent approach for the search for beyond the Standard Model (BSM) particles.

In the last few years, there has been a complete revision of the ATLAS reconstruction algorithm for these slow, muon-like particles. The changes in this revision are analysed, differences and similarities regarding reconstruction techniques and efficiencies in dependence of the various particle kinematics are pointed out and the impact for the search for SMPs is evaluated.

T 27.8 Di 18:15 Philo-HS4

Track Reconstruction Performance for Semi-stable Charged Particles at CMS — Samuel Bein, Viktor Kutzner, Peter Schleper, Georg Steinbrueck, •Alexandra Tews, and Benedikt Vormwald — Institut für Experimentalphysik, Universität Hamburg

A variety of extensions of the standard model predict charged particles with lifetimes of the order of nanoseconds, allowing them to leave short tracks inside the tracking system of a particle detector before decaying.
Studies on the track reconstruction performance are a crucial part of analyses with such semi-stable charged particles at CMS.
Key parameters assessing the tracking performance are the efficiency of the tracking algorithm to find and reconstruct such tracks, as well as the probability that a given track is a "fake", and thus does not correspond to one single true particle. The tracking efficiency is associated with important systematic uncertainties while the fake rate is important for estimating the background in such searches.
A study on the track reconstruction performance is done using proton-proton collision data collected with the CMS experiment at $\sqrt{s}$ = 13 TeV making use of both, real and simulated data, with the particularity that a data-driven method is employed to measure the tracking efficiency.

T 27.9 Di 18:30 Philo-HS4

Search for disappearing tracks with the CMS experiment at $\sqrt{s}$ = 13 **TeV** — •Viktor Kutzner, Benedikt Vormwald, Peter Schleper, Samuel Bein, Georg Steinbrück, and Alexandra Tews — Institut für Experimentalphysik, Universität Hamburg

The status of the search for long-lived charged BSM particles, which decay in the CMS detector and produce disappearing track signatures, is presented. This signature is characterized by missing hits in the outer layers of the tracker with little or no energy deposited in the calorimeter. The findings are interpreted in the anomaly-mediated supersymmetry breaking model, which predicts a small mass splitting between the two lightest SUSY particles, typically being a chargino and a neutralino. This results in longlived charginos, which decay into soft non-reconstructed leptons or hadrons and a lightest supersymmetric particle.

The search aims to include short disappearing tracks with less tracker hits with respect to earlier analyses. Multivariate analysis methods are investigated for different categories of the disappearing track selection and results are presented using proton-proton collision data with $\sqrt{s}$ = 13 TeV collected with the CMS experiment in 2016 and 2017.

T 27.10 Di 18:45 Philo-HS4

Search for heavy Majorana neutrinos in rare semileptonic B meson decays at the LHCb experiment — •Meriem Boubdir, Eluned Smith, and Stefan Schael — I. Physikalisches Institut B, RWTH Aachen

It is an open question of particles physics whether neutrinos are Dirac or Majorana fermions. Neutrinos of Majorana-nature (meaning they are their own antiparticles) would induce lepton number violating (LNV) processes. An example would be B meson decays with two same-sign leptons and a (pseudo-)scalar meson in the final state. The LHCb experiment is an ideal environment for the search for these striking signatures due to the large number of $b\bar{b}$ pairs produced in the detector acceptance. This talk presents updated results on a search for the LNV decay $B^- \to \mu^-\mu^-\pi^+$ using data collected by the LHCb experiment during the LHC Run 1 and 2. In addition, The analysis is extended to include a search for the related decay $B_c^- \to \mu^-\mu^-\pi^+$, which allows neutrino masses to be probed up to $\sim$ 6 GeV. The selection of the signal modes and the suppression of potential backgrounds will be discussed. Moreover, revised limits on the branching fractions of the signal decays, and of the heavy-to-light mixing angle $V_{\mu 4}$, will be introduced.

T 28: Suche nach dunkler Materie II

Zeit: Dienstag 16:30–19:05 Raum: Philo-HS5

Gruppenbericht T 28.1 Di 16:30 Philo-HS5

Direkte Suche nach Dunkler Materie mit EDELWEISS: Resultate und Perspektiven — •Bernhard Siebenborn und Klaus Eitel — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Im EDELWEISS Experiment werden bei einer Temperatur von 18mK hochreine Germanium-Kristalle mit NTD-Phonon-Sensoren verwendet, um Kernrückstöße durch WIMPs zu detektieren. Diese können über das gleichzeitige Vermessen von Ionisations- und Phonon-Signalen identifiziert werden. In den laufenden Messungen wird das Phonon-Signal über den Neganov-Luke Effekt verstärkt, was die Suche nach low mass WIMPs im GeV-Bereich ermöglicht. Aktuelle Entwicklungen und Resultate werden vorgestellt und ein Experimentansatz mit neuen Phonon-Sensoren diskutiert, der die Sensitivität auch in den MeV Massenbereich erweitern wird.

T 28.2 Di 16:50 Philo-HS5

Studies of the XENON1T electronic recoil spectrum for physics beyond dark matter direct detection — •Christian Wittweg — Institut für Kernphysik, WWU Münster

XENON1T located at Laboratori Nazionali del Gran Sasso is the most sensitive dark matter direct detection experiment in the world today. It uses a dual phase time projection chamber with a sensitive liquid xenon volume of ~ 2 tons to detect weakly interacting massive particles (WIMPs). Its unprecedented low energy electronic recoil background of $(1.93 \pm 0.25) \cdot 10^{-4}$ events/(keV·kg·day) and the high target mass also make it sensitive to rare nuclear decays such as double beta decay processes as well as alternative dark matter candidates. Analyses in these physics channels require a detailed understanding of the electronic recoil spectrum from background sources.

This talk will focus on energy calibration, energy resolution and background modelling. A comparison of Monte Carlo simulations with the measured background energy spectrum will be presented. This work is supported by Deutsche Forschungsgemeinschaft (DFG) through the Research Training Group "GRK 2149: Strong and Weak Interactions - from Hadrons to Dark Matter".

T 28.3 Di 17:05 Philo-HS5

Solar axion search with a GridPix detector at CAST — •Sebastian Schmidt, Klaus Desch, Jochen Kaminski, and Tobias Schiffer — Physikalisches Institut, Universität Bonn

The CERN Axion Solar Telescope (CAST) is a helioscope experiment at CERN, searching for solar axions and chameleons. The inverse Primakoff effect is utilized to reconvert the particles into X-rays in the magnetic field of an LHC prototype dipole magnet.

A gaseous detector based on 7 GridPixes, a combination of a 256×256 pixel Timepix ASIC and an integrated MicroMegas stage on top, together with veto scintillators and an FADC, are utilized at CAST to provide an ultra low background detector.

The analysis framework, written in a combination of Nim and Python, will be discussed. The focus will be signal / background separation, using convolutional neural networks to maximize background suppression while retaining high signal efficiency.

Preliminary results of the 2017/18 data taking period will be presented.

T 28.4 Di 17:20 Philo-HS5

Deep learning techniques and field simulations for the DARWIN dark matter search — •Anna-Sophie Frick, Guido Drexlin, Ferenc Glück, and Daniel Hilk — Karlsruhe Institute of Technology, Karlsruhe

In the last years, dual phase noble gas detectors like XENON1T have been probing WIMP-nucleon cross sections down to 10^{-46} cm^2. The DARWIN (**DAR**k matter **WI**mp search with liquid xeno**N**) project aims to push the sensitivity to the ultimate limit for the spin-independent WIMP-nucleon cross section of $\mathcal{O}(10^{-49}\text{cm}^2)$ at the neutrino floor which will require a total mass of 50 tons of LXe.

As an experiment searching for rare events, DARWIN requires a good discrimination of all possible background sources from potential WIMP signals. To enhance the signal recognition, convolutional network methods which have successfully been applied to the KATRIN experiment have been transferred to the DARWIN detector to guide the layout of a LXe prototype to be built at KIT. This talk summarizes current results of the performance of deep learning techniques regarding different patterns.

Additionally, to further improve the understanding of signals and patterns, it is indispensable to simulate the electrostatic field with high precision within the DARWIN detector. This talk gives a brief overview of the current results of field simulations.

T 28.5 Di 17:35 Philo-HS5

FUNK: Search for Hidden Photon Dark Matter in Visible Range — •Christoph M. Schäfer[1], Arnaud Andrianavalomahefa[1], Kai Daumiller[1], Babette Döbrich[2], Ralph Engel[1], Joerg Jaeckel[3], Marek Kowalski[4,5], Axel Lindner[4], Hermann-Josef Mathes[1], Javier Redondo[6], Markus Roth[1], Thomas Schwetz-Mangold[1], Ralf Ulrich[1], and Darko Veberic[1] — [1]Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany — [2]Physics Department, CERN, Geneva, Switzerland — [3]Institute for Theoretical Physics, Heidelberg University, Germany — [4]Deutsches Elektronen Synchrotron (DESY), Zeuthen, Germany — [5]Department of Physics, Humboldt University, Berlin, Germany — [6]Department of Theoretical Physics, University of Zaragoza, Spain

One possible candidate for the dark matter particles are hidden photons and, in case they exist and mix with ordinary tensor field, will be accompanied by a very small electric-field component, which on the surface of conducting materials converts into real photons. They are emitted nearly perpendicular to the surface and the frequency of the emitted real photons is matching the mass of the hidden photon. For this purpose a 14m^2 spherical metallic mirror was set up. By placing different detectors inside the radius point of the mirror, we are able to access various mass ranges of the hidden photon. We report on an experimental measurement completed using a low-noise photomultiplier tube, which is sensitive in the visible and near-UV part of the spectrum and thus covers the eV-range of possible hidden photon masses.

T 28.6 Di 17:50 Philo-HS5

Perspectives of Monojet searches on supersymmetric Dark Matter — •Conny Beskidt[1], Wim de Boer[1], and Dmitri Kazakov[1,2] — [1]Karlsruhe Institute of Technology (IETP) — [2]JINR, ITEP, Moscow, Russia

Roughly 85% of the matter in the Universe consists of dark matter made at least partially of weakly interacting massive particls (WIMPs). Supersymmetry (SUSY) can provide a perfect WIMP candidate: the Lightest Supersymmetric Particle (LSP), in many models the lightest neutralino, has all the required WIMP properties: it is neutral, massive, stable and weakly interacting. However, neutralinos are mixtures of gauginos and Higgsinos, so the LSP can become predominantly bino-, Higgsino- or singlino-like in the minimal and next-to minimal supersymmetric standard model. The impact of the current searches at the LHC for monojets on these supersymmetric models and their different scenarios is investigated.

T 28.7 Di 18:05 Philo-HS5

On the trail of dark matter by use of simplified models at CMS — Michael Dürr, Alexander Grohsjean, Kai Schmidt-Hoberg, Christan Schwanenberger, and •Nicole Stefanov — DESY, Hamburg, Germany

Various astrophysical observations could consistently be explained by the existence of dark matter. Assuming that it is a so-called weakly interacting massive particle, it could be produced and observed at the Large Hadron Collider.

In this talk, by use of simplified models, such a search for dark matter produced in association with a dileptonically decaying top quark pair will be covered focusing on the challenging kinematic reconstruction of the final state containing undetectable neutrino and dark matter pairs. The kinematic reconstruction is of particular interest since it enhances the detection capability of a potential signal and - in case of a discovery - it allows to study the nature of DM in great detail. Moreover, discovery prospects for extensions of the usual simplified models will be discussed.

T 28.8 Di 18:20 Philo-HS5

Search for Dark Matter produced in association with a W or Z boson with the ATLAS Experiment at 13 TeV — •Stanislav Suchek and Oleg Brandt — Kirchhoff-Institut für Physik, Universität Heidelberg

Dark Matter composes a significant part of the visible Universe. Despite a solid cosmological evidence, its nature, properties and interaction with the Standard Model sector is still to be unraveled. Looking for the direct production of Dark Matter particles at particle colliders can shed light on the mystery of Dark Matter.
The signature of this search is a pair of quarks coming from the decays of the Standard Model W and Z bosons, recoiling against missing transverse momentum from Dark Matter particles. In addition to small-R jets, large-R jets are used to identify highly boosted W and Z bosons. The results using 36 fb^{-1} of 2015+2016 ATLAS pp collision data are presented. In case of no significant excess, limits on s-channel vector mediator models, as well as limits with reduced model dependence at 95% confidence level on the visible cross-section of W/Z + Dark Matter production, will be presented for different missing transverse energy regions.

T 28.9 Di 18:35 Philo-HS5

Optimierung der Suche nach dunklen Materie mit dem ATLAS-Detektor im Mono-V-Kanal — •Makoto Teshima, Philipp Gadow, Oliver Kortner, Sandra Kortner, Hubert Kroha und Patrick Rieck — MPI für Physik, München, Deutschland

Astrophysikalische und kosmologische Messungen zeigen die Existenz von nichtbaryonischer dunkler Materie im Universum. Teilchen der dunklen Materie könnten in Proton-Proton-Kollisionen am LHC ent-

stehen. Wenn diese Teilchen zusammen mit einem Vektorboson erzeugt werden, kann man diese in Endzuständen mit großer fehlender Transversalenergie und zwei Jets aus dem Zerfall des Vektorboson finden. In dem Vortrag wird die Optimierung des Suche nach dunkler Materie in dieser Topologie besprochen. Besonderes Augenmerk wird hierbei auf die Wahl geeigneter Observabler wie etwa der fehlenden Transversalenergie und die Dijetmasse für die entgültige statistische Datenauswertung gelegt. Die erreichbare Empfindlichkeit bei der Suche nach dunkler Materie in Abhängigkeit der gewählten Observablen wird im Vortrag diskutiert.

T 28.10 Di 18:50 Philo-HS5

Suche nach Dunkler Materie in Ereignissen mit fehlender transversaler Energie und Jets beim ATLAS Experiment — •Andreas Reiss, Katharina Bierwagen und Volker Büscher — Johannes Gutenberg-Universität, Mainz, Deutschland

Astrophysikalische Beobachtungen legen die Existenz von Dunkler Materie im Universum nahe, deren Natur nicht genau bekannt ist. Durch die Datennahme mit dem Large Hadron Collider von 2015 bis 2017 bei einer Schwerpunktsenergie von 13 TeV werden neue Suchen nach Dunkler Materie in Proton-Proton-Kollisionen ermöglicht, die komplementär zu den indirekten und direkten Suchen sind.

Dieser Vortrag befasst sich mit der Suche nach Dunkler Materie und weiteren neuen Phänomenen in Ereignissen mit Abstrahlung von Jets im Anfangszustand und fehlender transversaler Energie. Dabei wird eine sehr genaue Untergrundabschätzung mit einer Genauigkeit von einigen Prozent benötigt. Hierbei ist es eine große Herausforderung, die datenbasierte Bestimmung der Untergründe und die Extrapolation in die Signalregion mit minimalen Theorieunsicherheiten durchzuführen. Als sensitive Variable wird hauptsächlich die fehlende transversale Energie verwendet in Kombination mit weiteren sensitiven Variablen. Ein Schwerpunkt wird hierbei auf Ergebnisse zu der Produktion von zwei Dunkle Materie Teilchen über Axial-Vektor- und Pseudo-Skalare-Mediatoren gelegt.

T 29: Kosmische Strahlung II

Zeit: Dienstag 16:30–19:05 Raum: Philo-HS6

Gruppenbericht T 29.1 Di 16:30 Philo-HS6

CRPropa 3.2: Improved open-source cosmic ray propagation framework from TeV to ZeV energies — •Lukas Merten for the CRPropa-Collaboration — Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany — Ruhr Astroparticle and Plasmaphysics Center

Experimental observations of Galactic and extragalactic cosmic rays in the last decade challenge the theoretical description of both the sources and the transport of cosmic rays. The latest version of the publicly available simulation framework CRPropa 3.2 aims at a consistent solution of the cosmic-ray transport problem, including the production and propagation of secondary neutrinos and electromagnetic cascades. The Monte-Carlo based software is not only able to describe the transport of cosmic rays in a ballistic single-particle propagation but is also able to solve a transport equation. This combined approach will allow a consistent description of cosmic rays from the highest energies down to the TeV-range. This talk will summarize the latest improvements of the code, e.g. solving the transport equation, improved electromagnetic cascades, source targeting, cosmic-ray acceleration and many technical improvements. The new opportunities coming with these developments will be explained including simple user examples.

T 29.2 Di 16:50 Philo-HS6

Modeling the cosmic ray transport in the Galactic Center using gamma-ray data and prediction of the neutrino flux — •Mehmet Guenduez and Julia Becker Tjus — Ruhr-Universität Bochum , Bochum, Germany

In April 2016 the H.E.S.S. collaboration published the detection of a high energy gamma-ray flux from the Galactic Center. The H.E.S.S. results suggest a single source (the supermassive blackhole SgrA*) and a hadronic origin, which would require proton energies in PeV-range. In this work, we found a realistic transport model based on the analytical solution for protons which considers the radial dependency, catastrophic and continuous losses. The model is specified for the Galactic Center and considers a single source (SgrA*) of the diffuse flux as well as SgrA East and SgrA* in combination. Additionally, different radial dependencies of the target particles are considered, so that the radial dependency of the gamma-ray luminosity of H.E.S.S. and Fermi are explained. In this talk, the model is presented together with the best fit to the gamma-ray data, its interpretation and the prediction of the expected neutrino flux.

T 29.3 Di 17:05 Philo-HS6

Interpolation von Magnetfeldern und die Implikationen für CRPropa — •Leander Schlegel, Julia Tjus, Björn Eichmann und Antonius Frie — Ruhr Astroparticle and Plasmaphysics Center, Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany

Über 100 Jahre nach ihrer Entdeckung ist der Ursprung der hochenergetischen kosmischen Strahlung nicht genau bekannt. Neben der Untersuchung möglicher Quellkandidaten und der Beschleunigungsmechanismen ist insbesondere das Verständnis der Propagation der geladenen Teilchen durch Magnetfelder wesentlich.

In den meisten numerischen Simulationsprogrammen werden die turbulenten Magnetfelder diskret auf einem dreidimensionalen Gitter generiert. Im Falle von der ballistischen Propagation, welche auf der Lösung der Bewegungsgleichung der kosmischen Strahlung beruht, muss das Magnetfeld auch zwischen den Stützstellen definiert sein, was durch die Interpolation der zugrundeliegenden Felder erreicht werden kann. Dieses Verfahren liefert häufig zwar eine schnelle Möglichkeit die erzeugten Felder kontinuierlich zu erweitern, führt aber häufig zu systematischen Fehlern und daraus resultierenden Problemen in der Simulation.

Diese Arbeit beschäftigt sich mit der bisher in CRPropa genutzten trilinearen, komponentenweisen Interpolation, welche systematisch zu kleine Werte für B_{rms} berechnet und zudem eine nicht Divergenz-freie Realisierung des Feldes liefert. In diesem Vortrag werden die Probleme mit der aktuellen Implementierung erläutert und mögliche Alternativen vorgestellt.

T 29.4 Di 17:20 Philo-HS6

Parametereinschränkung bei der Untersuchung des Überganges galaktischer zu extragalaktischer kosmischer Strahlung* — •Alex Kääpä und Karl-Heinz Kampert — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Der Energiebereich, der den Übergang zwischen kosmischer Strahlung galaktischen und derer extragalaktischen Ursprungs umfasst, ist bisher unbekannt. Das Energiespektrum unterhalb des sogenannten Knies kann gut durch konventionelle Modelle mit galaktischen Quellen beschrieben werden. Außerdem deutet die Beobachtung großskaliger Anisotropie auf extragalaktische Quellen oberhalb des sogenannten Knöchels hin. Allerdings bedarf der Energiebereich dazwischen näherer Betrachtung, zumal konventionelle galaktische und extragalaktische Modelle nicht den gemessenen Fluss bereitstellen können. Auch wenn Ergänzungen zu diesen Modellen, wie Wiederbeschleunigung bzw. Spallation, den Energiebereich nach oben bzw. nach unten erweitern können, hängen diese stark von Parametern ab, die bisher unzureichend verstanden sind und weiter eingegrenzt werden müssen. Einige dieser werden in diesem Vortrag diskutiert, insbesondere bezüglich galaktischer kosmischer Strahlung. Außerdem werden für die Untersuchung des Beitrags extragalaktischer kosmischer Strahlung vorläufige Ergebnisse aus Simulationen von Aspekten, wie der Abschirmung der Teilchen durch das galaktischen Magnetfeld, sowie ihrer Propagation in der Galaxie, vorgestellt.

* Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).

T 29.5 Di 17:35 Philo-HS6

Implementation von hadronischen Wechselwirkungen in CRPropa — •Julia Ebeling, Julia Tjus und Lukas Merten — Ruhr Astroparticle and Plasmaphysics Center, Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany

Die Produktion von sogenannten Sekundärteilchen der kosmischen Strahlung ist essentieller Bestandteil des Transports der kosmischen Strahlung. Die detaillierte, ortsaufgelöste Beobachtung von Photonen und Neutrinos, welche in diesen Prozessen erzeugt werden, kann wich-

tige Informationen zum Verständnis der Propagation der Quellen beitragen.

Die Software CRPropa ist ein Opensource-Code, der die Propagation kosmischer Strahlung beschreibt. Während Wechselwirkungen mit Magnet- oder Photonenfeldern bereits implementiert sind, wurde die hadronische Wechselwirkung zwischen der kosmischen Strahlung und dem interstellaren Medium bisher nicht beachtet. In dieser Arbeit sollen die Möglichkeiten einer zeiteffizienten Implementierung in den obigen Monte-Carlo Code erarbeitet werden. Diese Wechselwirkung hat auf die Primärteilchen der kosmischen Strahlung auf Grung der geringen Wechselwirkungswahrscheinlichkeit nur einen geringen Einfluss. Allerdings wird die Implementierung erlauben, zusammen mit der anisotropen Diffusion verlässlichere Aussagen über die räumliche Verteilung der Sekundärteilchen wie Neutrinos und Gammastrahlung zu treffen. Untersucht werden hierbei insbesondere die Implikationen, die sich für die Zusammensetzung der kosmischen Strahlung und die räumliche Verteilung der Sekundärteilchen ergeben.

T 29.6 Di 17:50 Philo-HS6

Kombination von Transport- und Bewegungsgleichung: Ermöglichung der Propagation von GeV bis EeV-Energien — •Patrick Reichherzer, Julia Tjus und Lukas Merten — Ruhr Astroparticle and Plasmaphysics Center, Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany

Nach wie vor wird der Transport der kosmischen Strahlung nicht vollständig verstanden, weshalb die Simulation der Teilchenpropagation durch turbulente Magnetfelder zum Verständnis der auf der Erde beobachteten Signaturen notwendig ist. CRPropa ist eine Software zur Simulation des Transports der kosmischen Strahlung mit zwei unterschiedlichen Methoden. Während die numerische Lösung der Bewegungsgleichung für hochenergetische Teilchen zweckmäßig ist, versagt dieser Ansatz für niederenegetische Teilchen aufgrund der zu zeitaufwendigen Berechnungen. Galaktische Teilchen, welche Energien unterhalb von PeV Energien besitzen, werden im Gegensatz dazu durch das Lösen der Transportgleichung simuliert. Durch detaillierte Untersuchung der Einsatzbereiche beider Module wird in dieser Arbeit der optimale Parameterraum für beide Beschreibungen bestimmt.

Um das Ziel einer einheitlichen Beschreibung des Teilchentransports, welcher sowohl galaktischer als auch extragalaktischer Natur sein kann, zu realisieren, ist ein dynamischer Switch zwischen diesen beiden bereits bestehenden Modulen erforderlich. Der Ansatz zur Implementierung basiert auf maschinellen Lernalgorithmen, die während des Lernprozesses intern abstrahierte mathematische Muster generieren, auf deren Basis zukünftige Daten kategorisiert werden können.

T 29.7 Di 18:05 Philo-HS6

Cosmic ray radio emission: towards a fast forward model — •David Butler[1], Tim Huege[1], and Olaf Scholten[2] — [1]Karlsruher Institut für Technologie - Institut für Kernphysik — [2]University of Groningen - Center for Advanced Radiation Technology

In the analysis of radio signals from cosmic ray air showers we often rely on the simple model of a point source located at the shower maximum. On the other hand we have Monte Carlo simulations of the particle physics which represent our most accurate models of cosmic ray air showers, but the high computation demands of high-energy cascades make them impractical for bulk application and more involved statistical analysis techniques.

We aim to unravel the key parameters which determine the radio signal at arbitrary antenna positions. To this end we slice the Monte Carlo single-particle contributions by region of origin and study the influence of e.g. cascade development, local parameters like the ambient density and also propagation effects along the line of sight. Some dependencies will be simple to model, allowing us to focus on the remaining components.

This approach should culminate in a fast semi-analytical forward model which preserves the accuracy of a full Monte Carlo cascade within inherent fluctuations.

T 29.8 Di 18:20 Philo-HS6

Targetverteilungsfunktionen zur Wechselwirkung der kosmischen Strahlung in der Milchstraße zur Implementierung in CRPropa — •Julien Dörner, Julia Tjus und Lukas Merten — Ruhr Astroparticle and Plasmaphysics Center, Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany

Die Propagation kosmischer Teilchen durch die Galaxie hat Einfluss auf alle Messgrößen auf der Erde. Eine wichtige Größe ist hierbei das Verhältnis aus sogenannten Primärteilchen, welche direkt an der Quelle erzeugt werden, und solchen, die erst beim Transport der kosmischen Strahlung entstehen, den sogenannten Sekundärteilchen.

Der derzeit öffentlich zugängliche Propagationscode CRPropa3 beschreibt den Transport der kosmischen Strahlung und enthält bereits wesentliche die Wechselwirkungsmodelle der geladenen kosmischen Teilchen mit dem Photonen-Hintergrund. Allerdings sind noch keine Nukleon-Nukleon-Wechselwirkungen in der Software inkludiert, so dass ein entscheidender Prozess der galaktischen Propagation innerhalb von CRPropa aktuell noch nicht vollständig beschrieben werden kann. Essentiell für die korrekte Beschreibung dieser Wechselwirkung ist die detaillierte Kenntnis über die Targetmassenverteilung.

In diesem Vortrag werden gängige Modelle der Massenverteilung innerhalb der Milchstraße dargestellt. Die Unterschiede zwischen den unterschiedlichen, analytischen und explizit auf einem Gitter definierten, Verteilungen werden vorgestellt und die Implementierung in den CRPropa3 Code diskutiert werden.

T 29.9 Di 18:35 Philo-HS6

Model for photo-nuclear interactions in sources of UHECR and astrophysical neutrinos — •Leonel Morejon, Anatoli Fedynitch, and Walter Winter — DESY Zeuthen, Platanenallee 6, D-15738 Zeuthen

Although the origin of UHECR is still undetermined, their potential sources have to belong the most violent class of astrophysical objects (e.g. TDEs, GRBs, AGNs), and, according to the Auger Observatory, the sources have to contain heavier nuclei. The production and transport of multiple astrophysical messengers (gamma, neutrinos and CR) inside these sources is described through coupled Boltzmann equations, which require as an input photo-nuclear cross sections for interactions of nuclei with dense photon fields. It has been shown that detailed multi-messenger calculations depend on the production properties of secondary particles and the nuclear physics that governs the disintegration of the interacting nucleus and initiates nuclear cascades in the accelerator. In this work, we give up some of the simplifications that were widely used in the past and study the impact of a more detailed photo-nuclear model on multi-messenger predictions.

T 29.10 Di 18:50 Philo-HS6

Optimisation of thinning for air shower simulations — •Maximilian Reininghaus and Ralph Engel — Institut für Kernphysik, Karlsruher Institut für Technologie

Thinning is an important technique to drastically reduce both computation time and size of output data in Monte-Carlo simulations of air showers, especially at highest energies. Instead of tracking every single particle produced in an interaction, a thinning algorithm randomly decides which particles are retained for further propagation while the remaining ones are discarded. To account for these discarded particles, a statistical weight is assigned to the retained particles.

However, this procedure introduces artificial fluctuations to observable quantities. Since these fluctuations spoil the quality of the simulation to some degree, it is important to study ways of optimising the procedure. In this contribution we compare different thininng algorithms, the influences of different implementations of weight limitation and modified probability distributions for the particle selection within the framework of a simple one-dimensional toy model of air showers.

T 30: Gammaastronomie I

Zeit: Dienstag 16:30–18:35 Raum: Philo-HS7

Gruppenbericht T 30.1 Di 16:30 Philo-HS7

e-ASTROGAM - The Next Big Step in Gamma-ray Astrophysics at MeV to GeV Energies — •Uwe Oberlack — JGU Mainz — on behalf of the e-ASTROGAM Collaboration

e-ASTROGAM (enhanced-ASTROGAM) is a breakthrough Observatory space mission dedicated to the study of the non-thermal universe in the photon energy range from 0.3 MeV to 3 GeV. This Compton and pair telescope, proposed as ESA's M5 medium-size mission in the Cosmic Visions program, is composed of a Silicon tracker, a calorimeter, and an anticoincidence system. Based on advanced, space-proven detector technology, the mission provides unprecedented sensitivity, angular and energy resolution, combined with polarimetric capability. The lower energy limit can be pushed to energies as low as 150 keV for the tracker and to 30 keV for calorimetric detection. e-ASTROGAM will open a new window on the non-thermal Universe, making pioneering observations of the most powerful Galactic and extragalactic sources, elucidating the nature of their relativistic outflows and their effects on the surroundings. With a line sensitivity in the MeV energy range one to two orders of magnitude better than previous instruments, e-ASTROGAM will determine the origin of key isotopes fundamental for the understanding of supernova explosions and the chemical evolution of our Galaxy. With its high sensitivity and large field-of-view, the mission will provide unique data of significant interest to a broad astronomical community, complementary to future observatories covering lower and higher energy parts of the electromagnetic spectrum, gravitational waves, as well as astrophysical neutrinos.

T 30.2 Di 16:50 Philo-HS7

Possibilities and challenges of Very-Large Zenith-Angle Observations with MAGIC — •Juliane van Scherpenberg for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München

The MAGIC Telescopes are a system of two Imaging Air Cherenkov Telescopes (IACTs) located at the Roque de los Muchachos observatory on the Canary Island of La Palma. MAGIC can observe very-high energy (VHE) gamma-rays from around 50 GeV to 50 TeV. Recently the feasibilty of performing observations at very large zenith angles (VLZA) has been investigated to extent observations up to the highest gamma-ray energy regime. However, measurements of this kind bear many challenges. The calibration of the atmosphere needs to be well understood as well as more technical restrictions concerning for example the quality of directional reconstruction at very high zenith angles. I will present the current efforts that are made to evaluate the possibilities and limits of VLZA observations with MAGIC and future IACTs.

T 30.3 Di 17:05 Philo-HS7

Analysis optimisation for >10 TeV ground-based very-high-energy gamma-ray astronomy — •Iryna Lypova, Stefan Ohm, David Berge, and Stefan Klepser — DESY, Zeuthen, Germany

The High Energy Stereoscopic System (H.E.S.S.) is an array of five Cherenkov telescopes located in Namibia. H.E.S.S. operates in the broad energy range between a few 10s of GeV to more than 50 TeV. Nominal analysis methods allow for the reconstruction of events with offsets up to 2.5 degrees: the field-of-view of the H.E.S.S. cameras. Especially at >10 TeV energies, events with larger offsets trigger the telescopes. An increase in the accessible offset range would hence result in significant improvement in the instrument sensitivity, especially at energies above 10 TeV, where source studies are limited by available photon statistics. An optimisation of the reconstruction and selection tools can increase the field of view and statistics at such high energies. An improved method that is capable of reconstructing events with offsets up to 4.5 degrees will be presented in this talk.

T 30.4 Di 17:20 Philo-HS7

FACT - Robotic Monitoring at TeV Energies — •Dominik Neise[1] and Maximilian Nöthe[2] for the FACT-Collaboration — [1]ETH Zürich, Zürich, Schweiz — [2]Technische Universität Dortmund, Dortmund, Deutschland

The FACT (First G-APD Cherenkov Telescope) can perform its scientific task of monitoring bright gamma-ray sources almost without any human interaction.

After first light in October 2011, FACT has been operated remotely since summer 2012. The need for manual interaction has been successively reduced to the point where FACT is now running robotic. In case of any problem, phone calls to experts are initiated automatically.

This automation results in high duty cycle as well as very fast reaction on flaring events. FACT is contributing to multi-wavelength and multi-messenger studies both as triggering and follow-up instrument. In follow-ups it can often provide unique information as - unlike other instruments - being able to observe during full moon. Based on an automatic quick-look analysis, the FACT collaboration sends automatically alerts to the multi-messenger network AMON and triggers target-of-opportunity (ToO) observations of satellites, as e.g. INTEGRAL, Swift, Astrosat, in the context of ToO proposals.

Interaction of experts is necessary for those cases where webforms have to be filled manually to initiate ToO observations of other instruments. In the presentation, we will discuss the implementation of the robotic system and special caveats to be taken into account.

T 30.5 Di 17:35 Philo-HS7

FACT - Analysis of Photon-Stream Data of the Crab Nebula — •Kevin Sedlaczek[1] and Maximilian Nöthe[2] for the FACT-Collaboration — [1]Technische Universität Dortmund, Deutschland — [2]Technische Universität Dortmund, Deutschland

The First G-APD Cherenkov Telescope (FACT), located at the Observatorio del Roque de los Muchachos (La Palma, Canary Islands, Spain), is designed to detect cosmic gamma rays at energies around 1 TeV. It is the first full-size Imaging Atmospheric Cherenkov Telescope equipped with G-APD photon detectors. The events recorded by FACT can be represented in a format containing a list of arrival times of individual photons. This list is called the photon-stream and designed to suit high level physics analysis. The performance on physics analyses is still one of the open questions concerning this new representation. For this purpose, an analysis of the Crab Nebula is performed on the photon-stream data. The Crab Nebula is a well measured source of gamma rays and therefore predestinated for such a comparative analysis. First results from this ongoing work will be discussed.

T 30.6 Di 17:50 Philo-HS7

FACT – Public Gamma-Ray Crab-Nebula Observations and Simulation — •Maximilian Nöthe and Kai Arno Brügge for the FACT-Collaboration — Exp. Physik 5b, TU Dortmund, Otto-Hahn-Str. 4a, 44227 Dortmund, Deutschland

Pioneered 50 years ago, ground-based gamma-ray astronomy made a large step forward in the past decade. Still the instruments are run by collaborations as experiments instead of open observatories. The huge downside of this is that the data are private, preventing a lot of interesting studies being done by the astronomer's community. FACT, a gamma-ray telescope on Canary island La Palma, took the lead and publishes gamma-ray excess rates based on a quick-look-analysis of its observations in near real time.

Now FACT goes one step further towards modern astronomy and publishes a high quality Crab-Nebula observation sample recorded in 2013 together with simulations to the general public. Here, we present our Crab-Nebula sample and our simulation sample. We show where the data can be downloaded, and how it might be used. We encourage you to use our sample for education on either all or some of the following tasks: read-out calibration, signal extraction, air-shower feature generation, machine learning, gamma-ray source detection, or gamma-ray energy spectrum reconstruction.

T 30.7 Di 18:05 Philo-HS7

Development of novel back-coated, ultra-thin glass mirrors for Imaging Air Cherenkov Telescopes — •Juliane van Scherpenberg, Razmik Mirzoyan, and Masahiro Teshima for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München

Imaging Air Cherenkov Telescopes (IACTs) have no protective domes and are constantly exposed to varying weather conditions at desert and/or high mountain conditions. The reflective surface of currently used mirrors in IACTs generally are made of about 100 nm thin layers of aluminum covered by a protective quartz layer. Constant exposure to wind, which can carry dust particles, to rain and large temperature variations damages these layers and can lead to a noticeable decrease in reflectivity over the timespan of a few years. Furthermore, it is

practically impossible to clean the mirrors from dirt and dust without damaging their surface which further reduces their reflectivity. I will present the state of development of new back-coated, ultra-thin glass mirrors. They should be very resistant to external influences and easy to clean. We anticipate that such mirrors will have a constant reflectivity over a long time period that is comparable to the lifetime of IACTs themselves.

T 30.8 Di 18:20 Philo-HS7

A pointing solution for the medium size telescopes for the Cherenkov Telescope Array — •Domenico Tiziani and Christopher van Eldik — Erlangen Centre for Astroparticle Physics, Erlangen, Germany

One important calibration for each telescope of the Cherenkov Telescope Array (CTA) is the pointing. The pointing calibration guarantees a correct transformation of positions on the focal plane of the instrument to sky coordinates and therefore directly influences the directional reconstruction of cosmic gamma rays. The favoured approach for this calibration for the medium size telescopes (MST) uses an optical CCD-camera that is installed in a central position of the mirror dish of each telescope. This camera has a wide field of view and images the focal plane of the telescope and the night sky in parallel. In this talk precision studies and progress in the verification of this calibration method are presented. Results derived from simulations and from data taken in laboratory tests and at the prototype telescope in Berlin/Adlershof are shown.

T 31: Neutrinophysik VI

Zeit: Dienstag 16:30–19:00 Raum: Z6 - HS 0.001

T 31.1 Di 16:30 Z6 - HS 0.001

Ion monitoring in the KATRIN experiment — •Manuel Klein for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims at the model-independent measurement of the electron neutrino mass. It is designed for a neutrino mass sensitivity of 0.2 eV (90% CL) after three full years of measurement time. KATRIN measures the end point of the tritium beta-decay spectrum using a MAC-E filter and a Windowless Gaseous Tritium Source (WGTS). While neutral tritium gas molecules are pumped out from the beamline, decay electrons are guided to the detector by strong magnetic fields. Tritium ions, however, would also follow the magnetic field lines to the Pre- and Main Spectrometer, where they could cause background by ionisation and contamination. Preventing this is imperative for KATRIN measurements.

Ring electrodes in the transport section will block the tritium ions via positive electric potentials. These potentials could possibly be neutralised by negative space charges. Several ion detection methods therefore will monitor the residual ion flux, with specific advantages in terms of sensitivity, continuous availability and systematics. The most sensitive method is observation of the background from tritium ions by ionisation of residual gas in the spectrometers. Other ion detection methods are based on Fourier Transform Ion Cyclotron Resonance (FT-ICR) and Faraday Cup measurements of neutralisation currents.

Supported by research training group GRK 1694, the YIG VH-NG-1055, BMBF (Ø05A17VK2) and the Helmholtz Association.

T 31.2 Di 16:45 Z6 - HS 0.001

Investigation of ion-induced background processes in the KATRIN spectrometers — •Woo-Jeong Baek for the KATRIN-Collaboration — Hermann-von-Helmholtz-Platz 1 Building 402, Room 206 76344 Eggenstein-Leopoldshafen, Germany

The KArlsruhe TRItium Neutrino (KATRIN) experiment targets the determination of the effective electron (anti-)neutrino mass with a sensitivity of 0.2eV/c^2 by means of a precise measurement of the tritium β electron energy spectrum close to the endpoint. The experimental setup of KATRIN consists of a windowless gaseous tritium source (WGTS), the cryogenic and differential pumping sections ensuring the transport of the signal electrons, the MAC-E filter based electrostatic pre- and main spectrometer followed by the focal plane detector which enables the measurement of the transmitted electrons. The required sensitivity on the neutrino mass limits the allowed nominal background rate to 10 mcps. In order to achieve this goal, a detailed understanding of background processes such as the generation of low energy electrons due to positive ions is essential. In addition to the simulation of the ion transport along the KATRIN beamline, scattering processes of different ion species on residual gas molecules were investigated via simulations in the spectrometer section to gain a deeper knowledge on this background causing mechanism. The results will be presented focusing on the characteristics of ion-induced background processes.

This work has been supported by BMBF (05A17VK2).

T 31.3 Di 17:00 Z6 - HS 0.001

Azimuthal Investigation of Spectrometer Background in the KATRIN Experiment — •Fabian Block for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), IKP, Hermann-von-Helmholtz-Platz 1, Building 402 Room 206, 76344 Eggenstein-Leopoldshafen

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment will investigate the endpoint region of the β decay spectrum to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.). Therefore the β electrons are magnetically guided from the windowless gaseous tritium source through the transport and pumping section towards the tandem spectrometer section. In the tandem spectrometer section, consisting of a pre- and main spectrometer, only the electrons near the energetic endpoint of the β decay spectrum are transmitted to the focal plane detector. In order to reach the aimed sensitivity goal a thorough understanding of the background processes in both spectrometers is needed.

In this talk the results of detailed investigations of the spatial background distribution gained in long-term measurements with the full spectrometer and detector section set-up of KATRIN are presented. Especially the azimuth angle distribution is examined with statistical methods with regard to a misalignment between the spectrometer background and the focal plane detector. Furthermore a hint to a spatial deformation of the background is presented.

This work was supported by BMBF (05A17VK2) and the HGF.

T 31.4 Di 17:15 Z6 - HS 0.001

Another look at KATRIN's response function for isotropic and mono-energetic sources* — •Lukas Voss for the KATRIN-Collaboration — Bergische Universität Wuppertal

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to measure the effective electron neutrino mass in a model-independent way with a sensitivity of 200 meV/c^2 (90 % C.L.).

Electrons are emitted isotropically in the Windowless Gaseous Tritium Source (WGTS) and guided by magnetic fields through the transport section and the two spectrometers. They are detected when they reach the focal plane detector (FPD). While the electrons travel towards the detector, their energy and angle to the guiding field are being influenced by elastic and inelastic scattering.

With help of KATRIN's software package KASSIOPEIA the response function of the experiment is simulated. The response function is governed by the energy resolution and includes energy losses by elastic and inelastic scattering. Thereby, the expected spectral shape for isotropically emitted electrons, and electrons originating from an electron-gun at varying tritium cross-sections are investigated as well as the feasibility of full MC simulation of the response-function in KATRIN.

The results of the simulation are discussed in this talk.

* Gefördert durch das BMBF.

T 31.5 Di 17:30 Z6 - HS 0.001

Bayesian Analysis of the KATRIN Krypton Calibration Data — •Martin Ha Minh for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical University Munich

The KArlsruhe TRItium Neutrino (KATRIN) Experiment is a large-scale experiment for the model-independent determination of the effective mass of the electrin-antineutrino with a sensitivity of 200 meV/c^2 (90% C.L.). It investigates the tritium β-decay close to the kinematic endpoint of the energy spectrum with a high-resolution electrostatic spectrometer (ΔE = 0.93 eV at 18.6 keV).

A gaseous ^{83}Kr source has been introduced into the KATRIN experiment in summer 2017. Due to the krypton's emission of monoenergetic conversion electrons and its behavior similar to the tritium gas it is ideal to be used for calibration purposes. This talk discusses the analysis of this first calibration campaign based on a Bayesian approach. Special focus will be on the study of systematic effects.

This work is supported by the Max Planck Institute for Physics.

T 31.6 Di 17:45 Z6 - HS 0.001

Development of a MC Generator for the KATRIN Experiment — •Christian Karl for the KATRIN-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.) via the kinematics of tritium β-decay. As a means to test, optimize, and validate the data analysis tools a Monte Carlo (MC) generator has been developed.

A MC generator produces artificial data sets by simulating the model theoretically and applying statistical smearing. As the true values of the physics parameters are known this provides a powerful tool to test analysis tools.

This talk will present the functionality and use cases of a MC generator for the KATRIN experiment. These include testing the fitting tools, the effect of various systematics on the neutrino mass measurement and the capability of different data blinding methods.

T 31.7 Di 18:00 Z6 - HS 0.001

Alignment simulations for the KATRIN experiment — •Marco Deffert for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment aims to determine the effective neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.) by measuring the enegry of electrons from the tritium β-decay. The β-electrons produced in the windowless gaseous tritium source (WGTS) are magnetically guided through the beamlines of the transport and pumping section to the huge main spectrometer for energy measurement. In the center of the main spectrometer, the so called analyzing plane, the magnetic field is minimal and the electric retarding potential is maximal. In order to get the exact potential for each detector pixel, the trajectory of the electrons is simulated backwards from the detector to the analyzing plane. The simulations include all known misalignment of magnetic coils and beam tube elements but up to now, uncertainties on these misalignments were not taken into account. A first attempt to include uncertainties in the simulations for the KATRIN experiment and resulting systematics on the potential will be presented. This work was supported by KSETA.

T 31.8 Di 18:15 Z6 - HS 0.001

SAMAK: new analysis software for the KATRIN experiment — •Pablo Israel Morales Guzman for the KATRIN-Collaboration — Max Planck Institute für Physik — Technische Universität München

The purpose of the KArlsruhe TRItium Neutrino (KATRIN) experiment is to measure the neutrino mass with a sensitivity of 200 $\mathrm{meV/c^2}$ with a 90 % C.L., by observing the spectrum of tritium beta decay electrons near the endpoint. It could also set stringent constraint on the existence of light sterile neutrinos.

The KATRIN experiment is set to start collecting data later this year (2018). As a mean of analysis validation, several independent tools were developed within the KATRIN collaboration. One of these tools is the Simulation and Analysis with Matlab in KATRIN (SAMAK, castle in Czech). SAMAK is a new software developed to simulate and fit the tritium beta decay spectrum, with the incorporation of the state of the art of the modeling of the spectrum, including the decay to the excited states of all tritium isotopologue molecules, for instance.

In this talk an overview of SAMAK will be given. As an example, we will discuss the measurement of the effective tritium beta decay endpoint in KATRIN, with both first light and whole 3y dataset.

T 31.9 Di 18:30 Z6 - HS 0.001

Cross-check of KATRIN simulation and analysis tools — •Dominik Fuchs for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical University of Munich

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.) by the investigation of the kinematics of tritium beta decay in a direct and model independent way.

The modeling of the spectrum is based on theoretical calculations using Fermi theory combined with properties of the experimental setup. Those properties include e.g. scattering of electrons in the source as well as spectrometer and detector responses.

Due to the high complexity of the modeling and fitting of the experimental data, a validation of the analysis tools is essential. For this purpose a procedure has been developed which is mainly based on comparisons of independent sofware. This talk will present the basic philosophy of the KATRIN validation procedure and show the results of a first detailed comparison of two independent KATRIN analysis tools.

T 31.10 Di 18:45 Z6 - HS 0.001

Determination of the tritium Q-value at the KATRIN Experiment — •Rudolf Sack — Westfälische Wilhelms-Universität

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is a next Generation tritium β-decay experiment which will allow a model independent investigation of the sub eV neutrino mass scale. With an estimated sensitivity of $0.2\,\mathrm{eV/c^2}$ (90% C.L.) it will improve the sensitivity of direct neutrino mass measurements by one order of magnitude. To reach this goal, it is important to understand the systematic uncertainties of this experiment. The measurement of the Q-value of tritium β-decay at KATRIN, which is closely related to the endpoint E_0 of the electron energy spectrum, can be compared to results of Penning trap experiments, by the group of EG Meyers et al., who published this value with an uncertainty of only $70\,meV$. This will allow us to check the systematics of the experiment, assuming that we can control our energy scale at this level. The estimated statistical error will be $\Delta E_0 = 2 - 3\,meV$ after an effective three years of measurement time. This work was supported by the DFG Graduate School 2149.

T 32: Neutrinophysik X

Zeit: Dienstag 16:30–19:05 Raum: Z6 - HS 0.002

Gruppenbericht T 32.1 Di 16:30 Z6 - HS 0.002

The Jiangmen Underground Neutrino Observatory — •Christoph Genster for the JUNO-Collaboration — IKP-2, Forschungszentrum Jülich

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector currently under construction near Kaiping in the province Guangdong in southern China. It will have an overburden of 1900 m.w.e. and will detect reactor antineutrinos from two nuclear power plants on a baseline of 53 km. Starting from 2020, JUNO plans to measure the neutrino mass ordering by probing the antineutrino energy spectrum. The energy resolution is designed to be better than 3% @ 1 MeV, in order to reach a significance of at least 3 sigma. In addition, JUNO can improve the precision on solar oscillation parameters below 1% and allows for the study of geoneutrinos and neutrinos from core-collapse supernovae. Furthermore, it has the potential to search for dark matter, sterile neutrinos, and non-standard interactions. This talk will give an overview on the physics potential and the current status of the project.

T 32.2 Di 16:50 Z6 - HS 0.002

Advances of the topological track reconstruction for large unsegmented liquid scintillator neutrino detectors. — •David Meyhöfer for the JUNO-Collaboration — University of Hamburg

The track reconstruction of charged particles in liquid scintillator (LS) detectors is of utmost importance for efficient cosmogenic background rejection and the analysis of multi-GeV neutrino interactions. A topological reconstruction of such events yields the possibility of gaining a 3D density distribution of the emitted scintillation and/or cherenkov photons. This reconstruction approach can in principle be used for any geometry of unsegmented LS detector and for MeV- up to several GeV-events. In association with the JUNO experiment in China, this topological reconstruction method is developed in Germany. With sim-

ulated muon events, this method has shown, that the particles differential energy loss dE/dx is obtainable. This talk will give an overview over the recent developments and the current status for this reconstruction approach.

T 32.3 Di 17:05 Z6 - HS 0.002

Topological Track Reconstruction in Liquid Scintillator Neutrino Detectors for MeV Events — •Henning Rebber[1], Björn Wonsak[1], Caren Hagner[1], Sebastian Lorenz[2], and David Meyhöfer[1] — [1]Universität Hamburg, Institut für Experimentalphysik — [2]Johannes Gutenberg-Universität Mainz, Institut für Physik

Neutrino detectors like the JUNO experiment in China demand for an unprecedented energy resolution while pushing the fiducial mass of liquid scintillator to ever higher dimensions. This complicates the tasks of event reconstruction and background reduction. For widespread events, like e.g. high energy (∼GeV) muons, current developments in the topological track reconstruction provide a 3D light emission density distribution based on isotropically emitted, unscattered scintillation photons. The method gives access to a particle's differential energy loss $\mathrm{d}E/\mathrm{d}x$ and can help in the essential task of background rejection.

But also for low energy events in the signal range (∼MeV) – although comparatively point-like – the topological features hold valuable information which can be used e.g. for particle discrimination. The current status of these low energy studies is presented. This work is supported by the DFG.

T 32.4 Di 17:20 Z6 - HS 0.002

Waveform Reconstruction for IBD and Muon Events in JUNO — •Michaela Schever[1,2], Yaping Cheng[1], Christoph Genster[1,2], Philipp Kampmann[1,2], Livia Ludhova[1,2], Rikhav Shah[1,2], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1,2] — [1]IKP-2 Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

The JUNO 20 kton liquid-scintillator detector aims at achieving an outstanding energy resolution of $3\%/\sqrt{E(\mathrm{MeV})}$ of Inverse Beta Decay (IBD) events to determine the neutrino mass hierarchy at the desired statistical significance of $> 3\sigma$. Therefore, the charge and arrival times of individual photons detected by each single PMT have to be reconstructed with great precision. To ensure a low dead time for this large scale detector, the suppression of the cosmic muon background is performed by partial volume veto, which relies on the precise reconstruction of the first hit time and charge of the muon signals in each PMT.

The talk presents the current status of the waveform analysis for MeV neutrino and muon events in Germany. The IBD waveform study is based on the deconvolution method, which unfolds the photoelectron hit pattern and the single photo-electron response via transforms of the signal between the time and frequency domain. The results of IBD photo-electron reconstruction and several reconstruction methods for the first hit time of muons and the corresponding charge are presented.

T 32.5 Di 17:35 Z6 - HS 0.002

Determination of the Nonlinearity Parameter for LAB Based Liquid Scintillators for JUNO — •Konstantin Schweizer, Lothar Oberauer, and Julia Sawatzki — Technische Universität München

The organic liquid scintillator based JUNO experiment (Jiangmen Underground Neutrino Observatory) has the aim to determine the neutrino mass hierarchy. To achieve this goal an unprecedented energy resolution of 3% at 1 MeV is crucial. Therefore the energy dependent light yield for electrons depositing energy in the scintillator has to be known precisely. There was an experiment conducted to measure the nonlinearity of the light yield of low energy electron events with a low threshold of 5 keV. A photomultiplier tube (PMT) was used to detect the light produced by a Compton electron in a liquid scintillator sample. A High Purity Germanium Detector, operated in coincidence with the PMT, was used to determine the deposited energy in the scintillator by measuring the remaining energy of the Compton scattered gamma ray. The talk will present the current status of the experiment. This work is supported by the DFG Cluster of Excellence "Origin and Structure of the Universe", the DFG research unit "JUNO" and the SFB1258.

T 32.6 Di 17:50 Z6 - HS 0.002

Impact of energy response of liquid scintillator detector on JUNO Mass Hierarchy sensitivity — •Yaping Cheng[1], Christoph Genster[1,2], Philipp Kampmann[1,2], Livia Ludhova[1], Michaela Schever[1,2], Rikhav Shah[1], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1,2] — [1]IKP-2 Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector that will be located at Kaiping, Jiangmen city in South China. An energy resolution of 3% at 1 MeV is required to determine the neutrino mass hierarchy by spectral analysis. In this largest liquid scintillator detector, a good understanding of the position-dependence of the energy response is essential. The intrinsic non-linearity response of liquid scintillator, mainly originating from the quenching effect and Cherenkov light contribution, will cause distortion to the observed spectra. In this presentation, I will report my studies of non-linearity and non-uniformity's impact on neutrino mass hierarchy sensitivity.

T 32.7 Di 18:05 Z6 - HS 0.002

Reduction of the ^{14}C background for the neutrino mass-hierarchy measurement of the JUNO experiment — •Philipp Kampmann[1,2], Yaping Cheng[1], Christoph Genster[1,2], Livia Ludhova[1,2], Michaela Schever[1,2], Rikhav Shah[1,2], Achim Stahl[2], Christopher Wiebusch[2], and Yu Xu[1,2] — [1]IKP-2 Forschungszentrum Jülich — [2]III. Physikalisches Institut B, RWTH Aachen University

The Jiangmen Underground Neutrino Observatory (JUNO) will be a 20 kt liquid scintillator neutrino detector. Its main goal is the determination of the neutrino mass hierarchy from a precise measurement of the energy spectrum of anti-electron-neutrinos 53 km away from the reactor. To precisely measure the oscillation pattern of the reactor spectrum an unpredecent energy resolution for this kind of detector of 3% at 1 MeV is needed. Pile-up events with background from radioactive decays such as those from ^{14}C can spoil the reconstruction of the neutrino energy. In this talk a clusterization method for detecting spoiled pile-up events is presented. It is optimized to give the best sensitivty on the neutrino mass-hierarchy. Furthermore the suppression of dark-noise using this method is presented.

T 32.8 Di 18:20 Z6 - HS 0.002

Positron and Electron Discrimination with Deep Neural Network Image Recognition with JUNO — •Thilo Birkenfeld[1], Christoph Genster[2], Florian Kiel[1], Achim Stahl[1], and Christopher Wiebusch[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]Institut für Kernphysik Jülich

The JUNO detector is going to be a 20kt liquid scintillator neutrino observatory, currently under construction near Kaiping, China, with a baseline of about 50km to two reactor plants. With its excellent energy resolution and large fiducial volume, it will be able to determine the neutrino mass hierarchy from the energy spectrum. The neutrinos are detected by measuring the signature of the inverse beta decay (IBD), which consists of a prompt positron- and a delayed neutron capture signal. The coincidence of an electron and a neutron, caused by nuclear decay, can mimic such an IBD signature. Those differ by the additional positron annihilation. New developments in deep learning techniques give the possibility to distinguish the different event shapes. In this talk the method to discriminate positrons and electrons via image recognition neural networks is presented.

T 32.9 Di 18:35 Z6 - HS 0.002

Thermonuclear Supernova Neutrino Signals in JUNO — Max Büsken[1], Florian Kiel[1], Livia Ludhova[2], •Josina Schulte[1], Achim Stahl[1], Jochen Steinmann[1], and Christopher Wiebusch[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]Institut für Kernphysik, Forschungszentrum Jülich

JUNO (**J**iangmen **U**nderground **N**eutrino **O**bservatory) is a 20kt liquid scintillator-based detector currently under construction in China. The main goal is the determination of the neutrino mass hierarchy, but the large mass and the good energy resolution make it possible to also investigate astrophysical processes - such as supernovae. Neutrino models of core-collapse supernovae have been investigated thoroughly though the exact mechanism of thermonuclear supernovae is still a mystery. The neutrino signal of a type Ia supernova could help in the understanding of the explosion mechanism at the end of a white dwarfs' life. The prominent neutrino interactions in JUNO and the final rates will be discussed.

T 32.10 Di 18:50 Z6 - HS 0.002

Detection Potential for the Diffuse Supernova Neutrino Background in the Large Liquid Scintillator Detector JUNO — •Julia Sawatzki and Lothar Oberauer — Technical University of Munich, Chair for Experimental Astroparticle Physics E15, James-Franck-Str. 1, 85748 Garching b. München

The planned 20 kt liquid scintillator detector JUNO (Jiangmen Underground Neutrino Observatory) will offer the possibility of a diffuse supernova neutrino background (DSNB) measurement. Although the cosmic background of neutrinos generated by core collapse supernova explosions throughout the universe is present in all flavors, the study will focus on the measurement of electron antineutrinos via the inverse beta decay, as this coincidence reaction provide powerful background suppression. This is of particular importance, as the relic neutrino signal rate in JUNO is, with few events per year, quite low. Therefore good background knowledge as well as powerful background suppression techniques are required. Neutrinos produced in nuclear reactors, the atmosphere, and cosmic muons, which can induce cosmogenic isotopes or fast neutrons, are the main background sources.
This project is supported by DFG (SFB 1258 and research unit "JUNO") and the Maier-Leibniz-Laboratorium at Garching.

T 33: Higgs II

Zeit: Dienstag 16:30–19:00 Raum: Z6 - HS 0.004

T 33.1 Di 16:30 Z6 - HS 0.004

Search for additional Higgs Bosons in Final States with b-Quarks with the LHC Run II data — •Rostyslav Shevchenko and Rainer Mankel — DESY, Hamburg, Germany

The discovery of a Higgs boson with the mass of 125 GeV in July 2012 was a huge breakthrough for particle physics. After the 5 years of a successful data taking at LHC, the properties of this particle are in good agreement with the predictions of the Standard Model (SM). However, the current precision of these measurements, allows models, such as Supersymmetry, with extended Higgs sectors, in which the discovered Higgs boson is only one of several Higgs bosons. This work focuses on the search for high mass Higgs bosons in a final state with b-quarks. The analysis was performed with data collected by the CMS experiment at a center-of-mass energy of 13 TeV in the year 2016, corresponding to an integrated luminosity of 36.9 fb-1. The results are interpreted within models, including the Minimal Supersymmetric Standard Model and Two Higgs Doublets Model.

T 33.2 Di 16:45 Z6 - HS 0.004

Modelling of the W+jets background in the 1-lepton channel for the VH, H → bb analysis — •Simona Gargiulo and Christian Weiser — Albert-Ludwigs-Universität Freiburg

The search for the decay of the Standard Model Higgs boson into a $b\bar{b}$ pair produced in association with a W or Z boson with the Atlas detector is presented. The analysed dataset corresponds to an integrated luminosity of 36.1 fb^{-1} collected in proton-proton collisions in Run 2 of the Large Hadron Collider at a centre-of-mass energy of 13 TeV. Final states containing zero, one and two charged leptons are considered targeting the decay channels $Z \to \nu\nu$, $W \to l\nu$ and $Z \to ll$.

The overall systematic uncertainty has significant contributions from the ones on the dominating background processes $t\bar{t}$ and W+jets. The focus of this talk will be on the estimation of the systematic uncertainties on the theoretical prediction of W+jets background in the 1-lepton channel. This estimation relies on the comparison of two different generators and on studies of their variations due to different parameters settings.

New developments allowing to use generators based studies more efficiently in the context of the analysis will also be discussed.

T 33.3 Di 17:00 Z6 - HS 0.004

Higgs tagging calibration in $g \to b\bar{b}$ events with the ATLAS experiment — •Ruth Jacobs, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Universität Bonn

The most likely decay of the SM Higgs boson is into two b-quarks. A recent result from the ATLAS collaboration showed evidence for the $H \to b\bar{b}$ decay in the vector boson associated production mode. To access other production modes, such as gluon gluon fusion, in connection with the $H \to b\bar{b}$ decay, it is useful to consider Higgs bosons with a large transverse momentum, as the relative background contribution is reduced in this kinematic regime. Other possible sources for these so-called boosted Higgs bosons are decays of heavy resonances, predicted by theories beyond the SM.
In the case of a boosted $H \to b\bar{b}$ decay, the b-quark fragmentation products are reconstructed using a single large-R jet. A Higgs boson identification algorithm ("Higgs tagging") can be used to decide whether a jet originated from a Higgs boson decay, based on the large-R jet properties. Since the Higgs tagging algorithm is optimized on simulated events, it is important to study whether the large-R jet properties are well described in the simulation. One possibility is to use data events of gluons splitting into b-quark pairs, which are available in sufficient amount at the LHC, compared to $Z \to b\bar{b}$ or $H \to b\bar{b}$. The $g \to b\bar{b}$ data sample is used to validate the modelling of different large-R jet properties in Monte Carlo simulation. It can also be used to derive a data-based calibration for a Higgs tagging algorithm in close-by b-jet events.

T 33.4 Di 17:15 Z6 - HS 0.004

Search for the $H \to b\bar{b}$ and $H \to c\bar{c}$ decay — •Elisabeth Schopf, Tatjana Lenz, and Norbert Wermes — Physikalisches Institut, Nussallee 12, 53115 Bonn

Since the discovery of the Higgs boson in 2012 many of its properties have been mainly measured in bosonic final states. The measurement of the Higgs boson couplings to fermions is still a very challenging task. The Higgs boson decay to bottom quarks has the largest branching ratio of 58%, but was not discovered yet. A measurement of the couplings to lighter, second generation fermions is even more difficult given smaller branching ratios and the overhelming amount of background events.

I will present an evidence for the $H \to b\bar{b}$ decay in the $(W/Z)H$ production channel. This result was obtained with 36.1 fb^{-1} of LHC data collected by the ATLAS experiment. Furthermore I will present a novel search for the $H \to c\bar{c}$ decay using the same data set. I will discuss the challenges of this decay channel, such as the identification of c-jets and the suppression of background processes.

T 33.5 Di 17:30 Z6 - HS 0.004

Verbesserung der Sensitivität der HH->4b Analyse mit einer multivariaten b-Jet Kalibration — •Alexander Melzer, Alessandra Betti, Florian Beisiegel, Stephan Hageböck, Tatjana Lenz und Norbert Wermes — Universität Bonn

Mit höherer Schwerpunktsenergie und steigender Datenmenge können in Run2 zunehmend Prozesse untersucht werden, die in Run1 unzugänglich waren. Einer dieser Prozesse ist der Zerfall eines Higgs-Paares in 4 b-Quarks. Eine großes Herausforderung dieser Analyse ist die Energieauflösung der b-Jets und ihre Unsicherheit. Die Standardkalibration konzentriert sich auf den dominanten Anteil leichter Jets. Fundamental anderen Eigenschaften der b-jets wie z.B. Sekundärvertices, Energieverlust durch Myonen und Neutrinos finden dabei keine Beachtung. Durch die Kombination, der Informationsflüsse aller Detektorsysteme, ist es möglich mit maschinell optimierten Algorithmen die Energieauflösung von b-Jets signifikant zu verbessern und die Sensitivität der Analysen und insbesondere der 4b-Analyse zu erhöhen.

T 33.6 Di 17:45 Z6 - HS 0.004

Boosted Higgs tagging algorithms for the CMS Experiment — •Andrzej Novak, Luca Mastrolorenzo, Xavier Coubez, and Alexander Schmidt — RWTH Aachen, Aachen, Germany

Algorithms for the identification of two b-quarks within one jet have been applied successfully in the CMS Experiment. Deep neural networks facilitated the tagging of boosted Higgs jets with improved performance compared to classical methods. This improvement builds on previous results showing that for the specific topology of a fat jet with two subjets there is a considerable performance to be gained by using a dedicated tagger as opposed to either separately tagging the flavour of two standard jets or tagging the flavour of subjets within the fat jets. We are pursuing the application of such methods to the H->cc decay as well. The two main challenges are lower statistics in comparison to H->bb as well as lower efficiency, due to the properties of charm

quarks.

T 33.7 Di 18:00 Z6 - HS 0.004

Fake-Abschätzung in der $t\bar{t}H(H \to b\bar{b})$ Analyse im Mono-Lepton-Kanal mit dem ATLAS-Experiment — •Johannes Mellenthin, Clara Nellist, Thomas Pfeiffer, Arnulf Quadt und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Das Top-Quark ist das schwerste Elementarteilchen des Standardmodells und koppelt dadurch besonders stark an das Higgs-Boson. Ein theoretisch präzise vorhergesagter, jedoch noch nicht beobachteter Produktionsmechanismus, ist die Erzeugung eines Higgs-Bosons in Assoziation mit Top-Quarks ($t\bar{t}H$). Dabei ist es möglich, die Top-Yukawa-Kopplung, welche von großer Bedeutung für theoretische Vorhersagen und die Wechselwirkung von Elementarteilchen ist, direkt zu bestimmen. Hierzu werden Daten des ATLAS-Experimentes bei einer Schwerpunktsenergie von 13 TeV verwendet. In der vorgestellten Analyse wird der semileptonische Zerfall des Top-Quark-Paares mit einem Elektron oder Myon im Endzustand betrachtet. Für den Kanal mit der höchsten Zerfallswahrscheinlichkeit $t\bar{t}H(H \to b\bar{b})$ ist der dominierende Untergrund $t\bar{t}b\bar{b}$. Ein weiterer Untergrund entsteht durch sekundäre Leptonen, die u.a. durch semi-leptonische c- und b-Quarkzerfälle und Photonkonversion entstehen können, und durch als Leptonen fehlidentifizierte Jets. Dieser Untergrund benötigt eine gesonderte Behandlung für Ereignisse mit vielen Jets und b-Jets. In diesem Vortrag wird die Modellierung dieses Untergrundes mittels einer datengestützten Methode vorgestellt.

T 33.8 Di 18:15 Z6 - HS 0.004

Search for single top + Higgs (H→ b$\bar{\text{b}}$) at the CMS experiment at $\sqrt{s} = 13$ TeV — •Kevin Flöh, Thorsten Chwalek, Nils Faltermann, Denise Müller, Thomas Müller, and David Seith — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

The production of a single top quark in association with a Higgs boson can be used to lift the degeneracy regarding the sign of the top quark Yukawa coupling. The t-channel and tW-channel single top + Higgs production with the Higgs boson decaying into a b$\bar{\text{b}}$ pair are analyzed. The Higgs boson can be radiated off by the top quark (coupling constant κ_t) or by the W boson (coupling constant κ_v). The interference between these two processes allows the access to the ratio of coupling constants. Boosted decision trees are used to reconstruct the signal processes and the t$\bar{\text{t}}$ background process as well as for the classification of the events. Exclusion limits are set on various κ_v-κ_t scenarios and models with CP-violation.

T 33.9 Di 18:30 Z6 - HS 0.004

Suche nach Top-Quark-Antiquark-Paar-Produktion in Assoziation mit einem Higgs-Boson im H→ b$\bar{\text{b}}$-Kanal im Bereich hoher transversaler Impulse am CMS-Experiment — •Karim El Morabit, Ulrich Husemann, Philip Keicher, Matthias Schröder und Michael Wassmer — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Eine Messung des Wirkungsquerschnittes für die Higgs-Boson-Produktion in Assoziation mit einem Top-Quark-Antiquark-Paar (t$\bar{\text{t}}$H) ermöglicht eine direkte Bestimmung der Top-Higgs-Yukawa-Kopplung. Mit der erhöhten Schwerpunktsenergie des LHC-Run-2 wird ein deutlicher Anstieg der Produktionsrate dieses Prozesses und somit eine höhere Präzision der Messung erwartet. Bisher konnte der Prozess bei dieser Schwerpunktsenergie jedoch nicht entdeckt werden.

Hierbei machen der sehr kleine Wirkungsquerschnitt und die große Anzahl an schwer zu trennenden Untergrundereignissen die Suche zu einer Herausforderung.

In Ereignissen, in denen Top-Quarks und Higgs-Bosonen hohe Transversalimpulse aufweisen, treten die Zerfallsprodukte dieser schweren Teilchen kollimiert auf. Dies ermöglicht die Nutzung spezialisierter *Fat-Jet*- und Substrukturalgorithmen für die Identifizierung von Top-Quarks und Higgs-Bosonen.

In diesem Vortrag wird deren Anwendung zur Suche nach t$\bar{\text{t}}$H-Produktion im semileptonischen t$\bar{\text{t}}$- und H→ b$\bar{\text{b}}$-Kanal im Bereich hoher transversaler Impulse vorgestellt.

T 33.10 Di 18:45 Z6 - HS 0.004

Verification of Deep Learning Methods for t$\bar{\text{t}}$H(H → b$\bar{\text{b}}$) with the CMS Experiment — •Yannik Rath, Martin Erdmann, Benjamin Fischer, Erik Geiser, Dennis Noll, Marcel Rieger, and David Schmidt — III. Physikalisches Institut A, RWTH Aachen University

The analysis of top-quark associated Higgs production allows for a direct measurement of the top-Higgs Yukawa coupling. In the t$\bar{\text{t}}$H(H → b$\bar{\text{b}}$) channel, one of the main challenges is the separation of background events, in particular the irreducible background of t$\bar{\text{t}}$ + b$\bar{\text{b}}$.

In our analysis, we make use of deep neural networks in order to categorize events into the different underlying physics processes. The aim is to separate all processes to improve the simultaneous constraint of both the signal and the background.

While neural networks are a natural choice for this kind of multi-classification, it is often difficult to understand what happens internally in a neural network. This concerns both the interpretation of what information is used by the network and the verification of the results. In this talk, we discuss these questions in the context of our t$\bar{\text{t}}$H analysis.

T 34: Top-Quarks: Eigenschaften I

Zeit: Dienstag 16:30–18:15 Raum: Z6 - SR 1.002

T 34.1 Di 16:30 Z6 - SR 1.002

Neuronale Netze zur Verbesserung der Messung der Topquarkmasse — Christoph Garbers, Fred Stober, Hartmut Stadie, Johannes Lange, Nataliia Kovalchuk, Peter Schleper und •Torben Lange — University of Hamburg

Die Eigenschaften des bisher schwersten gefundenen Elementarteilchens, des Top-Quarks, spielen eine große Rolle in Konsistenztests unseres aktuellen Standardmodells und dessen Erweiterungen. Insbesondere gilt dies für die Masse des Top-Quarks. Der Vortrag baut auf der CMS-Massenmessung im semi-leptonischen Zerfallskanal von $t\bar{t}$ Ereignissen auf, die aktuell den Wert $m_t = 172.25 \pm 0.08$ (stat. +JSF) ± 0.62 (sys) GeV liefert. Die Genauigkeit der Messung in dieser Analyse ist durch systematische Unsicherheiten beschränkt. Die hohe Anzahl von Ereignissen in diesem Kanal erlaubt jedoch eine restriktivere Ereignisselektion. Eine solche, mit Blick auf die systematischen Unsicherheiten optimierte, Ereignisselektion mit Hilfe neuronaler Netze wird in diesem Vortrag diskutiert.

T 34.2 Di 16:45 Z6 - SR 1.002

Measurement of the $t\bar{t}\gamma\gamma$ production cross-section in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — Ivor Fleck, •Nomin-Erdene Erdenebat, and Yichen Li — University of Siegen, Germany

This analysis of the production of a top-quark pair in association with two photons has been done with data collected during 2015 and 2016 corresponding to an integrated luminosity of 36.1 fb^{-1} at a center-of-mass of energy of $\sqrt{s} = 13$ TeV, in the single lepton channels. In the single lepton channels, one lepton and at least four jets are requested, with at least one jet being b-tagged and two isolated photons with $p_T > 20$ GeV and $|\eta| < 2.37$. The event yields and the kinematic distributions are compared between data and MC.

T 34.3 Di 17:00 Z6 - SR 1.002

Direct measurement of the top-quark decay width with the ATLAS detector — •Tomas Dado[1,2], Thomas Peiffer[1], Arnulf Quadt[1], Elizaveta Shabalina[1], Philipp Stolte-Cord to Krax[1], Stano Tokar[2], and Royer Ticse Torres[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Comenius University in Bratislava

The top quark is the heaviest known elementary particle in the Standard Model of elementary particle physics (SM). Due to its large mass, the lifetime of the top quark is expected to be extremely short and thus, its decay width is the largest among the SM fermions. If a deviation from the predicted value is observed, the result may hint at non-SM decay channels of the top quark or non-SM top couplings.

Direct measurements of the top-quark decay width using a dataset of proton-proton collisions at a center-of-mass energy of 8 TeV and 13 TeV are discussed. Both measurements exploit the template fitting

technique, where the templates for alternative top-quark decay widths are created by reweighting simulated events using theoretical Breit-Wigner distributions. The measurement at 8 TeV focuses on the single lepton channel of $t\bar{t}$ decays. Templates from two uncorrelated observables, one from the hadronic and one from the leptonic hemisphere are simultaneously fitted to data. The resulting top-quark decay width for the 8 TeV measurement is $\Gamma_t = 1.76 \pm 0.33(\text{stat.})\,^{+0.79}_{-0.68}(\text{syst.})$ GeV. Status and outlook for a measurement at 13 TeV are presented. Experimental techniques for 8 TeV and 13 TeV measurements are compared.

T 34.4 Di 17:15 Z6 - SR 1.002

Mechanismen zur Identifikation prompter Photonen am ATLAS-Experiment – maschinelles Lernen als Werkzeug zur Unterdrückung von Fakes — Andreas Kirchhoff, Thomas Peiffer, Arnulf Quadt, Elizaveta Shabalina, Joshua Wyatt Smith, Royer Edson Ticse Torres und •Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Photonen sind in einer Vielzahl von Topologien in der Hochenergiephysik zu finden, sowohl in Prozessen des Standardmodells als auch in Szenarien neuer Physik. Am ATLAS-Experiment werden Photonen zwar mit hoher Effizienz rekonstruiert, allerdings stammt nur ein Teil von ihnen aus der harten Interaktion. Auch in hadronischen Zerfallsprozessen werden sogenannte nicht-prompte Photonen produziert, die die Identifikationskriterien erfüllen. Daneben können Fehler erster Art auftreten, bei denen z.B. hadronische Jets oder Elektronen fälschlicherweise als Photonen klassifiziert werden. Erstere werden entsprechend als hadronische, letztere als leptonische Fake-Photonen bezeichnet.

Bei der Vermessung von $t\bar{t}\gamma$-Topologien am ATLAS-Experiment bei 13 TeV spielt die Photonidentifikation eine entscheidende Rolle, prompte von nicht-prompten Photonen und hadronischen und leptonischen Fakes zu unterscheiden. Neben strikten Identifikationskriterien werden hierzu neuronale Netze eingesetzt, die verschiedene Variablen der Energiedepositionen in den elektromagnetischen Kalorimetern ausnutzen. In diesem Vortrag werden die in der Analyse eingesetzten Methoden vorgestellt und ein Ausblick auf mögliche Erweiterungen und Verbesserungen in der Zukunft gegeben.

T 34.5 Di 17:30 Z6 - SR 1.002

Studies of interference effects in processes with flavor-changing neutral currents including a $tq\gamma$ coupling — •Salvatore La Cagnina, Gregor Gessner, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

In the Standard Model, flavor-changing neutral currents (FCNC) are not present at tree level and are highly suppressed by the GIM mechanism at higher orders. Beyond Standard Model theories, however, can allow FCNCs at tree level. One possible process containing an FCNC includes a top quark that interacts with an up-type quark and a photon ($tq\gamma$ vertex with $q = u, c$). The production mode, in which a single top quark is produced, is distinguished from the decay mode, in which one of the top quarks of a $t\bar{t}$ system decays through an FCNC interaction. In next-to-leading order, these both modes could interfere. Searches for processes with FCNCs, for example at the ATLAS experiment at the LHC, rely on several kinematic variables in order to define signal-pure search regions. The distributions of those variables, however, might be influenced by interference effects. Studies investigating these effects and their influence on analyses searching for FCNCs will be presented in this talk.

T 34.6 Di 17:45 Z6 - SR 1.002

Studien zur $t\bar{t}Z$-Produktion mit vollhadronischem $t\bar{t}$ -Zerfall und hohem fehlenden Transversalimpuls — Clara Nellist, Thomas Peiffer, Arnulf Quadt, •Marie Reinecke, Nils-Arne Rosien und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Das Top-Quark, das 1995 am Tevatron entdeckt wurde, ist das einzige Quark, das zerfällt, bevor es hadronisieren kann. Mit seiner charakteristischen Zerfallssignatur ist es ein idealer Kandidat zur Erforschung von Quarks. Obwohl das Top-Quark elektroschwach zerfällt, kann die Kopplungsstärke an W- und Z-Bosonen durch assoziierte Produktion vermessen werden. Erste solche Prozesse wurden erfolgreich am ATLAS- und am CMS-Experiment untersucht. Durch das Studium der Kopplung an das Z-Boson wird es möglich, den schwachen Isospin des Top-Quarks zu messen.
Diese Analyse beschäftigt sich mit dem Top-Quark-Paar-Zerfall in Assoziation mit einem in zwei Neutrinos zerfallenden Z-Boson und analysiert diesen Prozess im Hinblick auf eine mögliche Wirkungsquerschnittsmessung. Während Zerfälle mit ein oder zwei geladenen Leptonen im Endzustand von $t\bar{t}Z$ recht genau in aktuellen Studien untersucht werden und wurden, gibt es zum Endzustand mit zwei Neutrinos noch keine Ergebnisse. Das liegt daran, dass die Rekonstruktion des Bosons von zwei für den Detektor unsichtbaren Neutrinos erschwert wird. Die Signatur dieses Prozesses ist außerdem sensitiv auf neue Physik jenseits des Standardmodells.

T 34.7 Di 18:00 Z6 - SR 1.002

Top-antitop energy asymmetry in jet-associated top-quark pair production at ATLAS — •Alexander Basan, Peter Berta, Sabrina Groh, Melanie Schepp, and Lucia Masetti — Intitute of Physics, Johannes Gutenberg University Mainz

The top quark is particularly well suited to probe the standard model and many extensions thereof at the electroweak symmetry-breaking scale and beyond. Specifically, the charge asymmetry in $t\bar{t}$ events can provide sensitive probes for many models beyond the standard model including massive color-octet states, extra dimensions, flavor violating gauge bosons and axigluons.

In inclusive jet-associated top-quark pair production the asymmetry arises already at leading order in quark-gluon interactions. Furthermore, the $t\bar{t}j$ final states allow the definition of a new observable, the energy asymmetry, expressed in terms of the distribution of the energy difference $E_t - E_{\bar{t}}$.

This talk presents the measurement of the $t\bar{t}$ energy asymmetry in the lepton+jets channel at ATLAS with a center of mass energy of $\sqrt{s} = 13\,\text{TeV}$. Additionally to top quarks produced close to threshold, boosted topologies are studied separately to estimate the improvement in sensitivity due to the different kinematic region and reduced combinatorial background.

T 35: Elektronik

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 1.005

T 35.1 Di 16:30 Z6 - SR 1.005

Bestrahlung des Kontroll-Chip für eine Serielle Stromversorgungskette im ATLAS Pixeldetektor Upgrade — •Niklaus Lehmann[1], Christian Zeitnitz[1], Susanne Kersten[1] und Michael Karagounis[2] — [1]Bergische Universität Wuppertal — [2]Fachhochschule Dortmund

An der Bergischen Universität Wuppertal wird am neuen Detektor-Kontroll-System für das Phase II Upgrade des ATLAS Pixeldetektors gearbeitet. Der Detektor hat eine serielle Stromversorgung. Damit einzelne Module überwacht und kontrolliert werden können, wurde ein ASIC entwickelt, der unabhängig von der Modulversorgung parallel zu jedem Modul arbeiten kann. Mehrere Prototypen dieses ASICs wurden bereits entwickelt und getestet. Die dritte Iteration wurde unter Bestrahlung und in Langzeitmessungen getestet. Auch wird sie in Systemtests eingesetzt, um das Verhalten der gesamten seriellen Kette mit richtigen Pixelmodulen zu untersuchen. In diesem Vortrag gehe ich auf die verschiedenen Bestrahlungstests bezüglich Strahlenhärte und SEU Toleranz ein. Weiter wird beschrieben, wie wir die unterschiedlichen Probleme während der Bestrahlung und des Betriebes in der nächsten Generation beheben wollen.

T 35.2 Di 16:45 Z6 - SR 1.005

Entwicklung einer Testumgebung für den FPGA der LHCb-SciFi-Back-End-Elektronik — •Klaus David, Maximilian Giebel und Jan Jansen — Experimentelle Physik 5, TU Dortmund

Nach dem Upgrade des LHCb-Detektors im Jahr 2019 wird der gesamte Detektor mit der vollen Kollisionsrate von 40 MHz ausgelesen. Eine neue Detektorkomponente wird der SciFi-Tracker sein, welcher aus szintillierenden Fasern mit einem Durchmesser von 0,25 mm besteht, die mit Silizium-Photomultipliern ausgelesen werden. In der Ausleseelektronik werden in Front- und Back-End unter anderem Field Programmable Gate Arrays (FPGAs) verwendet. Hierbei handelt es sich um programmierbare logische Schaltungen, die Signale parallel verar-

beiten können. Dieser Vortrag behandelt die Entwicklung einer Testumgebung für den FPGA der Back-End-Elektronik. Sie erzeugt zufallsgenerierte Testdaten und versendet diese über Glasfaserkabel. Es werden die bisherigen Ergebnisse dieser Entwicklung dargestellt.

T 35.3 Di 17:00 Z6 - SR 1.005

FLEX cable design for the HGTD detector at ATLAS — Maria Soledad Robles Manzano[1,2], •Andrea Brogna[1], and Lucia Masetti[1,2] — [1]Institut für Physik, Johannes-Gütenberg Universität Mainz — [2]Exzellenzcluster PRISMA, Johannes-Gütenberg Universität Mainz

The High Granularity Timing Detector (HGTD), proposed for the ATLAS Phase-2 Upgrade, is designed to improve the pile-up mitigation in the ATLAS endcaps at the HL-LHC. The detector will cover a pseudorapidity range between 2.4 and 4.0 and a high granularity is required to provide a time resolution of 30 ps for minimun-ionizing particles. It will be made of Low Gain Avalanche Detectors (LGAD) with a transverse granularity of 1.3 x 1.3 mm^2, and bump-bonded to ASIC chips in individual modules of 20x40 mm^2. A flexible PCB (FLEX cable) is designed to readout and distribute power to each individual module with specific requirements that include both geometric and electrical constraints such as a 300 μm thickness, a high-speed rate of 1.28 Gbps and High Voltage (HV) distribution which should not interfere with the data transmission lines. This talk will cover the design of the first FLEX cable prototype as well as the planned tests for signal integrity and HV insulation in order to characterise the perfomance.

T 35.4 Di 17:15 Z6 - SR 1.005

MuTRiG: Silicon Photomutiplayer readout ASIC for precise timing and high event rate applications — Huangshan Chen, Konrad Briggl, Hans-Christian Schultz-Coulon, Wei Shen, and •Vera Stankova — Heidelberg University, Kirchhoff Institute for Physics

MuTRiG is a silicon Photomultipliers readout ASIC, for precise timing measurements and high event rate data transmission, required in high energy physics experiments. It is optimised for the Mu3e experiment designed to probe new physics by searching for the charged lepton-flavour violating decay $\mu \to e+e+e-$ with a branching ratio sensitivity of 10^{-16}. The chip will be used for the readout of the scintillating fiber and tile detectors. The ASIC comprise 32 fully differential analog front-end channels with integrated 50 ps time binning Time to Digital Converters. Dedicated digital block process and transfer the event data to the data acquisition system via a 1.28 Gbps LVDS link. Extensively measurements have been done to characterize the timing performance and the digital functionalities of the prototype chip. A front-end jitter has been characterized to be $<$ 20 ps with charge injection measurements for charges $>$ 350fC. A full chain jitter of $<$ 30 ps has been obtained for injected charge of 1 pC and for event rate up to 15 MHz. The maximum event rate of the chip is 20.24 MHz and 25 MHz for the standard and short event structure configurations respectively at the serial data link bit rate of 1.25 Gbps. The Bit Error Rate of the serial data link has been measured to be $< 5.90^{-16}$. The chip architecture and characterization measurements results will be presented.

T 35.5 Di 17:30 Z6 - SR 1.005

Optimization of the ATLAS (s)MDT readout electronics for high counting rates — Pedro Guerzoni de Figueiredo, Oliver Kortner, Hubert Kroha, Sebastian Nowak, and •Korbinian Schmidt-Sommerfeld — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Föhringer Ring 6, 80805 München

In the ATLAS muon spectrometer, Monitored Drift Tube (MDT) chambers are used for precise muon track measurement. For the high background rates expected at HL-LHC, which are mainly due to neutrons and photons produced by interactions of the proton collision products in the detector and shielding, new small-diameter Muon Drift Tube (sMDT)-chambers with half the drift tube diameter of the MDT-chambers and ten times higher rate capability have been developed. In order to avoid baseline shifts of the shaped signal the standard MDT readout electronics uses bipolar shaping which however, leads to a deterioration of signal pulses due to preceding background hits at high counting rates, leading to losses in muon efficiency and drift tube spatial resolution. These so-called signal pile-up effects can be mitigated by active baseline restoration (BLR), which can also eliminate the baseline shift in the case of unipolar shaping. Discrete multi-channel prototype electronics of both types have been tested with generated input pulses and in the Gamma Irradiation Facility at CERN under high γ-irradiation rates.

T 35.6 Di 17:45 Z6 - SR 1.005

Development of high reliability Powerboards for JUNO — •Florian Kiel, Achim Stahl, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University

For the next generation of large neutrino detectors, for example JUNO, a novel concept for the readout of the Photomultiplier-Tubes has been developed. All neccessary electronics for the operation and readout of the PMT are mounted to the back of the PMT, creating an intelligent PMT.

One of the boards needed in this setup is a board to produce and distribute all voltages needed. The latest prototype version of this Powerboard fulfills all electronics requirements e.g. low ripple and high efficiency while having a very high reliability. As the electronics can not be accessed after mounted to the PMT a low failure rate is a condition.

In this contribution the Powerboard for an intelligent PMT will be introduced focusing on the reliability of the board.

T 35.7 Di 18:00 Z6 - SR 1.005

A 36-channel silicon-photomultiplier readout integrated circuit for high granular imaging calorimetry — •Zhenxiong Yuan for the CALICE-D-Collaboration — Im Neuenheimer Feld 227, Heidelberg 69120, Germany

KLauS5 is a 36-channel mixed-mode silicon-photomultiplier (SiPM) charge readout integrated circuit dedicated to the high granular imaging calorimetry at future linear collider. Due to the high granularity and dense structure of the calorimeter system, one of the key aspects for its readout electronics is ultra-low power consumption. This application specified integrated circuit (ASIC) is designed to read out the SiPM charge information with high precision and over large dynamic range. Each channel consists of a low-noise front-end with two gain branches to deal with a large input signal range, and a 10/12-bit ADC to digitize the charge information; a common digital part for data storage and transmission is also implemented into this chip. The design of the ASIC and results of the characterization measurements will be presented.

T 35.8 Di 18:15 Z6 - SR 1.005

Tests of first prototypes of the EoS Card for the ATLAS ITk Strip Tracker — •Anastasiya Melnik and Marcel Stanitzki — DESY, Hamburg, Germany

Results of the testing of the first prototypes of the End-Of-Substructure Card (EoS) for the ATLAS ITk Strip Tracker will be presented, including high-speed link tests and reliability studies. The EoS Card is the interface between the building block of the ITk Strip Tracker (staves and petals) and the off-detector electronics. All the control and command signals, the data and the power will be passing through this card. The card concept is built around using the lpGBT (low power GigaBit Transceivers) chip set and the VTRx (Versatile Transceiver) optical link, both common developments for the LHC Upgrades. The first prototype of EoS board based on the current GBTx chip-set has been produced. First results of EoS testing will be presented, they includes Bit Error Rate Tests, there are included flatness test of the PCB and thermal cycling test.

T 35.9 Di 18:30 Z6 - SR 1.005

PMT-Dynodenauskopplung im Zuge des AugerUpgrade am Pierre-Auger-Oberservatorium zur Erweiterung des Messbereichs — •Jannis Pawlowsky für die Pierre Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstraße 20, Wuppertal

Am Pierre-Auger-Oberservatorium wird die kosmische Strahlung bei höchsten Energien vermessen. Mithilfe von Szintillationsdetekoren, welche oberhalb der Wasser-Cherenkov-Detekoren als Teil des AugerUpgrade eingebaut werden, soll eine Verbesserung der Elektronen/Myonen-Trennung erreicht werden. Die Lichtsignale der Szintillationsdetekoren werden von Photomultipliern (PMT) registriert. Um die Teilchendichten eines Luftschauers auch in der Nähe des Schauerzentrums zu vermessen, wird ein dynamischer Arbeitsbereich der PMT von 1-20000 Minimal-Ionisierender Teilchen gefordert. Oberhalb eines Anodenstroms von ca 150 mA kommt es jedoch zu einer Saturation der Anodensignale und damit zu einer Nichtlinearität in der Antwortfunktion des PMTs. Zur Messbereichserweiterung wird die Methode der Dynodenauskopplung betrachtet. Hierzu wird an der sechsten Dynode des 8-stufigen PMT ein Teil des Signals ausgekoppelt, welches um einen Faktor 50 geringer ist als das Anodensignal. Entsprechend geringer sind Raumladungseffekte im Bereich der Dynode, so dass das Dynodensignal noch linear zur Anzahl der einfallenden Pho-

tonen ansteigt, während das Anodensignal bereits saturiert. Durch die Auslese und den Vergleich beider Signale lässt sich der Messbereich erweitern. In diesem Vortrag wird die Realisierung der Auskopplung an verschiedenen PMT und Spannungsteilerschaltungen besprochen.

T 35.10 Di 18:45 Z6 - SR 1.005

Funktionstest und Charakterisierung des CMS Binary Chips — Felix Bögelspacher, Alexander Dierlamm, •Alexander Droll, Thomas Müller und Daniel Schell — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Im Rahmen des Phase-2-Upgrades des CMS-Experiments wird der komplette äußere Spurdetektor ausgetauscht. Der neue Spurdetektor wird aus zwei verschiedenartigen Modulen aufgebaut sein. Eines dieser Module, das 2S-Modul, besteht unter anderem aus zwei parallel ausgerichteten Siliziumstreifensensoren, die vom CMS Binary Chip (CBC) ausgelesen werden.

Die grundlegende Neuerung wird der Beitrag des Spurdetektors zum Level-1-Trigger sein. Dazu identifiziert der CBC Teilchen mit großen Transversalimpulsen anhand der Krümmung ihrer Trajektorien im Magnetfeld des CMS-Detektors. Im Detail geschieht dies durch die Detektion von Treffern in beiden Sensorlagen innerhalb eines gewissen Koinzidenzfensters.

Dieser Vortrag beschäftigt sich mit der Charakterisierung des CBCs. Darüber hinaus wird eine Auswahl an Tests zur Überprüfung der Funktionsfähigkeit des CBCs in Prototypmodulen vorgestellt.

T 36: Higgs

Zeit: Dienstag 16:30–18:35 Raum: Z6 - SR 1.010

Gruppenbericht T 36.1 Di 16:30 Z6 - SR 1.010

Can we discover a light singlet-like NMSSM Higgs boson at the LHC? — •Conny Beskidt[1], Wim de Boer[1], and Dmitri Kazakov[1,2] — [1]Karlsruhe Institute of Technology (IETP) — [2]JINR, ITEP, Moscow, Russia

In the next-to minimal supersymmetric standard model (NMSSM) one expects an additional singlet-like Higgs boson with small couplings to standard model (SM) particles via mixing. Although the mass can be well below the discovered 125 GeV Higgs boson its small couplings may make it difficult to discover it at the LHC. We use a novel scanning technique to efficiently scan the whole parameter space and determine the range of cross sections and branching ratios. This allows to give perspectives for the future searches for light Higgs bosons at the LHC with luminosities up to 300 and 3000 1/fb. Specific LHC benchmark points are selected, which represent the salient NMSSM features.

T 36.2 Di 16:50 Z6 - SR 1.010

Next-to-leading order reweighting method for simulated processes of gluon fusion Higgs boson production — •Artur Gottmann[1], Josry Metwally[1], Andrew Gilbert[2], René Caspart[1], Roger Wolf[1], and Günter Quast[1] — [1]Karlsruhe Institute of Technology — [2]European Organization for Nuclear Research

The precision of the gluon fusion Higgs boson production cross section at next-to-leading order QCD plus parton shower accuracy with Powheg can be improved by treating the calculation as a multiscale problem: The calculation is split into the individual differential distributions from only the top quark, only the bottom quark and the top-bottom interference.

In Two-Higgs-Doublet models like the MSSM, where the distributions themselves in addition depend on the model parameters, this approach can be used to naturally incorporate the dependencies of the differential distributions on the model parameters into the calculation. In the MSSM all contributions to gluon fusion production, which can be associated to the Higgs-bottom quark coupling, like Δb corrections, have also been taken into account as next-to-leading order SUSY corrections. Non-considered SUSY contributions to the differential cross section have been checked to lie below 5%. This method has been exploited for the first time for the recently published search of CMS for additional neutral MSSM Higgs bosons on the LHC Run II data of 2016.

T 36.3 Di 17:05 Z6 - SR 1.010

Three-Higgs-Doublet Model with Generalized CP Symmetry — I. P. Ivanov[1], •M. Köpke[2], M. M. Mühlleitner[2], and D. Sokolowska[3] — [1]Instituto Superior Tecnico, Lisbon, Portugal — [2]KIT, Institute for Theoretical Physics, Karlsruhe, Germany — [3]University of Warsaw, Institute of Theoretical Physics, Warsaw, Poland

The flaws of the Standard Model (SM) call for new physics extensions that provide answers to (at least some of) the unsolved puzzles of the SM. These models usually come with extended Higgs sectors. Higgs extensions that are constrained by specific symmetries lead to interesting phenomenological effects. In particular, multi-Higgs models with generalized CP symmetries have become an increasingly interesting field of study. In this talk, we present the 3-Higgs-doublet model with a CP4 symmetry that has recently been proposed by Ivanov and Silva. We outline the astrophysical and phenomenological consequences of this symmetry.

T 36.4 Di 17:20 Z6 - SR 1.010

CP-odd Yukawa Couplings of the 125 GeV Higgs Boson — Margarete Mühlleitner[1], Rui Santos[2,3,4], and •Jonas Wittbrodt[5] — [1]ITP, KIT, 76128 Karlsruhe, Germany — [2]ISEL, Instituto Politecnico de Lisboa 1959-007 Lisboa, Portugal — [3]Centro de Fisica Teorica e Computacional, Universidade de Lisboa, 1749-016 Lisboa, Portugal — [4]LIP, Universidade do Minho, 4710-057 Braga, Portugal — [5]DESY, Notkestraße 85, 22607 Hamburg, Germany

While precision studies of the 125 GeV Higgs boson get underway, little is still known about a possible CP-violating pseudoscalar admixture to this state. We performed a parameter scan in one of the simplest models with a CP-violating scalar sector, the Complex 2HDM (C2HDM), including the important constraint from the electric dipole moment of the electron. We show that there are still viable scenarios where the Yukawa couplings of the 125 GeV display near maximal CP-violation. Depending on the 2HDM Yukawa type, two intriguing configurations are possible. First, the CP-even and CP-off Yukawa couplings to a given fermion can be of similar size. Second, the Higgs boson can couple as a scalar to certain fermions and as a pseudoscalar to others. These possibilities can lead to interesting observable consequences.

T 36.5 Di 17:35 Z6 - SR 1.010

Bounded-From-Below Constraints for General Higgs Potentials — I. P. Ivanov[1], •M. Köpke[2], and M. M. Mühlleitner[2] — [1]Instituto Superior Tecnico, Lisbon, Portugal — [2]KIT, Institute for Theoretical Physics, Karlsruhe, Germany

In theories with interacting scalar fields, the scalar Higgs potential must be bounded from below in order for a stable vacuum to exist. For general Higgs potentials these constraints for boundedness-from-below are difficult to derive. In the past, they were usually studied on a model by model basis and involved lengthy proofs of inequalities. In this talk, I present a method that can be applied to general Higgs potentials and carried out by a computer, resulting in analytic expressions that can be used to check for the validity of a parameter point of the model.

T 36.6 Di 17:50 Z6 - SR 1.010

Three-loop Yukawa matrix beta functions in the Standard Model and beyond — •Florian Herren[1], Luminita Mihaila[2], and Matthias Steinhauser[1] — [1]Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology (KIT) — [2]Institut für Theoretische Physik, Universität Heidelberg

We present the calculation of Yukawa matrix beta functions to three loops in the two-Higgs-doublet model and the SM. Special emphasis is put on the problems arising in the computation of beta functions if the Lagrangian under consideration contains unphysical parameters, as is the case for the SM and 2HDMs. Furthermore, we present practical solutions to the aforementioned problems.

T 36.7 Di 18:05 Z6 - SR 1.010

$gg \to hh$ @NLO in the high energy limit — Joshua Davies, Go Mishima, Matthias Steinhauser, and •David Wellmann — Karlsruher Institut für Technologie (KIT), Karlsruhe, Deutschland

We consider the process $gg \to hh$ at NLO in the limit of a vanishing

Higgs mass. We perform an expansion for a small top quark mass since we are interested in the high energy limit where $s, t \gg m_t$. In this limit we obtain analytic results with the help of differential equations for the master integrals.

T 36.8 Di 18:20 Z6 - SR 1.010

Higgs mass prediction in the MSSM based on a combination of fixed-order corrections and resummed bottom and tau contributions — •Ivan Sobolev[1] and Georg Weiglein[2] — [1]DESY, Hamburg, Germany — [2]DESY, Hamburg, Germany

In constrast to the Standard Model (SM) in the Minimal Supersymmetric Standard Model (MSSM) Higgs mass is a predictable quantity. Since radiative corrections are large, a very precise calculation is required to limit the theoretical uncertainty from unknown higher order corrections. In the limit of heavy superparticles radiative corrections to Higgs mass scale logarithmically with the mass of the superparticles. These large logarithms can be resummed by making use of effective field theory. However, in case of light superparticles fixed-order calculations are expected to be more precise. To profit from virtues of both methods they should be combined. This method, known as 'hybrid', is known for a while and is implemented in the publicly available code FeynHiggs. Our aim is to apply this method to corrections coming from down-type fermions, especially to tau and bottom corrections. In this talk we report on our progress in implementing this method into the code.

T 37: Theorie: QCD / Top-Physik / Elektroschwache Physik

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 1.013

T 37.1 Di 16:30 Z6 - SR 1.013

NLO and off-shell effects in top quark mass determinations — Gudrun Heinrich[1], Andreas Maier[2], Richard Nisius[1], Johannes Schlenk[3], Markus Schulze[4], •Ludovic Scyboz[1], and Jan Winter[5] — [1]Max-Planck-Institut für Physik, München, Germany — [2]Experimental Physics Department, CERN, Geneva, Switzerland — [3]IPPP, University of Durham, Durham, UK — [4]Humboldt-Universität zu Berlin, Institut für Physik, Berlin, Germany — [5]Department of Physics and Astronomy, Michigan State University, East Lansing, USA

While systematic experimental uncertainties are better understood in top measurements at LHC, it is not clear how the non-doubly resonant and non-factorizable contributions to the final state $pp \to W^+W^-b\bar{b} \to (e^+\nu_e)(\mu^-\bar{\nu}_\mu)b\bar{b}$ influence the determination of the top mass. Several narrow-width approximations with different descriptions of the top decay are compared to the full NLO prediction for $W^+W^-b\bar{b}$ production, namely the direct top decay at LO and NLO accuracy as well as via a parton shower. To take the equivalent of an experimental analysis as a benchmark, the different theoretical descriptions are used to calibrate template fit functions and estimate the offset in the top mass determination from pseudo-data.

T 37.2 Di 16:45 Z6 - SR 1.013

NLO QCD Predictions for $Wb\bar{b}$ Production in Association with Jets at the LHC — Felix Anger, Fernando Febres Cordero, Harald Ita, and •Vasily Sotnikov — Albert-Ludwigs-Universität Freiburg, Freiburg, Germany

We present NLO QCD predictions for $Wb\bar{b}$ production in association with up to three light jets at the LHC. We compute in the four-flavor scheme with a non-vanishing bottom-quark mass. The matrix elements are obtained with a new version of the BlackHat library, which is upgraded to handle massive particles.

T 37.3 Di 17:00 Z6 - SR 1.013

NLO QCD predictions for Z+Photon+jets production — •Johannes Krause and Frank Siegert — TU Dresden, Institut für Kern- und Teilchenphysik

We present next-to-leading order QCD results for Z+gamma production, including additional jets. Besides a comparison to recent experimental data and the discussion of uncertainties and scales, we also show a possibility to remove the overlap between Z+gamma processes and Z+jets due to additional final state radiation.

T 37.4 Di 17:15 Z6 - SR 1.013

Associated production of a top quark pair with a W or Z boson at the LHC at NNLL+NLO — Anna Kulesza[1], Leszek Motyka[2], •Daniel Schwartländer[1], Tomasz Stebel[3], and Vincent Theeuwes[4] — [1]Institute for Theoretical Physics, WWU Münster, D-48149 Münster, Germany — [2]Institute of Physics, Jagellonian University, S. Łojasiewicza 11, 30-348 Kraków, Poland — [3]Institute of Nuclear Physics PAN, Radzikowskiego 152, 31-342 Kraków, Poland — [4]Department of Physics, SUNY Buffalo, 261 Fronczak Hall, Buffalo, NY 14260-1500, USA

The measurements of associated production of a vector or a scalar boson with a top-antitop quark pair provide an important test for the Standard Model at the LHC.

In particular these are the key processes to measure the top quark properties. Furthermore they are very relevant in searches for new physics, both as being directly sensitive to it and as providing an important background.

While NNLO calculations for this particular type of 2 to 3 processes are currently out of reach, a class of corrections beyond NLO can be taken into account with the help of resummation methods. In this talk we consider an application of soft gluon resummation in Mellin space to these processes at hadron colliders and discuss numerical predictions at NNLL matched to NLO precision for the LHC.

T 37.5 Di 17:30 Z6 - SR 1.013

Four-jet and three-jet plus gamma DPS production in pp and pA collisions at the LHC — •Oleh Fedkevych and Anna Kulesza — Institut für Theoretische Physik, Wilhelm-Klemm-Straße 9, 48149 Münster, Deutschland

In spite of the recent progress in both theoretical and experimental studies many aspects of *proton-proton* (pp) and *proton-nucleus* (pA) collisions still require a detail investigation. At high collision energies, the probability of simultaneous scatterings of different pairs of partons, contributing to the same inelastic event, has to be considered. In particular, *double parton scattering* (DPS) processes can also play a dominant role for some specific kinematic regions of multi-jet production.

In this talk we will discuss the DPS contribution to four-jet and three-jet plus gamma production in pp and pA collisions as well as its dependence on different kinematical cuts and different phenomenological assumptions.

T 37.6 Di 17:45 Z6 - SR 1.013

New Features in `pySecDec` — •Stephan Jahn — Max-Planck-Institut für Physik, Muenchen, Deutschland

The evaluation of master integrals is an important step in the computation of higher-order corrections. Direct numerical integration of multi-loop-integrals is usually impossible due to intrinsic divergences. The program `pySecDec` computes solutions by extracting dimensionally regularized divergences prior to numerical integration. In this talk, we present the latest new features of `pySecDec`.

T 37.7 Di 18:00 Z6 - SR 1.013

Automation of QCD at NLO: $pp \to Zj + X$ as a toy example — •Pascal Stienemeier, Jürgen Reuter, Vincent Rothe, and Christian Weiss — DESY Theory Group, Notkestr. 85, D-22607 Hamburg, Germany

In order to cope with increased experimental accuracy of the LHC era, the accuracy of theoretical predictions has to be increased as well. For this task, sophisticated tools for automated computation, namely matrix-element generators and Monte-Carlo event generators, have to take next-to-leading order effects into account.

A hadronic initial state like protons at the LHC however incorporates computational challenges such as infrared initial state divergences. A possibility to substract these divergencies is the Frixione-Kunszt-Signer (FKS) subtraction scheme whose implementation in Whizard is currently being validated.

In this talk I will show details of the implementation and validation of the FKS subtraction, particularly the initial state splittings and regions, using as a prime example computed by Whizard the simplest

process where all these components are needed, namely $pp \to Zj + X$ at QCD NLO.

T 37.8 Di 18:15 Z6 - SR 1.013

Integrating double soft emissions for NNLO computations — •Maximilian Delto and Kirill Melnikov — Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology (KIT)

We will describe an analytic calculation of the phase-space integral of the double soft eikonal function in dimensional regularisation required for fully-differential next-to-next-to-leading order computations in QCD. We will consider cases when the radiating partons are in a back-to-back kinematics, relevant for Drell-Yan and Higgs production, and when the radiating partons are at an arbitrary angle, relevant e.g. for DIS and weak boson fusion processes.

T 37.9 Di 18:30 Z6 - SR 1.013

Two mass contributions to three loop operator matrix elements and the variable flavour number scheme — Johannes Blümlein[1], Abilio De Freitas[1], Carsten Schneider[2], and •Kay Schönwald[1] — [1]DESY, Zeuthen, Deutschland — [2]RISC, Johannes Kepler Universität Linz, Österreich

Beginning at three loop order, massive operator matrix elements receive contributions from irreducible diagrams containing two different masses, i.e. the charm and bottom quark. Since their mass ratio $m_c^2/m_b^2 \sim 1/10$ is non-negligible, both have to be decoupled together.

We show the implications of the simultaneous decoupling for the variable flavor number scheme and present the three loop, two mass contributions to the pure singlet and gluonic operator matrix element.

T 37.10 Di 18:45 Z6 - SR 1.013

More efficient parameterization of phase-space in `WHIZARD` — •Manuel Utsch[1], Wolfgang Kilian[1], Thorsten Ohl[2], Jürgen Reuter[3], and Simon Brass[1] — [1]Department Physik, University of Siegen, D-57068 Siegen, Germany — [2]Institut für Theoretische Physik und Astrophysik, University of Würzburg, D-97074 Würzburg, Germany — [3]Theory Group, DESY Hamburg, D-22603 Hamburg, Germany

Monte Carlo integration of transition matrix elements requires the use of variance reduction techniques in order to produce reliable results. The event generator `WHIZARD` uses a Multi-Channel approach which makes use of several parameterizations of phase-space and appropriate mappings of random numbers to invariant masses and angles. Processes with large numbers of final state particles lead to a vast number of possible phase-space parameterizations. We describe a new, efficient implementation of the algorithm for the construction of phase-space parameterizations and present results for the obtained speed-up.

T 38: Gasgefüllte Detektoren II

Zeit: Dienstag 16:30–18:45 Raum: Z6 - SR 2.002

T 38.1 Di 16:30 Z6 - SR 2.002

Characteristics of a Diamond like Carbon Coated (DLC) Gas Electron Multiplier (GEM) — •Amirrafiq Alfarra, Serhat Atay, Ivor Fleck, and Ulrich Werthenbach — University of Siegen, Siegen, Germany

Abstract

We are investigating in this work the characteristics of a diamond like carbon coated (DLC) gas electron multiplier (GEM). Both electrodes of this GEM were covered by a layer of diamond like carbon. The purpose of this coating is to reduce the probability of discharge and thus allowing us to increase the GEM voltage to reach higer gain. The DLC GEM is being operated in an Ar and CO2 gas mixture.The gain is being studied using x-ray radiation of Fe55 source at variate voltage and for different drift distances. Measurements are being taken using a pad readout system and compared with the results of CERN GEMs.

T 38.2 Di 16:45 Z6 - SR 2.002

Characterization of The Ceramic GEM for The ILCTPC — Amirrafiq Alfarra, •Serhat Atay, Ivor Fleck, and Ulrich Werthenbach — University of Siegen

The International Large Detector (ILD) will become one of the detectors of the International Linear Collider. A Time Projection Chamber, instrumented with Gas Electron Multipliers (GEM), could be constructed inside the ILD as the central tracking chamber. A new type of GEMs made out of ceramics are investigated. They have a thickness of 120 μm and a hole diameter of 200 μm. This talk will present the results from the characterization of these ceramic GEMs, especially for the properties as the gas gain and the long term stability. The results are also compared to the Garfield++ simulation. Gains of higher than 100 have been measured in an Ar:CO_2 (80:20) mixture after conditioning.

T 38.3 Di 17:00 Z6 - SR 2.002

Spatial Resolution Enhancement for Micro-Pattern-Gaseous-Detectors — •Bernhard Flierl[1], Otmar Biebel[1], Maximillian Herrmann[1], Felix Klitzner[1], Phillipp Lösel[1], Ralph Müller[1], and Andre Zibell[2] — [1]Ludwig-Maximilians-Universität München — [2]Julius-Maximilians-Universität Würzburg

The quality of position reconstruction of minimal ionizing particles using standard methods in planar gaseous detectors is often depending on the relative inclination of the particle track with respect to the detector. Different methods aim to overcome this by using time resolved readout in order to reconstruct the full track in a TPC-like scheme. We show a tracking method, which provides high spatial resolution together with excellent reconstruction efficiency at lowered requirements on timing resolution. At the example of small Gaseous-Electron-multiplier-detectors (GEM) with an active area of 100x100 mm^2 and square-meter sized micromegas detectors the resolution enhancement for multi-layer detectors is illustrated, which has been measured with a 150 GeV muon beam at the SPS accelerator at CERN. The detectors feature one- and two-dimensional strip read-out equipped with time-resolving APV25 chips, which allows a spatial resolution of below 0.15 mm independent of the track inclination.

T 38.4 Di 17:15 Z6 - SR 2.002

Bestimmung der dE/dx Auflösung eines GEM-basierten TPC-Auslesesystems — •Paul Malek für die LCTPC-Deutschland-Kollaboration — Deutsches Elektronen-Synchrotron DESY — Universität Hamburg, Institut für Experimentalphysik

Für den International Large Detector (ILD) am geplanten International Linear Collider (ILC) ist eine Zeitprojektionskammer (Time Projection Chamber, TPC) als zentraler Spurdetektor geplant. Um die nötige Spurauflösung zu erreichen, ist ein Gasverstärkungs- und Auslesesystem mit mikrostrukturierten Gasdetektoren (Micro Pattern Gaseous Detectors, MPGD) vorgesehen. Eine der untersuchten Möglichkeiten für die Gasverstärkung und Detektion sind Gas-Electron-Multiplier (GEM).

In diesem Beitrag werden Ergebnisse von Teststrahlmessungen mit einem modularen, GEM basierten TPC Auslesesystem vorgestellt. Der Schwerpunkt der Analysen lag auf der Messung des spezifischen Energieverlustes (dE/dx). Unter anderem werden die Abhängigkeit der dE/dx Auflösung von der Spurlänge sowie von Korrekturen der Ladungsmessung diskutiert.

T 38.5 Di 17:30 Z6 - SR 2.002

Measurement of neutrino interactions in gaseous argon with T2K — •Lukas Koch — RWTH Aachen University

The T2K near-detector, ND280, employs three large argon gas TPCs (Time Projection Chambers) for particle tracking and identification. The gas inside the TPCs can be used as an active target to study the neutrino interactions in great detail. The low density of the gas leads to very low track energy thresholds, allowing the reconstruction of very low momentum tracks, e.g. protons with kinetic energies down to O(1 MeV). Since different nuclear interaction models vary considerably in their predictions of those low momentum track multiplicities, this makes neutrino interactions on gases a powerful probe to test those models.

The TPCs operate with an argon-based gas mixture (95% by volume) and have been exposed to the T2K neutrino beam since the beginning of the experiment in 2010. Due to the low total mass of the gas, neutrino argon interactions happen only rarely, compared to

the surrounding scintillator-based detectors. We expect about 600 such events in the recorded data so far (about 300 in the fiducial volume). We are able to separate those events from the background and thus demonstrate the viability of using gaseous argon as a target for a neutrino beam. This enables us to do a cross-section measurement on gaseous argon, the first measurement of this kind. All previous neutrino cross-section measurements on argon were performed in liquid argon TPCs.

T 38.6 Di 17:45 Z6 - SR 2.002

Transverse Diffusion in the TPC of the T2K Near Detector — Philip Hamacher-Baumann, Lukas Koch, •Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University

Transverse diffusion affects the spatial resolution in a Time Projection Chamber (TPC). In the TPCs of the T2K near detector it can be derived from the charge distribution on the MicroMeGaS plane. The electron cloud width is reconstructed from the charge fraction detected by the individual anode pads along the track. This cloud width depends on the drift distance between the point of ionization and the MicroMeGaS. From this the transverse diffusion coefficient can be extracted. Care has to be taken of the E-Field and B-Field inhomogeneities, because they can have an impact on the diffusion as well.

T 38.7 Di 18:00 Z6 - SR 2.002

Study on the performance of thin-gap RPCs for the ATLAS muon spectrometer upgrade — •Catriona Bruce, Oliver Kortner, and Hubert Kroha — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Thin-gap resistive plate chambers (RPCs) make excellent muon trigger chambers in high radiation environments. The ATLAS experiment will equip the inner layer of its barrel muon spectrometer with thin-gap RPCs to increase barrel trigger acceptance from 78% to over 95%. The choice of operating voltage impacts the time resolution, spatial resolution, and efficiency and requires careful consideration prior to the final design decision. To this end, a full-sized prototype has been tested in a highly energetic muon beam at CERN. The presentation will summarize the conclusions about operating voltage and consequences for spectrometer performance.

T 38.8 Di 18:15 Z6 - SR 2.002

Latest developments in improving the specific energy loss measurement in the Transition Radiation Tracker (TRT) at ATLAS — Philip Bechtle, Klaus Desch, Christian Grefe, and •Philipp König — Universität Bonn

Particle identification (PID) is a crucial part for many analyses carried out at a particle physics experiment. One important observable for PID is the specific energy loss dE/dx. In addition, it is an interesting observable for searches for exotic particles as those particles can have a completely different energy loss behavior than known particles described in the Standard Model. In ATLAS, the dE/dx of charged particles is measured in the vertex detector and in the Transition Radiation Tracker TRT. The measurement of dE/dx in the TRT will be introduced and the latest improvements to this measurements will be discussed. In particular, this talk will focus on the measurement of dE/dx under different pile-up conditions, give an insight into different possible calibration techniques and discuss the separation of different particle types that can be achieved.

T 38.9 Di 18:30 Z6 - SR 2.002

Cooling of the VMM3 readout ASIC — Michael Lupberger[1], Hans Muller[1], Eraldo Oliveri[1], Leszek Ropelewski[1], and •Lucian Scharenberg[2] — [1]CERN, Geneva, Switzerland — [2]Physikalisches Institut, University of Bonn, Bonn, Germany

During the next long shutdown of the LHC an upgrade of the Muon system of the ATLAS detector is planned. Within this "New Small Wheel Upgrade" the VMM is developed as new front-end readout ASIC.

Due to its high rate capabilities and with its integrated digitisers, zero suppression, and programmable gain and shaping times the VMM is also interesting for other applications. In the gaseous detector community represented by the RD51 collaboration, the VMM is highly requested for becoming the next standard frond-end chip for their vastly flexible Scalable Readout System (SRS). Therefore the Gas Detector Development Group (GDD) at CERN, in cooperation with the European Spallation Source (ESS), implements the VMM into the SRS.

With a power consumption of about two Watts a lot of heat is transmitted to the carrier boards and detector frames, which could also affect the detection performance. Therefore the performance of the VMM depending on the temperature was measured with a dedicated constructed test set-up, which included temperature control and monitoring. With the results obtained it was possible to decide, if a passive cooling is sufficient or if an active cooling solution is required.

In this talk the functionality of the VMM and its implementation into the SRS, the test set-up and the results of the "VMM cooling project" are presented.

T 39: Flavor Physik I

Zeit: Dienstag 16:30–18:50 Raum: Z6 - SR 2.006

Gruppenbericht T 39.1 Di 16:30 Z6 - SR 2.006

Suche nach neuer Physik in (semi-)leptonischen Zerfällen von B-Mesonen bei LHCb — •Stefanie Reichert, Johannes Albrecht, Tobias Tekampe, Titus Mombächer, Alexander Battig, Niklas Nolte, Johannes Heuel, Maik Becker, Gerwin Maier und Alex Seuthe — Technische Universität Dortmund

Im Standardmodell der Elementarteilchenphysik ist die Kopplungsstärke der schwachen Wechselwirkung universell, was bedeutet, dass die Kopplung an alle Leptonen gleich stark ist. Aktuell verdichten sich experimentelle Hinweise auf eine mögliche Verletzung dieser Vorhersage, was, wenn bestätigt, eine klare Messung von Physik jenseits des Standardmodells wäre. Desweiteren ließe sich aus der Verletzung der Lepton-Universalität in einer Vielzahl von Modellen für neue Physik die Existenz von Zerfällen ableiten, welche die Erhaltung der Lepton-Flavour-Zahl verletzen. Im Vortrag wird eine Auswahl der neusten Ergebnisse der LHCb-Kollaboration von Suchen nach neuer Physik in rein leptonischen und semi-leptonischen Zerfällen von B-Mesonen vorgestellt. Hierbei wird der Fokus auf Suchen nach Verletzungen der Lepton-Universalität sowie der Lepton-Flavour-Zahl-Erhaltung liegen.

T 39.2 Di 16:50 Z6 - SR 2.006

Die Suche nach dem seltenen Zerfall $\phi \to e^{\pm}\mu^{\mp}$ mit dem LHCb-Experiment — Johannes Albrecht, •Niklas Nolte und Stefanie Reichert — Technische Universität Dortmund

Das im Standardmodell der Teilchenphysik verankerte Prinzip der Erhaltung der Lepton-Flavour-Zahl verbietet den Zerfall $\phi \to e^{\pm}\mu^{\mp}$. Experimentelle Hinweise auf die Verletzung einer theoretisch verwandten Symmetrie, der Lepton-Flavour-Universalität, geben Anreiz zur Suche nach Zerfällen wie diesem. Mehrere Erweiterungen des Standardmodells prognostizieren dafür experimentell erreichbare Verzweigungsverhältnisse. Als Test des Standardmodells wird hier eine Suche nach dem Zerfall $\phi \to e^{\pm}\mu^{\mp}$ mit Daten des LHCb-Experiments aus dem Run 2 des LHC vorgestellt. Experimentell stellt vor allem die Rekonstruktion der Bremsstrahlung des Elektrons eine Herausforderung dar.

T 39.3 Di 17:05 Z6 - SR 2.006

Search for New Physics in Singly Cabbibo Suppressed D Decays at the Belle Experiment — •Dmytro Levit — Technische Universität München

The Standard Model predicts CP-Violation effects to be confined to $\Delta I = 1/2$ amplitudes in singly Cabibbo suppressed D decays. Therefore the measurement of CP violation in $\Delta I = 3/2$ amplitudes will provide evidence of new physics.

In our analysis we undertake the first measurement of the branching ratio for the $D^{\pm} \to K^0_s K^{\mp}\pi^{\pm}\pi^{\pm}\pi^0$ decay using the data sample of the Belle experiment. Additionally an amplitude analysis of the decay will be performed to estimate the effect of the new physics contribution to the decay.

The branching ratio measurement, will be presented in the contribution.

T 39.4 Di 17:20 Z6 - SR 2.006

Search for the Lepton Flavor Violating Decay $B^0 \to \tau^\pm e^\mp$ and $B^0 \to \tau^\pm \mu^\mp$ — •Philipp Meyer and Thomas Kuhr — Ludwig-Maximilians-Universität München, Deutschland

Lepton flavor violation (LFV) has been observed in neutrino oscillations, but not yet in processes with charged leptons. Charged lepton flavor violation is predicted in some theories beyond the Standard Model and its observation would be a clear sign of new physics. This talk will present a search for $B^0 \to \tau^\pm e^\mp$ and $B^0 \to \tau^\pm \mu^\mp$ at the Belle experiment. The analysis uses the basf2 software framework of the Belle II collaboration and relies on the full reconstruction of the second B meson in $Y(4S) \to B^0\bar{B}^0$ events.

T 39.5 Di 17:35 Z6 - SR 2.006

Search for B -> K(*) nu nu with inclusive tag B reconstruction — •Benjamin Haser, Thomas Kuhr, and James Kahn — Ludwig-Maximilians-Universität München

Rare B decays with one neutrino and one anti/neutrino in the final state, belong to the theoretically cleanest flavor-changing neutral current (FCNC) processes. One decay channel is the B -> K(*) nu nu (b -> s nu nu) which is sensitive to physics beyond the standard model (SM). The trick for these measurements is to reconstruct all decay particles of one of the B mesons. However, in this talk, the reconstruction is performed by inclusive B meson reconstruction techniques where the full B meson decay chain is not explicitly reconstructed. The basic idea of an inclusive B meson tag reconstruction is to combine the four-momenta of all particles in the rest of event signal-side B candidate. The achieved tagging efficiency is usually one order of magnitude above the hadronic and semileptonic tagging methods. In consequence, the methods suffer from a high background as well as a very impure tag sample.

T 39.6 Di 17:50 Z6 - SR 2.006

Suche nach dem Zerfall $B \to \mu\nu$ mit dem Belle Experiment — •Markus Prim, Florian Bernlochner, Michael Feindt, Martin Heck und Pablo Goldenzweig — KIT

Das Belle-Experiment am japanischen Forschungszentrum KEK hat im Zeitraum von 1999 bis 2010 einen Datensatz von 772 Millionen $B\bar{B}$ Zerfällen der $\Upsilon(4S)$ Resonanz aufgezeichnet. Seltene Zerfälle dieser B-Mesonen eignen sich um das Standardmodell der Teilchenphysik zu testen, da Physik jenseits des Standardmodells einen großen Einfluss auf das Verzweigungsverhältnis dieser Zerfälle nehmen kann. Einer dieser seltenen Zerfallskanäle ist $B \to \mu\nu$. In diesem Vortrag wird die Suche nach diesem Zerfall mit inklusiver Tag-Seiten Rekonstruktion präsentiert.

T 39.7 Di 18:05 Z6 - SR 2.006

Suche nach dem seltenen Zerfall $B_s^0 \to e^+e^-$ mit dem LHCb Experiment — Johannes Albrecht[1], •Alexander Battig[1], Titus Mombächer[1], Stefanie Reichert[1] und Nicolas Scharmberg[2] — [1]Technische Universität Dortmund — [2]University of Manchester

Die Suche nach den im Standardmodell unterdrückten Zerfällen der Art $B_s^0 \to l^+l^-$ bietet ideale Bedingungen für die Suche nach neuer Physik. Tests der Leptonflavouruniversalität ($\mathcal{R}_K$, $\mathcal{R}_{K^*}$) deuten auf ein unterschiedliches Verhalten von Myonen und Elektronen hin. Ergänzend zur Messung des Verzweigungsverhältnisses des Zerfalls $B_s^0 \to \mu^+\mu^-$, welches mit dem Standardmodell kompatibel ist, bietet sich daher der Zerfall $B_s^0 \to e^+e^-$ als Nulltest für das Standardmodell an.

In diesem Vortrag wird die Suche nach $B_s^0 \to e^+e^-$ mit dem LHCb Experiment vorgestellt. Der zugrunde liegende Datensatz wurde in Run 1 und Run 2 des LHC aufgezeichnet und entspricht einer integrierten Luminosität von $4.65\,\mathrm{fb}^{-1}$.

T 39.8 Di 18:20 Z6 - SR 2.006

Angular analysis of $B_s^0 \to \phi\mu^+\mu^-$ decays — •Marcel Materok, Christoph Langenbruch, and Eluned Smith — RWTH Aachen

The LHCb experiment at the LHC is dedicated to the search for new phenomena beyond the Standard Model (SM) through precision measurements of heavy flavour decays. Rare semileptonic $b \to s\mu^+\mu^-$ decays are particularly interesting as they constitute flavor changing neutral currents that are forbidden at tree-level in the SM and are only allowed at loop level. New heavy particles beyond the SM can thus give significant contributions and affect branching fractions and angular observables.

The rare decay $B_s^0 \to \phi\mu^+\mu^-$ has been previously analysed by the LHCb collaboration using data taken in 2011 and 2012, during Run 1 of the LHC. In this analysis, both the branching fraction and the angular observables have been determined and a deviation corresponding to around 3σ from SM predictions were found for the branching fraction.

This talk will give an overview of the analysis strategy to measure the angular observables in the $B_s^0 \to \phi\mu^+\mu^-$ decay using the combined Run 1 and 2 LHCb Data. The current status of the analysis will also be presented.

T 39.9 Di 18:35 Z6 - SR 2.006

Study of $D^0 \to \pi^+\pi^-\pi^+\pi^-$ at Belle — •Johannes Rauch — Technische Universität München

Singly Cabibbo suppressed decays of charm mesons are expected to show a very small CP asymmetry, if any, in the Standard Model. Therefore, these channels provide a good probe for new physics. Spectroscopy of various decay channels in multi-hadronic states have seldomly been undertaken in the current era of large data sets provided e.g. by the Belle experiment. We will present the current status of an analysis of $D^0 \to \pi^+\pi^-\pi^+\pi^-$. Preliminary results of event selection and partial wave analysis will be shown.

T 40: Detektorsysteme I

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 2.007

T 40.1 Di 16:30 Z6 - SR 2.007

Performance of the KATRIN detector system — •Florian Fränkle for the KATRIN-Collaboration — Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT)

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a largescale experiment with the objective to determine the effective electron anti-neutrino mass with an unprecedented sensitivity of 0.2 eV/c^2 at 90% CL in a model-independent way, based on precision β-decay spectroscopy of molecular tritium. The experimental setup consists of a high luminosity windowless gaseous tritium source, a magnetic electron transport system with differential and cryogenic pumping for tritium retention, and an electro-static spectrometer section for energy analysis, followed by a detector system for counting transmitted β-electrons.

The focal-plane detector system for KATRIN consists of a multi-pixel silicon p-i-n-diode array, custom readout electronics, two superconducting solenoid magnets, an ultra high-vacuum system, a high-vacuum system, calibration and monitoring devices, a scintillating veto, and a custom data-acquisition system. It is designed to detect the low-energy electrons selected by the KATRIN main spectrometer. This talk will describe the system and summarize its performance after its final installation.

This work was supported by the U.S. Department of Energy under award numbers DE-FG02-97ER41020, DE-FG02-97ER41041, DE-FG02-97ER41033, BMBF (05A17VK2), and the HGF.

T 40.2 Di 16:45 Z6 - SR 2.007

The detector model for the Compact Linear Collider and its implementation in DELPHES — •Ulrike Schnoor for the CLICdp-Collaboration — European Organisation for Nuclear Research CERN

The Compact Linear Collider CLIC is a high-energy electron-positron accelerator being studied as an option for the post-LHC era. Detector and physics studies after the Conceptual Design Report have resulted in an updated detector model for CLIC. Its design and performance are presented in this talk. The detector model has been implemented in a publicly available parameter card for the DELPHES fast simulation tool, which can be used for studies of CLIC's physics potential. Its performance is validated based on the Higgsstrahlung process ($e^+e^- \to HZ$), which constitutes the dominant Higgs production channel and hence a strong physics case for the anticipated first stage of CLIC with a center-of-mass energy of 380 GeV.

T 40.3 Di 17:00 Z6 - SR 2.007

Contributions to the ATLAS New Small Wheel Upgrade by the Würzburg University — •Thorben Swirski, Deb Sankar Bhattacharya, and Raimund Ströhmer — Universität Würzburg

One of the prime motivations for the luminosity upgrade of the Large Hadron Collider (LHC) is to get a deeper insight into the Higgs sector. The luminosity upgrade will result in a very high particle rate up to 15 kHz/cm^2, for which the forward muon tracking station (Small Wheel or SW) must be upgraded. The detector upgrade is also a necessary step to ensure better muon trigger and more precise tracking than the present scenario. As the primary precision tracker, the New Small Wheel (NSW) will include Micromegas, which is a fast detector with intrinsic spatial resolution of the order of 100 μm. The construction of NSW has already been started. The responsibility for the development of the small sectors (SM2) of the Micromegas quadruplets have been partially distributed in four German Universities of Freiburg, Mainz, Munich and Würzburg, which is supported by the BMBF. In this presentation we are giving a detailed report on the contribution from the Würzburg group to the next ATLAS upgrade.

T 40.4 Di 17:15 Z6 - SR 2.007

Entwicklung eines Controllers für das Detektor-Kontroll-System (DCS) des ATLAS Pixeldetektors — •Sebastian Scholz[1], Susanne Kersten[1], Niklaus Lehmann[1], Christian Zeitnitz[1], Rizwan Ahmad[2], Tobias Fröse[2], Michael Karagounis[2] und Alexander Walsemann[2] — [1]Bergische Universität Wuppertal — [2]FH Dortmund

Für das geplante Upgrade des LHC zum HL-LHC (High Luminosity Large Hadron Collider) ist als innerste Komponente ein neuer Pixeldetektor für das ATLAS Experiment geplant. Die einzelnen Pixelmodule sollen durch eine serielle Spannungsversorgung versorgt werden, welche durch bereits entwickelte DCS Chips überwacht werden wird. Zur Kommunikation mit diesen Chips wird aktuell ein Controller-Chip entwickelt, der bis zu 64 DCS Chips auslesen und steuern kann. Die Kommunikation des Controllers mit einem PC erfolgt über das CANopen-Standard. Es wird der aktuelle Entwicklungsstand des Controllers präsentiert.

T 40.5 Di 17:30 Z6 - SR 2.007

Serial powering implementation and Readout for the ATLAS ITk Outer Barrel Demonstrator — Matthias Hamer[1], •Florian Hinterkeuser[1], Fabian Huegging[1], Jens Janssen[1], Niklaus Lehmmann[2], Susanne Kersten[2], Susanne Kuehn[3], and Klaus Desch[1] — [1]Universität Bonn — [2]Universität Wuppertal — [3]CERN

The high luminosity upgrade for the Large Hadron Collider at CERN requires a complete overhaul of the ATLAS detector. The current tracking detector will be replaced by an all-silicon tracking detector, the ITk. It will occupy the same volume as the current ATLAS tracker and will cover a significantly larger phase space.

The new ITk pixel detector will consist of multichip modules produced in 65 nm CMOS technology. Due to the significantly higher number of modules and the increased power consumption of the new FE chips, a parallel powering scheme is not feasible, such that a serial powering scheme will be implemented. In this scheme, modules are powered in series and supplied by a constant current source, reducing the amount of service cables needed to power the detector.

While the concept of serial powering has already been proven, a prototype for the ITk Pixel Outer Barrel with a representative support structure, services and number of modules per serial powering chain is currently being assembled at CERN. This talk will present an overview of the implementation of the serial powering scheme as well as the commissioning of that demonstrator using a USBPix based readout system.

T 40.6 Di 17:45 Z6 - SR 2.007

CLAWS in the SuperKEKB commissioning Phase 2: Monitoring of Beam Backgrounds — •Daniel Heuchel, Miroslav Gabriel, Hendrik Windel, Naomi van der Kolk, and Frank Simon — Max Planck Institute for Physics

The SuperKEKB accelerator in Tsukuba, Japan, is currently undergoing an extensive commissioning campaign, split in three phases. During the second phase, which started in September 2017, the vertex detector of Belle II will be replaced by a detector system called Beam Exorcism for a Stable ExperimenT II (BEAST II), specifically designed to measure background rates at the interaction point (IP) for different operation parameters of the accelerator.

One of the subsystems of this commissioning detector are the sCintillation Light And Waveform Sensors (CLAWS), consisting of two ladders with 8 scintillator tiles, each individually read out by a silicon photomultiplier. CLAWS is specifically designed to study the time evolution of background originating from the continuous top-off injection of the accelerator. Thus, the system features sub-ns time resolution combined with continuous sampling over millisecond time scales. In this contribution, we will present the design of the CLAWS phase 2 ladders, discuss the basic performance of the detector elements and present results from the commissioning in the laboratory and in a test beam at DESY. Furthermore, the integration into BEAST II and results from first data acquisition runs, scheduled for February 2018, will be discussed.

T 40.7 Di 18:00 Z6 - SR 2.007

Development of intelligent Photomultipliers — Florian Kiel, •Jochen Steinmann, and Achim Stahl — III. Physikalisches Institut B, RWTH Aachen University

For the next generation of large neutrino detectors, for example JUNO, a novel concept for the readout of the Photomultiplier-Tubes has been developed. The idea is to build an intelligent PMT, which has all neccessary electronics mounted at the back of the PMT. This electronics is able to digitise and analyse the measured data, using the VULCAN-ASIC designed by the FZ-Jülich and an FPGA. Due to the high computing power of the selected FPGA the electronics is even able to do a low level waveform reconstruction. Based on the analysed data, the operational parameters of the PMT, e.g. applied voltage, can be regulated autonomous. Since the PMT will be connected via digital signals only, the performance does not decrease with long analog cables. This concept can be easily adapted from the laboratory to any size of detector. A first demonstration will be done using a 20" Hamamatsu PMT. In this contribution the concept and the road to the first prototype will be presented.

T 40.8 Di 18:15 Z6 - SR 2.007

Building a Tracking Detector for the P2 Experiment — •Marco Zimmermann for the P2-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University, Mainz — PRISMA Cluster of Excellence

The P2 Experiment aims to measure the weak mixing angle at low Q^2 via the parity violating asymmetry in elastic electron-proton scattering. It will be located at the new Mainz Energy Recovery Superconducting Accelerator (MESA), which will provide a 150 μA beam of alternatingly polarized 145 MeV electrons.

While the main asymmetry measurement is performed with integrating Cherenkov detectors, the tracking system is developed in order to determine the momentum transfer in the target and for systematic studies. The high signal and background particle rates are the main challenge, in particular because of bremsstrahlung photons produced in the liquid hydrogen target. The particle rates are analysed in a Geant4-based Monte Carlo simulation. Measurements of the sensor response to photons were performed and compared to the simulation.

The detector will be built using High Voltage Monolithic Active Pixel Sensors (HV-MAPS) made of silicon thinned to 50 μm. Four tracking planes will be arranged as two double layers. For each double layer, four modules are built to cover together about one sixth of azimuthal space. Every module consists of about 600 sensors, of which each has 2x2cm^2 area and an expected power consumption of about 1W. The main mechanical setup of one module will be shown together with simulations of the gaseous helium cooling system.

T 40.9 Di 18:30 Z6 - SR 2.007

FANGS: Radiation monitoring during the commissioning phase of the Belle II detector — •Patrick Ahlburg, Jochen Dingfelder, Andreas Eyring, Jens Janssen, Hans Krüger, Carlos Marinas, David-Leon Pohl, and Norbert Wermes — University of Bonn

The SuperKEKB accelerator has been upgraded with the goal of an instantaneous luminosity 40 times higher compared to KEKB. Before the installation of the Belle II vertex detector in 2018, the BEAST II experiment has been developed for the study of machine induced backgrounds during the commissioning phase of the SuperKEKB accelerator. The experiment will measure the expected radiation for the components of the inner detectors and support the tuning of the accelerator beam optics and collimator system.

The FANGS (FE-I4 ATLAS Near Gamma Sensors) detector is part

of the BEAST II experiment and with its hybrid pixel sensors from the ATLAS IBL modules sensitive to low keV X-rays and high particle rates. The scope of this talk revolves around the production of the FANGS detector, the final performance tests and the recent installation in the BEAST II experiment in November 2017.

T 40.10 Di 18:45 Z6 - SR 2.007

Charakterisierung großflächiger Silizium-Photomultiplier für den Einsatz im SHiP-Experiment — •Julian Schliwinski für die SHiP LScin SBT-Kollaboration — HU Berlin, Berlin, Deutschland

SHiP ist ein Vorschlag, mit einem Beamdump-Experiment am CERN SPS-Beschleunigerkomplex nach sehr schwach wechselwirkenden, neutralen Teilchen im Massenbereich von 0,1 GeV - 10 GeV zu suchen. Hadronen aus den Proton-Proton-Kollisionen werden absorbiert und Myonen durch ein Magnetsystem ausgelenkt, so dass neben Neutrinos nur noch andere neutrale Teilchen in einem etwa 50m langen Volumen vorhanden sind und in diesem zerfallen können. Dieses Zerfallsvolumen soll mit Flüssigszintillator umgeben sein (Surrounding Background Tagger = SBT), um Untergrund unterdrücken zu können. Die Szintillationsphotonen sollen mit sogenannten Wavelength Shifting Optical Modules (WOMs), die an Photosensoren angekoppelt werden, nachgewiesen werden. Der mögliche Einsatz von Silizium-Photomultiplier (SiPMs) als Photosensoren im SBT ist Gegenstand aktueller Untersuchungen.

Im Vortrag wird die Analyse von Ladungsintegrationsspektren unterschiedlicher SiPMs und die resultierenden, charakteristischen Parameter vorgestellt und diskutiert.

T 41: Halbleiterdetektoren / Strahlenhärte I

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 2.010

T 41.1 Di 16:30 Z6 - SR 2.010

Direct Measurement of Optical Cross-Talk in SiPMs Using Light Emission Microscopy — •Derek Strom, Razmik Mirzoyan, and Jürgen Besenrieder — Max-Planck-Institut für Physik, München

Silicon Photomultipliers (SiPMs) are attractive light detectors for high energy and astroparticle physics experiments. They are compact in size, have fast (few ns) response time, operate at lower voltage compared to classical photomultiplier tubes, are insensitive to magnetic fields, and offer photon detection efficiencies of $> 40\%$. The optical cross-talk effect, whereby light emitted during the initial avalanche breakdown process may be absorbed by neighboring cells causing additional breakdowns, can degrade the measurement sensitivity of SiPMs. We describe ongoing work at the Max Planck Institute for Physics in Munich where we constructed a light emission microscopy setup to directly measure the emission due to optical cross-talk in SiPMs. We present an overview of our setup and measurements performed.

T 41.2 Di 16:45 Z6 - SR 2.010

Direct temperature measurement of SiPMs via IV diode characteristics — •Naomi Vogel, Michael Wagenpfeil, Sebastian Schmidt, Tobias Ziegler, and Thilo Michel — Erlangen Centre for Astroparticle Physics (ECAP), Friedrich-Alexander-Universität Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen

Silicon photomultipliers (SiPMs) are semiconductor photo-detectors with single-photon resolution consisting of a pixel matrix of single avalanche photodiodes operated in Geiger-mode. Several characteristic parameters of the detector, e.g. the breakdown voltage, are temperature-dependent. Therefore, knowing the precise temperature at which a SiPM is operated is crucial for all characterization efforts. We present a method using a SiPM as a thermometer by deriving its temperature directly from the diode IV-characteristics which need to be calibrated in advance in a climate chamber under controlled ambient conditions.

T 41.3 Di 17:00 Z6 - SR 2.010

Characterization of SiPMs after radiation damage — •Sara Cerioli, Erika Garutti, Robert Klanner, David Lomidze, Joern Schwandt, and Milan Zvolsky — University of Hamburg, Hamburg, Germany

Silicon PhotoMultipliers (SiPMs) are light detectors with sensitivity to single photons. Thanks to their excellent performance (high gain and low noise), their robustness and insensitivity to magnetic fields, they find many applications in high energy physics experiments and many other fields. For applications in collider experiments one of the major limitation is due to radiation damage.

This talk present characterization procedures for SiPMs irradiated with reactor neutrons to fluences up to 10^{14} cm^{-2}. The measurements are performed in a controlled climate chamber, which can reach a temperature of 50° C. Blue pulsed laser light is used to illuminate the SiPM and the waveform recorded using a 2.5 GHz oscilloscope to investigate the signal response and the gain.

The increase of dark count rate and noise, and the decrease of signal of the irradiated SiPMs, as a function of the fluence, operational temperature and voltage are determined, and compared with results obtained by an analysis of the current-voltage characteristics of the same SiPMs. Moreover, it has been made also a detailed simulation of the SiPM, allowing a further comparison and comprehension of the results.

T 41.4 Di 17:15 Z6 - SR 2.010

Annealingverhalten von bestrahlten p-Typ Streifendetektoren — •Leena Diehl, Riccardo Mori, Ines Messmer, Marc Hauser, Ulrich Parzefall und Karl Jakobs — Universität Freiburg

Hochenergetische Teilchen verursachen Schäden in Siliziumdetektoren, was zu Defektbildung und dadurch zu einer steigenden effektiven Dotierungskonzentration in p-Typ Detektoren führt. Dies resultiert einerseits in schlechterem Ladungstransport und Ladungssammlung und andererseits in einer steigenden Verarmungsspannung und einem größerem Leckstrom. Die entstandenen Gitterdefekte sind beweglich, wobei die Beweglichkeit stark von der Temperatur abhängig ist.

In diesem Vortrag werden Langzeitstudien zu verschiedenen Schadensparametern in Abhängigkeit der Ausheilungszeit bei Raumtemperatur und 60° C in p-Typ Streifendetektoren, die mit bis zu $3e14\frac{n_{eq}}{cm^2}$ bestrahlt wurden, präsentiert. Die Messungen beinhalten das Verhalten der Ladungssammlung, des Leckstrom und der effektiven Dotierungskonzentration sowie den Vergleich der Parameter bei den unterschiedlichen Temperaturen. Insbesondere liegt der Fokus auf der Suche nach Erklärungen zu stark abweichenden Werten von vorherig bekannten Werten in ähnlichen Sensoren.

T 41.5 Di 17:30 Z6 - SR 2.010

Labormessungen von bestrahlten und unbestrahlten Reinerstrukturen — Silke Altenheiner[1], Sascha Dungs[1,2], Andreas Gisen[1], Claus Gössling[1], Valerie Hohm[1], Reiner Klingenberg[1], Kevin Kröninger[1], •Anna-Katharina Raytarowski[1] und Mareike Weers[1] — [1]TU Dortmund, Lehrstuhl für Experimentelle Physik IV — [2]CERN

Aufgrund der erhöhten Luminosität des High Luminosity LHC wird ein neuer Spurdetektor, der sogenannte Inner Tracker (ITk), für das ATLAS-Experiment benötigt.

Der aktuelle Spurdetektor besteht unter anderem aus planaren n^+-in-n-Silizium-Pixelsensoren. Für eine mögliche Effizienzsteigerung beim Nachweis von Teilchen wurden verschiedene Pixelimplantationen entwickelt und auf Testsensoren angeordnet. Diese werden als Reinerstrukturen bezeichnet.

Mit Protonen bzw. Neutronen bestrahlte sowie unbestrahlte Reinerstrukturen wurden mit IV- , CV- und Quellenmessungen untersucht.

In diesem Vortrag werden die Ergebnisse dieser Messungen vorgestellt.

T 41.6 Di 17:45 Z6 - SR 2.010

The GeMSE Low-Background Facility for Meteorite and Material Screening — •Diego Ramírez García — Albert-Ludwigs-Universität Freiburg, Freiburg im Breisgau, Germany

Low-background gamma-ray spectrometry is a widely used method in different scientific disciplines. It serves for, e.g., the assessment of the radiopurity of materials for rare event search experiments, while in the field of Geology it is crucial to characterize meteorite samples. GeMSE (Germanium Material and meteorite Screening Experiment) is an interdisciplinary project addressing both of these topics. Using a p-type high-purity germanium (HPGe) detector installed in the Vue-des-Alpes

underground laboratory ($\sim$ 620 m.w.e. depth), the GeMSE facility features several layers of shielding, a permanent N_2-flushing in a closed glove-box and an active muon veto. As a result, the background levels are highly competitive: $<$ 240 counts/day in the 100 - 2700 keV energy range.
GeMSE is ideally suited for the ongoing material selection campaign for the upcoming XENONnT dark matter detector. This talk will describe the facility, the calibration methods and the data analysis, and will present some results of recently measured samples.

T 41.7 Di 18:00 Z6 - SR 2.010

Shallow angle measurements on prototypes for the CMS Phase II pixel sensors — •Caroline Niemeyer[1], Aliakbar Ebrahimi[1], Finn Feindt[1], Erika Garutti[1], Daniel Pitzl[2], Jörn Schwandt[1], Georg Steinbrück[1], and Irene Zoi[1] — [1]Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Notkestraße 85, D-22607 Hamburg

For the High-Luminosity LHC the irradiation level that the detectors will have to withstand will be reaching a 1 MeV neutron equivalent fluence of 2.3×10^{16} neq/cm^2 and a total ionizing dose of 10 MGy at the innermost part of the CMS pixel detector. The upgraded Phase-2 Inner Tracker is designed to maintain or improve the tracking and vertexing capabilities under these high pileup and radiation conditions. Various pixel sensor designs with pixel sizes of 50×50 μm^2 and 100×25 μm^2 have been manufactured on silicon wavers with an active thickness of 150 μm. They have been bump bonded to ROC4Sens read-out chips and are evaluated at the DESY test beam facilities. The shallow angle method is used to measure the depletion depth and the charge collection efficiency as a function of the distance from the readout pixels. The edge-on method, in which the beam transverses the sensor parallel to its surface, allows for in-silicon tracking and thus to obtain the intrinsic position resolution of the silicon sensors and to study the influence of δ-electrons on the position resolution without using an external reference tracking detector. The results of these measurement methods for the new pixel sensor designs will be presented.

T 41.8 Di 18:15 Z6 - SR 2.010

Modulbauentwicklung für das Phase-II-Upgrade des äußeren CMS-Spurdetektors — Tobias Barvich, Alexander Dierlamm, Ulrich Husemann, •Stefan Maier und Marius Neufeld — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Für den äußeren Bereich des zukünftigen CMS-Spurdetektors werden im Rahmen des Phase-II-Upgrades sowohl Siliziumpixel-, als auch -streifensensoren in Detektormodulen eingesetzt. Diese Module bestehen aus zwei dicht übereinander liegenden Sensoren und sind damit in der Lage Teilchen mit hohem Transversalimpuls bereits im Auslesechip zu identifizieren. Dies ist Startpunkt für einen neuartigen spurbasierten Trigger, mit dem interessante Ereignisse angereichert werden können.

Dieses Konzept erfordert eine präzise Positionierung der Sensoren sowie eine verlässliche Qualitätskontrolle während des Modulbaus. Der Vortrag gibt eine Übersicht über die einzelnen Montageschritte sowie Qualitätskontrollen während dieser Fertigung anhand von Prototypen. Es werden die Klebeschritte mit einer halb-automatisierten Auftragestation sowie eine optische und lasergestützte Vermessung der relativen Sensorpositionen innerhalb eines Moduls näher erläutert.

T 41.9 Di 18:30 Z6 - SR 2.010

Enhanced lateral drift sensors: concept and development — •Anastasiia Velyka and Hendrik Jansen — DESY, Hamburg

Future experiments in particle physics require few-micrometer position resolution in their tracking detectors. Silicon is today's material of choice for high-precision detectors and offers a high grade of engineering possibilities. Instead of scaling down pitch sizes, which comes at a high price for increased number of channels, our new sensor concept seeks to improve the position resolution by increasing the lateral size of the charge distribution already during the drift in the sensor material. To this end, it is necessary to carefully engineer the electric field in the bulk of this so-called enhanced lateral drift (ELAD) sensor. This is achieved by implants with different values of doping concentration deep inside the bulk which allows for modification of the drift path of the charge carriers in the sensor.

In order to find an optimal sensor design, detailed simulation studies have been conducted using SYNOPSYS TCAD. Process simulations are used to provide the production-determined shapes of the implants in order to allow for a realistic modelling.

Results of a geometry optimisation are shown realising an optimal charge sharing and hence position resolution. A position resolution of a few micrometer is expected by using deep implants without relying on a Lorentz drift or tilted incident angle. Additionally, a description of the multi-layer production process is presented, which represents a new production technique allowing for deep bulk engineering.

T 41.10 Di 18:45 Z6 - SR 2.010

Optimization of bias rail implementations for segmented silicon sensors — Marta Baselga, Alexander Dierlamm, Thomas Müller und •Daniel Schell — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Bias rails are fundamental design features of segmented strip as well as pixelated silicon sensors that are necessary to distribute the ground potential from the bias ring to the implants. However, adding these rails is usually accompanied with a certain degree of efficiency loss and modification of the electric field which could result in an early breakdown of the sensor.

TCAD simulations provide a deeper insight into the process of how the electric field evolves and how charge is collected. By simulating various sensor layouts with different parameter settings an optimized design can be obtained.

This contribution summarizes an extensive simulation study looking for an optimal set of design parameters to maximize the breakdown voltage and the charge collection efficiency of the sensor. The results are complemented by measurements performed at the DESY test beam facility in Hamburg, Germany.

T 42: Top-Quarks: Produktion I

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 2.011

T 42.1 Di 16:30 Z6 - SR 2.011

Suche nach der Einzel-Top-Quark-Produktion im s-Kanal bei einer Schwerpunktsenergie von 13 TeV mit dem CMS-Experiment — Thorsten Chwalek, Nils Faltermann, •Denise Müller, Thomas Müller, Genti Saliu und Fabian Schenkel — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Die Produktion einzelner Top-Quarks erfolgt, im Gegensatz zur Top-Quark-Paarproduktion, über die elektroschwache Wechselwirkung. Daher ist dieser Prozess sensitiv auf mögliche Abweichungen im elektroschwachen Sektor des Standardmodells. Eine besondere Herausforderung stellt hierbei die Produktion über den s-Kanal dar. Dieser Produktionsmodus ist zwar theoretisch exakt beschrieben, weist jedoch nur einen geringen Anteil an der gesamten Produktion einzelner Top-Quarks auf. Dies erfordert eine gute Trennung zwischen Signal- und Untergrundereignissen.

Dieser Vortrag beschreibt die Suche nach der Einzel-Top-Quark-Produktion im s-Kanal unter Verwendung der 2016 bei einer Schwerpunktsenergie von 13 TeV gemessenen Daten des CMS-Experiments.

T 42.2 Di 16:45 Z6 - SR 2.011

Search for single top quark production in association with a W and a Z boson in the 3ℓ channel with the ATLAS experiment at 13 TeV — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], Carlo A. Gottardo[1], Sebastian Heer[1], Vadim Kostyukhin[1], •Ö. Oğul Öncel[1,2], Arshia Ruina[1], and Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

Production of tWZ in pp collisions is a rare process predicted by the Standard Model with an expected cross section of less than 0.01 pb. As it has not been measured yet, it is one of the current research frontiers in top-quark physics. The tWZ is also important in other top-quark related measurements: for example in $t\bar{t}Z$ production, as an important background. A better understanding of this process will contribute to

the improvement of other measurements as well.

A search for this process in the 3ℓ-channel using ATLAS data collected at the LHC during 2015 & 2016 with 36.1 fb^{-1} integrated luminosity and at a center-of-mass energy of 13 TeV is presented. The main challenges are the small cross section and the irreducible background contaminations from the WZ and $t\bar{t}Z$ processes. This talk will present the current progress in addressing those challenges, particularly with the help of multivariate techniques.

T 42.3 Di 17:00 Z6 - SR 2.011

Messung des Wirkungsquerschnittes der Einzel-Top-Quark-Produktion im t-Kanal bei 13 TeV mit dem CMS-Experiment — Thorsten Chwalek, Nils Faltermann, Thomas Müller, •Philipp Ott und Tim Pambor — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Mit Hilfe des Datensatzes, der bislang in Run II am LHC aufgezeichnet wurde, können Präzisionsmessungen der Eigenschaften der Einzel-Top-Quark-Produktion durchgeführt werden. Anschließend können diese zur Validierung der Vorhersagen des Standardmodells der Teilchenphysik verwendet werden. Im Gegensatz zur Top-Quark-Paarerzeugung findet die Produktion einzelner Top-Quarks über den Austausch geladener Ströme in elektroschwachen Wechselwirkungen statt. Sie ist daher seltener, aber sensitiv auf die direkte Kopplung zwischen Top-Quark, W-Boson und Bottom-Quark. Der t-Kanal-Prozess stellt den dominanten Produktionsmechanismus für Einzel-Top-Quarks dar. In einem multivariaten Verfahren werden Signal- und Untergrundereignisse klassifiziert und anschließend der Wirkungsquerschnitt der Einzel-Top-Quark-Produktion im t-Kanal bestimmt.

In diesem Vortrag wird die oben beschriebene Messung des Wirkungsquerschnittes anhand der im Jahr 2016 bei 13 TeV mit dem CMS-Experiment gemessenen Daten vorgestellt.

T 42.4 Di 17:15 Z6 - SR 2.011

Anwendung der Matrixelement-Methode zur Messung des Wirkungsquerschnittes für die Produktion einzelner Top-Quarks im s-Kanal bei einer Schwerpunktsenergie von 13 TeV mit dem ATLAS-Detektor — •Stephan Kaphle — Humboldt-Universität zu Berlin

Für die Untersuchung des Standardmodells und möglicher Erweiterungen spielt die Produktion einzelner Top-Quarks in elektroschwachen Prozessen (Single-Top) eine wichtige Rolle. Die Single-Top-Produktion findet in drei Kanälen statt: t-Kanal, s-Kanal und assoziierter Produktion von W-Bosonen. In pp-Streuung am Large Hadron Collider (LHC) besitzt der s-Kanal den kleinsten Produktionsquerschnitt und wird von vielen Untergrundprozessen überlagert. Mit der Matrixelement-Methode konnte der s-Kanal in einer Untersuchung der Daten des ATLAS-Experiment am LHC während der Laufzeit mit einer Schwerpunktsenergie von 8 TeV bei einer integrierten Luminosität von 21 fb^{-1} mit einer Signifikanz von $3{,}2\sigma$ nachgewiesen werden. Die Matrixelement-Methode berechnet eine Diskrimante für ein Ereignis unter Verwendung des Matrixelementes für den Signal- und die dominanten Untergrundprozesse. Dadurch wird eine gute Trennung von Signal- und Untergrundereignissenund ermöglicht. Die aktuelle hier vorzustellende Analyse wendet die gleiche Methode auf aktuelle Daten mit einer Schwerpunktsenergie von 13 TeV an, um von der höheren Luminosität von derzeit bis zu 93 fb^{-1} zu profitieren. Es wird der aktuelle Stand der Analyse präsentiert.

T 42.5 Di 17:30 Z6 - SR 2.011

Studies for the search for flavor-changing neutral currents in single-top quark production processes in association with a photon at the ATLAS experiment — •Gregor Gessner, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Flavor-changing neutral currents (FCNC) are highly suppressed by the GIM mechanism within the Standard Model (SM). It is speculated that the top quark may play a key role in the search for deviations from the SM prediction since its mass is close to the electroweak symmetry breaking scale. In several models for physics beyond the SM, the cross section of processes including top quarks and FCNC may be larger by several orders of magnitude than expected in the SM.
Studies will be presented for the search of processes in which top quarks are produced in association with a photon via a flavor-changing neutral interaction ($qg \to t\gamma$ with $q = u, c$). The studies are performed using data recorded at the ATLAS experiment at the LHC at $\sqrt{s}$=13 TeV.

T 42.6 Di 17:45 Z6 - SR 2.011

Single top production in association with a Z boson with ATLAS — •Marius Blaut and Jan C. Brock — Physikalisches Institut, University of Bonn

Evidence of the electroweak process in which a Z boson is radiated in t-channel single top-quark production (tZq channel) was first reported by the ATLAS collaboration after analyzing 13 TeV data collected in 2015 and 2016. The analysis, which was performed in the trilepton final state, is extended by adding data collected in 2017.

The trilepton decay topology of this process is characterised by one jet originating from a b quark, three charged leptons with high transverse momentum (including an opposite sign, same flavour pair from the Z boson) and one light-quark jet that tends to be in the forward direction and missing transverse momentum.

The main sources of background are diboson and $t\bar{t}Z$ production, as well Z+jets and $t\bar{t}$ events with a lepton which is fake or non-prompt. The data-driven technique used to estimate the non-prompt and fake lepton background will be presented along with the preliminary results of this analysis.

T 42.7 Di 18:00 Z6 - SR 2.011

Measurement of the Single Top tW Inclusive Cross Section in the Single Lepton Final State at 13 TeV with ATLAS — Ian C. Brock and •Federico G. Diaz Capriles — Physikalishes Institut, University of Bonn

Single top-quark production in association with a W boson (known as the tW channel) can be measured in the ATLAS detector at the Large Hadron Collider. In general, single top-quark cross-section measurements allow for a precise test of Standard Model physics and can aid in the discovery of new physics (i.e. FCNC, anomalous couplings, ...). The tW channel has the second largest cross-section of the three main single top production processes at the LHC and it is sensitive to different new physics from that of the s- and t-channels. In this work, tW production is studied in the lepton plus jets channel by selecting events with three jets, one lepton and some amount of missing transverse momentum. Separation of signal and background events is performed by a neural network trained on Monte Carlo samples. This training helps identify the tW signal from its more prominent backgrounds, top-quark pair production and W plus jets events, which share similar signatures but have much greater cross-sections. Lastly, a likelihood fit is used to extract the signal cross-section.

T 42.8 Di 18:15 Z6 - SR 2.011

Search for FCNC in strong interactions with the ATLAS detector — •Gunnar Jäkel, Wolfgang Wagner, and Dominic Hirschbühl — Bergische Universität Wuppertal

Flavor changing neutral currents (FCNC) are forbidden at tree level and highly suppressed at higher orders in the standard model. In some new physics models leading order contributions could enhance cross sections for FCNC processes by many orders of magnitude. A search for direct top quark production is presented. In this process a u(c)-quark interacts with a gluon and produces a top quark. Different cuts and neural networks are studied to increase the sensitivity of the search.

T 42.9 Di 18:30 Z6 - SR 2.011

Feasibility Studies on the Measurement of Boosted Single Top Quark Production with the CMS Experiment — •Christopher Matthies, Roman Kogler, and Johannes Haller — Institut für Experimentalphysik, Universität Hamburg

Due to its unique properties, the top quark plays a key role in the search for physics beyond the Standard Model. Besides just being the heaviest elementary particle, its mean life time is significantly smaller than the usual time scale of hadronization processes. Thus, it can be surveyed as an isolated quark, allowing unique experimental studies.

At the LHC, only measurements of inclusive single top production cross sections have been performed so far. In this work, feasibility studies of measurements with highly boosted top quarks, with high transverse momentum, from single top quark production are presented. These processes provide stringent tests of the Standard Model predictions in the top sector and play an important role in searches for new physics with boosted top quarks in the final state. Additionally, such a measurement could help to constrain new physics models which predict particles with large couplings to top quarks.

T 42.10 Di 18:45 Z6 - SR 2.011

Studies on the four-tops production process with the ATLAS detector — Clara Nellist, Thomas Peiffer, Arnulf Quadt,

•Paolo Sabatini, and Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

The Large Hadron Collider (LHC) at CERN is a proton-proton collider that has provided, in the last three years, an exceptional integrated luminosity of about 80 fb^{-1} at $\sqrt{s} = 13$ TeV. This large dataset pushes the hosted experiment towards more and more challenging analyses, aimed at the measurement of ultra-rare processes. One of those is certainly the process of four top quarks production.

The four-top production process, having a Standard Model (SM) cross-section of $\sigma_{t\bar{t}t\bar{t}} \approx 9$ fb, has a particular role in many Beyond-the-Standard-Model theories that predict particles much heavier than the top quark, which are then able to decay into a single or a pair of tops. A precise measurement of this cross-section represents not only a strong test for the SM predictions, but also an opportunity for the detection of new physics signals. A feature of this process is a strong hadronic environment, resulting in a large number of jets in the final state, many of which are b-jets. Consequently, this makes a precision measurement very challenging.

In this talk an overview over the main features of the analysis as well as detailed discussions on the features of the process are given.

T 43: Neutrinophysik II

Zeit: Dienstag 16:30–18:40 Raum: Z6 - SR 2.012

Gruppenbericht T 43.1 Di 16:30 Z6 - SR 2.012

The Large Enriched Germanium Experiment for Neutrinoless double beta Decay - LEGEND — •Yoann Kermaidic — Max Planck Institute fur Kernphysik, Heidelberg

The search for neutrinoless double beta ($0\nu\beta\beta$) decay is a very sensitive tool for probing whether neutrinos are Dirac or Majorana particles. A potential discovery has far reaching consequences for particle physics and cosmology (leptogenesis). Current ^{76}Ge based experiments, Gerda and Majorana Demonstrator, benefit from a superior energy resolution and the lowest background at $Q_{\beta\beta}$ in the field if normalized by the resolution. This demonstrates the feasibility of Germanium for a next generation experiment. The Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) collaboration has been founded with the goal to build a ton scale experiment and boost the $0\nu\beta\beta$ decay half-life sensitivity by two orders of magnitude. The collaboration envisions a phased approach based on the Gerda and Majorana Demonstrator experience, starting with existing resources as appropriate to expedite physics results. This talk will present the general aspect of Legend and focus on the ongoing developments for the first 200 kg phase using the Gerda cryostat at LNGS underground laboratory in Italy.

T 43.2 Di 16:50 Z6 - SR 2.012

Towards the Development of Highly Integrated Low-mass Signal Readout Electronics for Germanium Detectors — •Frank Edzards — Max Planck Institute for Physics, Munich, Germany

The LEGEND experiment is a future large-scale experiment that will search for the neutrinoless double beta decay ($0\nu\beta\beta$) in the isotope ^{76}Ge using high purity germanium detectors. Its observation would decisively proof that neutrinos are their own antiparticles, reveal that the conservation of the lepton number is violated and provide information on the neutrino mass.

This talk focuses on the signal readout which is one of the most important components of a $0\nu\beta\beta$ experiment since it facilitates the conversion of charges produced within the detectors into appropriately shaped voltage signals. Current $0\nu\beta\beta$ experiments such as GERDA and Majorana Demonstrator use a *discrete signal readout solution* consisting of a JFET amplifier, an RC-circuit and a preamplifier. We are developing a highly integrated low-mass signal amplifier based on state-of-the-art *application specific integrated circuit* (ASIC) technology which allows for the combination of all relevant components in a single low-mass chip.

This work is supported by the Max Planck society and the DFG SFB 1258 ("Neutrinos and Dark Matter in Astro- and Particle Physics").

Gruppenbericht T 43.3 Di 17:05 Z6 - SR 2.012

Status and prospects of the COBRA experiment — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

The COBRA experiment is dedicated to the search for the hypothesized neutrinoless double beta-decay ($0\nu\beta\beta$-decay). The observation of this lepton number violating process would prove the Majorana nature of neutrinos and shed first light on physics beyond the established Standard Model. The COBRA collaboration is currently operating a demonstrator array of 4×4×4 monolithic crystals at the underground facility LNGS (Italy). The detectors are made of CdZnTe, which is a commercially available semiconductor at room temperature. In 2018 a new detector module will be implemented to establish the COBRA extended demonstrator (COBRA XDEM). For this a new prototype of CdZnTe detectors with advanced veto capabilities has been developed and approved. In the transition phase the existing COBRA demonstrator was optimized for low-threshold operation to investigate the fourfold forbidden non-unique β-decay of ^{113}Cd. The spectral shape of the electron momentum distribution of this highly forbidden decay is sensitive to the effective value of the axial vector coupling strength g_A in a nuclear medium. Such experimental input is urgently needed in the scientific discussion of quenching effects that might affect the half-life predictions for the $0\nu\beta\beta$-decay. This talk will present the status of COBRA XDEM, the current and improved detector technology as well as the status of the recent physics analysis.

COBRA is funded by the German Research Foundation DFG.

T 43.4 Di 17:25 Z6 - SR 2.012

Selection criteria for $2\nu2\beta$-decay measurements with the COBRA experiment — •Julia Küttler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

The COBRA collaboration searches for the neutrinoless double beta-decay ($0\nu2\beta$-decay). This process is forbidden in the Standard Model of particle physics due to the lepton-number violation. Currently a demonstrator setup using coplanar-grid CdZnTe detectors is operated at the underground facility LNGS in Italy. The setup consists of 64 detectors, each with a volume of 1 cm^3, arranged in four layers of 4×4 detectors. The CdZnTe semiconductor crystals contain nine double-β isotopes with several possible decay modes. The main focus is on ^{116}Cd due to its high Q-value of 2813 keV. Besides the effort to search for the $0\nu2\beta$-decay the $2\nu2\beta$-spectrum of the normal double-decay should be measured to confirm half-life measurements of other groups. The most promising $2\nu2\beta$-decays are coming from ^{116}Cd and ^{130}Te which have not been measured yet by the COBRA experiment itself.

This talk will focus on different selection criteria with the aim to identify run periods and detectors with a high background index. Such a data partitioning will improve the background understanding since one data sample will be background enriched while the other results in a cleaner spectrum. Combining both information will be beneficial for the intended $2\nu2\beta$-decay analysis of ^{116}Cd with the COBRA demonstrator.

T 43.5 Di 17:40 Z6 - SR 2.012

Investigation of EC/β^+-decays with the COBRA experiment — •Juliane Volkmer for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

This talk's topic will be the investigation of double beta-decay modes with the COBRA experiment and focus on EC/β^+-decays. In contrast to $\beta^-\beta^-$-decays, $\beta^+\beta^+$-decay modes have not been observed yet, mainly due to their relatively small Q-values coupled with an extremely long half-life. Also, if the emission of two positrons is energetically possible, three different decay modes have to be dealt with: $\beta^+\beta^+$, EC/β^+ and EC/EC. Having a lower half-life than $\beta^+\beta^+$-events and creating a more characteristic signature than EC/EC-events, EC/β^+-decays are the most promising of those to be detected. Measuring the half-life of 2νEC/β^+-events would help to probe models used to calculate nuclear matrix elements. By constraining the model parameters with such ex-

perimental input it is possible to improve the half-life predictions for the standard neutrinoless double beta-decay. $0\nu EC/\beta^+$-events on the other hand are especially sensitive to the involvement of right-handed currents in the decay mechanism, thus, could help to gain a deeper understanding of the general physics involved. The COBRA demonstrator, consisting of $4 \times 4 \times 4$ crystals of the semiconductor CdZnTe, provides three different isotopes capable of EC/β^+-decays. Additionally, the experiment's granularity greatly improves the probability to recognize the events' characteristic decay structures. First investigations of the feasibility, the characteristic decay signature in the COBRA demonstrator and background discrimination will be presented.

T 43.6 Di 17:55 Z6 - SR 2.012

Status of the XDEM-Phase for the COBRA-Experiment — •Lucas Bodenstein-Dresler for the COBRA-Collaboration — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4, 44227 Dortmund

The COBRA collaboration searches for neutrinoless double beta-decay. If this decay would be detected, it would proof that the neutrino is a Majorana particle.
The COBRA demonstrator is located at the Gran Sasso underground laboratory in Italy with a $4 \times 4 \times 4$ array of $1\,cm^3$ CdZnTe detectors. In the beginning of 2018, the setup will be upgraded with an extended demonstrator (XDEM). XDEM comprises of a new layer of nine CdZnTe detectors with $(2 \times 2 \times 1{,}5)\,cm^3$ installed on top of the current inner housing. The goal of XDEM is to show that large-volume CdZnTe detectors can be used in low-background applications.
This talk will present the preparation of XDEM and the current status of the experiment. This includes the design of a new detector-holder and a new cable management. Furthermore, a guideway for the calibration sources has been realised. For the read-out electronics a new preamplifier box was built and tested.

T 43.7 Di 18:10 Z6 - SR 2.012

Detector Evaluation for the COBRA XDEM — •Robert Temminghoff for the COBRA-Collaboration — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4, 44227 Dortmund

The COBRA experiment is designed with the goal to search for neutrinoless double beta-decay, a long sought-after process whose existence could hint at physics beyond the Standard Model. In the ongoing demonstrator phase of the experiment 64 CdZnTe detectors with a volume of $1\,cm^3$ each are operated in the LNGS underground laboratory in Italy.

The setup is currently being extended with an additional array of nine CdZnTe detectors with a volume of $6\,cm^3$ each (XDEM phase). These detectors will also feature an instrumented guard-ring electrode which is used to suppress surface related background contributions. Thereby the COBRA collaboration will improve the experiments background level and demonstrate the usage of large volume CdZnTe detectors for double beta-decay searches.

In this talk, results from the evaluation of the detectors used for the XDEM phase will be shown. In total ten detectors from two different manufacturers have been tested, of which the best nine will be installed at the LNGS. The evaluation includes a determination of the ideal working point as a function of the applied bulk- and grid-bias, measurements of the energy resolution and the efficiency as well as electrical tests.

T 43.8 Di 18:25 Z6 - SR 2.012

A measurement of the thermal neutron capture on gadolinium with the ANNRI spectrometer at J-PARC — Pretam Kumar Das[1], Rohit Dir[1], William Focillon[2], Michel Gonin[2], Kaito Hagiwara[1], Hideo Harada[3], Nobuyuki Iwamoto[3], Tsubasa Kayano[1], Atsushi Kimura[3], Yusuke Koshio[1], •Sebastian Lorenz[1,4], Takaaki Mori[1], Shoji Nakamura[3], Iwa Ou[1], Makoto Sakuda[1], Mandeep Singh Reen[1], Takashi Sudo[1], Michael Wurm[4], Tomoyuki Tanaka[1], Yoshiyuki Yamada[1], and Takatomi Yano[5] — [1]Okayama University, Japan — [2]École Polytechnique, France — [3]Japan Atomic Energy Agency — [4]Johannes Gutenberg-Universität Mainz, Germany — [5]Kobe University, Japan

Due to its high cross-section for thermal neutron capture and the succeeding emission of a γ cascade with a total energy of $\sim 8\,MeV$, gadolinium (Gd) is used in low-energy neutrino searches to increase the tagging efficiency for neutron capture signals from inverse beta decay reactions. Prominent examples are Daya Bay, Double Chooz and RENO, which use Gd-doped liquid scintillator. Since now also Super-Kamiokande plans to dissolve Gd in its water target, a precise modeling of the γ ray cascade from the Gd(n,γ) reaction is important to study neutron tagging efficiencies in MC simulations. However, existing MC frameworks do not reproduce the capture reaction in detail when compared to experimental outcomes. Using the ANNRI germanium spectrometer at J-PARC, the thermal neutron capture on enriched ^{157}Gd has been measured and the data are used to build a corresponding model. This talk presents results of the ANNRI-Gd experiment.

T 44: Experimentelle Methoden der Astroteilchenphysik II

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 2.013

T 44.1 Di 16:30 Z6 - SR 2.013

mDOM - a multi-PMT optical module for future upgrades of IceCube — •Lew Classen, Tabea Eder, Daniel Guderian, Alexander Kappes, Cristian Lozano, Florian Sprenger, Florian Trittmaack, and Martin Unland for the IceCube-Collaboration — Institut für Kernphysik, Westphälische Wilhelms-Universität Münster

Following the discovery of a high-energy astrophysical neutrino flux by IceCube research and development for a next-generation neutrino observatory in Antarctica is under way. A significant relative enhancement in sensitivity for the envisionend detector is expected from novel optical sensors. Among the most promising new designs is the so-called mDOM, a multi-PMT Digital Optical Moule. Optical modules based on this concept feature an array of several small photomultipliers (PMTs) housed inside a transparent pressure vessel, resulting in several advantages with respect to the conventional single-PMT design, such as a larger sensitive area, a uniform solid angle coverage as well as enhaced intrinsic directional senisitivity. The contribution will introduce the sensor concept and provide an overview of the current status of development of the device.

T 44.2 Di 16:45 Z6 - SR 2.013

The Wavelength-Shifting Optical Module for IceCube - Status and Performance — •Peter Peiffer for the IceCube-Gen2-Collaboration — Universität Mainz, Deutschland

The Wavelength-shifting Optical Module (WOM) is a single photon sensor developed in the context of the IceCube neutrino telescope. It provides a large photosensitive area with low detector noise and improved UV sensitivity. This is achieved by combining a wavelength-shifter coated tube with two small, low-noise PMTs. Incident UV photons are absorbed by the wavelength-shifter and are re-emitted isotropically. We show that on average ∼40% of the re-emitted light is captured by total internal reflection and guided to the PMTs at the ends of the 90 cm tube. Compared to the IceCube DOM, the noise is a factor 10 lower, while the effective area is up to a factor of 2 higher. This leads to a factor 20 improvement in the S/N ratio. Apart from IceCube, this sensor can also be employed in other experiments, that aim at the detection of UV photons with a high S/N ratio. (e.g. SHiP) In this contribution the performance characteristics of the WOM and an update of the current status of the prototype development are discussed.

T 44.3 Di 17:00 Z6 - SR 2.013

In situ calibration of multi-PMT optical modules in the deep ice at the South Pole — •Tabea Eder, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

Based on the discovery of high-energy cosmic neutrinos by the IceCube Neutrino Observatory, a next-generation neutrino telescope at the South Pole is in the planning phase. The utilization of new detector module concepts are being considered to further increase the detector sensitivity. A promising candidate is the multi-PMT Digital Optical Module (mDOM), which provides a larger effective photocathode area and information on the photon arrival direction due to 24 3-inch PMTs in one module, in comparison to the standard single-PMT

DOMs currently used in IceCube. A critical aspect of this design is the monitoring of the time calibration between the PMTs within an mDOM module after deployment in the ice. For such an in-situ measurement, the time differences between correlated signals in two PMTs caused by radioactive decays in the pressure vessel can be utilized. In the talk, the calibration method will be introduced and the current status of the studies presented.

T 44.4 Di 17:15 Z6 - SR 2.013

Dark rates from radioactive decays in the multi-PMT digital optical module — •Martin Antonio Unland Elorrieta, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

In the framework of a planned upgrade of the IceCube Neutrino Observatory and a next-generation neutrino telescope at the South Pole, new optical modules are being developed, which are expected to significantly increase the detector sensitivity. One such concept is the multi-PMT Digital Optical Module (mDOM) which features 24 three-inch PMTs inside a pressure vessel pointing in all directions. This design provides i.a. an almost uniform angular acceptance, an increased effective area and the possibility of using local coincidences between PMTs of the same module. As the deep ice at the South Pole has a very low optical activity, light produced by the mDOM itself represents the dominant background source. Two major sources are Cherenkov and scintillation light produced by radioactive decays inside the module's pressure vessel. After an introduction, the talk presents detailed investigations of the underlying production mechanisms and their parameter, as well as results from a Geant4 simulation of the module response to this background.

T 44.5 Di 17:30 Z6 - SR 2.013

Background light sources in photomultiplier tubes operated at negative HV — •Florian Trittmaack, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Westfälische Wilhelms-Universität Münster, Institut für Kernphysik, Deutschland

A significant sensitivity gain for future neutrino telescopes at the South Pole is anticipated to come from new optical sensor designs. One such design is the Multi-PMT Digital Optical Module (mDOM), which incorporates 24 3" photomultipliers (PMTs). Due to the low level of optical background in the deep ice, the dominant background is produced by the optical modules themselves with the PMTs being major sources. After an introduction to mechanisms of dark rate production inside a PMT, the talk presents investigations to characterize and identify the major sources for the 3 PMTs operated with negative high volatge used in the mDOM and possible ways to reduce it.

T 44.6 Di 17:45 Z6 - SR 2.013

Sensitivity of multi-PMT optical modules to the energy spectrum of MeV supernova neutrinos — •Florian Sprenger, Cristian Jesús Lozano Mariscal, Lew Classen, and Alexander Kappes for the IceCube-Collaboration — Westfälische Wilhelms-Universität Münster, Institut für Kernphysik, Münster

Within the efforts for the next generation neutrino observatory at the South Pole, new optical modules like the multi-PMT optical module (mDOM) are being developed, which are expected to significantly increase the detector sensitivity to high energy astrophysical neutrinos. On the other hand, neutrinos from core-collapse supernovae with energies as low as few MeVs can reveal a detailed picture of the events that accompany the collapse of the core and verify and enhance our picture of these powerful explosions. With its unique features like local coincidences and information on the arrival direction of detected photons, the mDOM may allow for event-by-event detection of MeV neutrinos with a single module while at the same time keeping the background sufficiently low. The talk presents the first study on the energy sensitivity for SNe by using local coincidences in the mDOM.

T 44.7 Di 18:00 Z6 - SR 2.013

Measurement of luminescence spectra of ultra-purified water and ice — •Sarah Pieper — Bergische Universität Wuppertal, Deutschland

Luminescence is the phenomenon of a medium emitting photons as a deexcitation mechanism, that is exceeding thermal radiation and is delayed concerning the time of excitation. It can be characterized by parameters such as light yield, emission spectrum, and decay times.

It was proposed that luminescence of water and ice can be used as a new detection method at particle detectors that use water or ice as their target medium. These detectors use directly or indirectly produced Cherenkov light as a detection method. Therefore the detection of particles is restricted by their velocities using this method.

Luminescence light, on the other hand, is produced by particles due to their energy transfer to the medium. Therefore particles with a large energy transfer can be detected even below velocity ranges detectable due to Cherenkov light emission. In order to use luminescence light, the characteristics, mentioned above, need to be known for the properties given in these detectors.

As a first step, the characteristics are determined for ultra-purified water and ice. Light yield of ultra-purified water and ice and its temperature dependance in a temperature range from $-40°C$ to $20°C$ has already been measured. Measurements of the emission spectrum are ongoing, using different types of radioactive sources for excitation. The present status of this investigation will be presented.

T 44.8 Di 18:15 Z6 - SR 2.013

Logging device for in-situ measurements of luminescence in ice — •Anna Pollmann for the IceCube-Collaboration — Bergische Universität Wuppertal

Luminescence is induced by highly ionizing particles passing through matter due to excitation of surrounding atoms. In particular, this mechanism is present also in pure H_2O ice, which was irradiated by ionizing radiation.

The production of luminescence light is not constrained by a minimal speed threshold of the incident particle as in contrast to Cherenkov light. Thus, slow particles can be detected by utilizing luminescence in large water-Cherenkov detectors with high sensitivity such as IceCube. These particles are highly ionizing, heavy particles proposed beyond the Standard Model of particle physics, such as magnetic monopoles.

The observables of luminescence, such as wavelength spectra and decay times, are highly dependent on the properties of the medium. The usage of luminescence at the IceCube neutrino telescope will therefore be prepared by an in-situ measurement within a deep bore hole which is close to IceCube.

A logging device will be presented that is currently under development in order to measure the depth dependent properties of luminescence in the South Pole ice. A radioactive source will be attached to the ice within the bore hole and the backwards scattered luminescence light will be collected and analyzed.

T 44.9 Di 18:30 Z6 - SR 2.013

Entwicklung einer Sonde zur Messung der Ausbreitungseigenschaften ultravioletten Lichts im antarktischen Eis — •Jannes Brostean-Kaiser für die IceCube-Gen2-Kollaboration — DESY Zeuthen

Das weltweit größte Neutrinoteleskop IceCube soll in den nächsten Jahren zu IceCube Gen2 erweitert werden. Zur Steigerung der Sensitivität wurden für diese Erweiterung neue optische Module entwickelt. Eines der neuen Module (WOM) vergrößert den sensitiven Wellenlängenbereich des Teleskops in das Ultraviolette. Für eine Abschätzung der Sensitivitätssteigerung durch die neuen Module wurde eine Sonde entwickelt, welche die Absorptions- und Streulängen von Ultravioletem Licht in Südpoleis messen kann. Desweiteren wurden erste Tests und Simulationen zu der Messung durchgeführt. In diesem Vortrag wird die Entwicklung der Sonde, sowie die Vorhersagen der Simulation dargestellt.

T 44.10 Di 18:45 Z6 - SR 2.013

The IceCube Neutrino Observatory as an instrument for glaciology — •Martin Rongen and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory instruments about 1 km^3 of deep, glacial ice at the geographic South Pole with 5160 optical modules to detect Cherenkov light of passing particles. After discovering a diffuse flux of high-energy cosmic neutrinos, there is an on-going search to identify their astrophysical sources. This effort relies heavily on an ever more precise understanding of the optical scattering and absorption properties of the instrumented ice. In turn, IceCube can now provide a unique insight into the glacier which, due to the large distances observed, is in many ways complementary to ice cores. We observe a direction-dependent extinction length, with the direction of least extinction being aligned with the local flow direction of the ice. In this talk, a depth-dependent measurement of the strength of this anisotropy will be presented. Possible explanations of the effect are going to be discussed.

T 45: Hauptvorträge II

Zeit: Mittwoch 11:00–12:10 Raum: Z6 - HS 0.004

Hauptvortrag T 45.1 Mi 11:00 Z6 - HS 0.004
Plasma Wakefield Accelerators - The Wave of the Future or a Side Note in History? — •Jens Osterhoff — Deutsches Elektronen-Synchrotron DESY, Hamburg

The field of particle acceleration in plasma wakes has seen remarkable progress in recent years. These days, acceleration gradients of more than 10 GV/m can be readily achieved using either ultra-short intense laser pulses or high-current-density particle beams as wakefield drivers. With the demonstration of first GeV electron beams and a general trend towards improved reproducibility, beam quality and control over the involved plasma processes, plasma-acceleration techniques are starting to draw considerable interest in the traditional accelerator community. As a consequence, DESY, Germany's leading accelerator centre, has established a research programme for plasma-based novel acceleration techniques with the goal to symbiotically combine conventional and new accelerator concepts for future applications in medical imaging, photon science, and particle physics. This presentation will review plasma-wakefield principles and sketch possible pathways to first usage scenarios.

Hauptvortrag T 45.2 Mi 11:35 Z6 - HS 0.004
Auf dem langen Weg zur Sensation? – Direkte Suchen nach neuer Physik am LHC — •Johannes Erdmann — TU Dortmund, Experimentelle Physik IV

Viele Modelle, die Probleme des Standardmodells lösen, sagen die Existenz neuer Phänomene voraus, die am LHC beobachtbar sein sollten. Trotz großer Hoffnungen wurden bisher keine Anzeichen für solche Phänomene beobachtet. Deren Entdeckung würde jedoch unser Bild von der Teilchenphysik auf einen Schlag verändern. Die ATLAS- und CMS-Kollaborationen suchen in den aufgezeichneten Kollisionsdaten mit zunehmender Sensitivität nach einer Fülle wohlmotivierter neuer Prozesse. Im Vortrag wird ein Überblick über den Status dieser Suchen anhand einer Auswahl aktueller Ergebnisse gegeben.

T 46: Eingeladene Vorträge I

Zeit: Mittwoch 14:00–16:00 Raum: Z6 - HS 0.001

Eingeladener Vortrag T 46.1 Mi 14:00 Z6 - HS 0.001
Search for New Physics at a Future Beamdump Facility at the CERN SPS: The SHiP Experiment. — •Daniel Bick — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHIP is a new general purpose fixed target facility, currently in the design phase at CERN. In its initial phase, the 400 GeV proton beam extracted from the SPS will be dumped on a heavy target with the aim of integrating 2×10^{20} pot in 5 years. A dedicated detector, based on a long vacuum tank followed by a spectrometer and particle identification detectors, will allow probing a variety of models with light long-lived exotic particles and masses below $\mathcal{O}(10)\,\mathrm{GeV}/c^2$. The main focus will be the physics of the so-called Hidden Portals, i.e. the search for Dark Photons, Light scalars and pseudo-scalars, and Heavy Netrinos. Another dedicated detector will allow the study of neutrino cross-sections and angular distributions. ν_τ deep inelastic scattering cross sections will be measured with a statistics 1000 times larger than currently available, with the extraction of the F_4 and F_5 structure functions, never measured so far and allow for new tests of lepton non-universality with sensitivity to BSM physics.

Eingeladener Vortrag T 46.2 Mi 14:24 Z6 - HS 0.001
NNLO QCD in Higgs and vector-boson processes at the LHC — •Marius Wiesemann — CERN, Geneva, Switzerland

The LHC is entering its precision era. Without any clear signs of physics beyond the Standard Model in hadron collisions, the measurement of small deviations from Standard-Model predictions has become the best opportunity to disentangle new-physics phenomena. This requires, in particular, highly precise theoretical predictions of Standard-Model processes. In this talk, state-of-the-art radiative corrections at NNLO QCD are presented for several production processes involving Higgs and vector-boson final states. All possible leptonic decay channels of the vector bosons are included in the calculations, by consistently accounting for all resonant and non-resonant diagrams, off-shell effects and spin correlations. The underlying NNLO subtraction procedure is discussed in detail, and we introduce an automatic extrapolation procedure that allows us, for the first time, to control the systematic uncertainties of qT subtraction down to the few permille level (or better). Several direct applications of the results in LHC measurements are discussed.

Eingeladener Vortrag T 46.3 Mi 14:48 Z6 - HS 0.001
Searches for Dark Matter at Belle II — •Torben Ferber — DESY, Hamburg, Germany

The next-generation B-factory experiment Belle II at the upgraded KEKB accelerator, SuperKEKB, will start physics data taking in 2018. It is an asymmetric e+e- collider that will operate with 40x the instantaneous luminosity of KEKB/Belle and aims to collect 50 times more data in total. Belle II offers the possibility to search for a large variety of dark sector particles in the GeV mass range complementary to LHC and dedicated low energy experiments. These searches will profit both from the very large dataset that will be acquired by the Belle II experiment, and from specifically designed triggers for the early running of Belle II. This talk will review planned dark sector searches with a focus on the discovery potential of the first data.

Eingeladener Vortrag T 46.4 Mi 15:12 Z6 - HS 0.001
Search for Dark Matter with the ATLAS detector — •Katharina Bierwagen — Johannes Gutenberg-Universität Mainz

Cosmological and astrophysical observations indicate the presence of Dark Matter in the universe which cannot be explained by the Standard Model. Searches for Dark Matter are performed by both the ATLAS and CMS experiment in events involving large missing transverse momentum in the final state. So far no signal for physics beyond the Standard Model has been found.

This talk summarizes the recent results by the ATLAS Collaboration based on the full proton-proton collision dataset collected at a centre-of-mass energy of 13 TeV in 2015 and 2016.

Eingeladener Vortrag T 46.5 Mi 15:36 Z6 - HS 0.001
Highlights from Higgs physics in CMS — •Chayanit Asawatangtrakuldee — DESY, Hamburg, Germany

The latest results related to the Higgs boson, h(125), are presented using proton-proton collision data corresponding to an integrated luminosity of 35.9 fb^{-1} at a center-of-mass energy of 13 TeV recorded by the CMS detector at the LHC. In particular, the highlights will be shown including updated results from ZZ and $\gamma\gamma$ decay channels, the newest results from Higgs boson decays to $\tau\tau$, $\mu\mu$, Higgs boson decays to a pair of b-quarks in associated with vector bosons (W/Z) production and boosted gluon fusion production, as well as highlights from Higgs boson production with top-quarks. In addition, the latest results from a pair production of the Higgs boson will be also discussed in this talk.

T 47: Eingeladene Vorträge II

Zeit: Mittwoch 14:00–16:00 Raum: Z6 - HS 0.002

Eingeladener Vortrag T 47.1 Mi 14:00 Z6 - HS 0.002
Wissen ist Macht – die Matrixelement-Methode für Suchen mit Top-Quarks — •Olaf Nackenhorst — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Top-Quarks werden am LHC im Zusammenhang mit vielen interessanten Physikprozessen produziert. Die Endzustände und Signaturen im Detektor sind häufig komplex und können nicht immer einfach vom Untergrund getrennt werden. Eine Möglichkeit die Trennkraft zwischen Signal und Untergrund zu erhöhen, ist es mit Hilfe der Matrixelement-Methode Informationen zu verwenden, die der theoretische Beschreibung des harten Streuprozesses zu Grunde liegen.

Die Suche nach dem Higgs-Boson, produziert in Assoziation mit einem Top-Quarkpaar und bei der das Higgs-Boson in ein Bottom-Quarkpaar zerfällt, war die erste Suche am ATLAS-Experiment, die die Matrixelement-Methode verwendet hat. Kürzlich wurde die Matrixelement-Methode zum ersten Mal auch bei einer Suche nach Phänomenen jenseits des Standardmodells verwendet. In dieser Analyse wurde nach der Produktion von exotischen vektorartigen Quarkpaaren gesucht, die vollständig in hadronische Endzustände zerfallen. Beide Suchen werden mit Fokus auf die Verwendung der Matrixelement-Methode vorgestellt und diskutiert.

Eingeladener Vortrag T 47.2 Mi 14:24 Z6 - HS 0.002
IAXO & MADMAX - Axion Searches with Helio- & Haloscopes — •Christoph Krieger — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn — Institut für Experimentalphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Axions feature a small mass and only weak couplings which provide a suitable candidate for Dark Matter. The detection of axions relies mostly on the conversion of axions to photons inside a strong electromagnetic field via the inverse Primakoff effect.

Axion helioscopes look for axions produced in the solar core which reach earth and can be detected by strong magnets pointed towards the sun converting them back into X-ray photons. The International Axion Observatory (IAXO) is a next generation helioscope currently under consideration.

The Magnetized Disc and Mirror Axion Experiment (MADMAX) is a proposed dielectric haloscope, supposed to be built at DESY in Hamburg. Here the conversion of axions into microwave photons happens at the surfaces of dielectric discs in a magnetic field. Dielectric haloscopes enable the detection of axions in a previously inaccessible mass range.

Prospects and first milestones for both experiments, IAXO and MADMAX, will be presented. For IAXO this especially includes the development of low background X-ray detectors while for MADMAX first results concerning the production of large area dielectric discs will be shown.

Eingeladener Vortrag T 47.3 Mi 14:48 Z6 - HS 0.002
The CMS Phase-II Tracker Upgrade — •Thomas Eichhorn — Deutsches Elektronen-Synchrotron DESY

From 2023 onward the Large Hadron Collider (LHC) at CERN will be upgraded to a new, so-called High-Luminosity LHC (HL-LHC). With this upgrade, the instantaneous luminosity will be increased to up to $7.5 \times 10^{34}\,\mathrm{cm^2 s^{-1}}$. After 10 years of operation, the CMS experiment will have accumulated an integrated luminosity of over $3000\,\mathrm{fb^{-1}}$. These unprecedented luminosities have enormous consequences for the LHC and its experiments, such as CMS, and here especially for the innermost detector component, the tracking detector. To address the anticipated vast increase in particle density and the unprecedented radiation damage, a complete redesign of the CMS Tracker is needed. This talk will explain the forseen upgrade of the CMS Tracker, its components and some of the technological choices. Ongoing R&D efforts will also be highlighted.

Eingeladener Vortrag T 47.4 Mi 15:12 Z6 - HS 0.002
The Higgs Physics at LHC: Status quo — •Tatjana Lenz — Bonn University

The more than five years ago discovered Higgs boson is the last missing piece of the Standard Modell of Elementary Particle Physics. Its properties are very Standard-Model-like and have been tested already at high precision. This presentation addresses new results on the Higgs boson based on the data set collected by ATLAS and CMS experiments during Run-2 started in 2015 at 13 TeV centre-of-mass energy. An overview of the recent measurements of Higgs boson properties as well as searches involving Higgs boson will be shown.

Eingeladener Vortrag T 47.5 Mi 15:36 Z6 - HS 0.002
Proton-lead and lead-lead collisions with LHCb — •Michael Winn — Laboratoire de l'accélérateur linéaire, Orsay, France

The LHCb experiment allows to study heavy-ion interactions in the forward region with a fully instrumented spectrometer, a unique opportunity at the LHC. In proton-lead collisions, both forward and backward rapidities are covered thanks to beam direction reversal. Recent results include measurements of cross sections, nuclear modification factors and forward-backward ratios for heavy quarkonia states, open heavy-flavour hadrons including baryons and dihadron correlations. These quantities are sensitive probes for nuclear effects in proton-nucleus collisions. Strong nuclear modifications are observed in particular at low Bjorken-x and constitute an important basis for the understanding of nucleus-nucleus collisions. In 2015, LHCb participated successfully for the first time in the lead-lead data-taking. The status of analyses in this collision system will be shown. Finally, an outlook for future opportunities with LHCb in heavy-ion collisions will be given.

T 48: Neutrinoastronomie III

Zeit: Mittwoch 16:30–19:00 Raum: Philo-HS1

T 48.1 Mi 16:30 Philo-HS1
Detecting Galactic core-collapse supernovae with the IceCube neutrino telescope — •Alexander Fritz for the IceCube-Collaboration — Johannes-Gutenberg Universität Mainz

The IceCube neutrino telescope is sensitive to the large flux of neutrinos from galactic core-collapse supernovae. In fact, for distances up to the Magellanic Clouds, IceCube will provide the smallest uncertainties world-wide on the time evolution of the neutrino flux and will roughly measure the average neutrino energy. Thanks to a tight monitoring and error recovery functionality, the detector uptime runs at 99.8% around the clock. I will summarize recent improvements in the data acquisition, monitoring, reconstruction and simulation. I will also discuss the effect of the neutrino mass on neutrino light curves and how a combined analysis of gravitational waves and neutrinos from supernovae may allow to study instabilities in the explosion mechanism, such as the standing accretion shock instability (SASI)

T 48.2 Mi 16:45 Philo-HS1
Steady point source analysis on a flaring blazar coincident with the IceCube high-energy neutrino IC170922A — •Benedikt Krammer, Stefan Coenders, Theo Glauch, Matthias Huber, Elisa Resconi, and Andrea Turcati for the IceCube-Collaboration — Technische Universität München

The high-energy neutrino event detected by IceCube on 2017 September 22 (IC170922A) resulted in the identification of an enhanced gamma-ray emission from the blazar TXS0506+056 by the Fermi Large Area Telescope and MAGIC. The gamma-ray source was found in directional and temporal coincidence with the neutrino. Based on this, we investigated 9.5 years of IceCube data, the largest detector livetime in a IceCube point source analysis to date, at the position of the blazar. The time-integrated analysis also covers the time window of the flare. We compare this analysis with our previous point source analysis with 7 years of data, which found an excess at the potential neutrino source position. This talk outlines the analysis, and discusses implications and interconnections with other experiments and observations.

T 48.3 Mi 17:00 Philo-HS1

Detection of a flaring blazar coincident with the IceCube high-energy neutrino IC-170922 — •Theo Glauch[1], Anna Franckowiak[2], Matthias Huber[1], Elisa Resconi[1], and Andrea Turcati[1] for the IceCube-Collaboration — [1]Technical University of Munich, Germany — [2]DESY Zeuthen, Germany

On September 22, 2017, the IceCube Neutrino Observatory has for the first time ever observed an extremely-high-energetic neutrino event candidate, IceCube-170922, in spatial and temporal coincidence with a flaring gamma-ray blazar. The IceCube event has a typical neutrino induced muon-track signature. Due to its high energy it is likely of astrophysical origin. Follow-up observations in a broad wavelength band have been performed. Most notably, measurements of the Large Area Telescope on board of the Fermi Gamma-ray Space Telescope, in a photon energy range between 100 MeV and 300 GeV, have revealed a flaring blazar, TXS 0506+056, at an angular distance of only 6 arcmin from the neutrino arrival direction. At time of the measurement the Fermi gamma-ray flux of the object exceeded the quiescence flux by a factor of around 6. In this talk we present a summary of the observational details and report on various chance probability calculations showing the significance of the coincidence in the light of different astrophysical source models. The chance for a random coincidence is shown to be very low for all the tested hypotheses.

T 48.4 Mi 17:15 Philo-HS1

Active Galactic Nuclei outflows as neutrino sources? — •Andrea Turcati[1], Paolo Padovani[2,3], and Elisa Resconi[1] — [1]Technische Universität München, Physik-Department, James-Franck-Str. 1, 85748 Garching — [2]European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching bei München, Germany — [3]Associated to INAF - Osservatorio Astronomico di Roma, via Frascati 33, I-00040 Monteporzio Catone, Italy

Over the last few years the IceCube Neutrino Telescope has reported the first observations of a high-energy astrophysical neutrino flux. Recently, these observations have been strengthened by the publication of a sample of 82 high-energy starting events, and 36 high-energy muon neutrino tracks. Many different scenarios for the astrophysical origin of the IceCube neutrinos have been explored, but a clear answer has yet to emerge. Among the possible neutrino sources, blazars are so far the most supported by the data. Nevertheless their maximum contribution to the astrophysical neutrino flux has been constrained to be subdominant. We consider here a new, possibly contributing class of neutrino emitters: Active Galactic Nuclei outflows. We present the results of quantitative tests, exploring the possible connection between IceCube neutrinos and Active Galactic Nuclei objects displaying outflows or outflow-like properties.

T 48.5 Mi 17:30 Philo-HS1

Search for High-Energy Neutrinos from Tidal Disruption Events (TDEs) — •Robert Stein for the IceCube-Collaboration — DESY Zeuthen, Germany

Since the detection of high-energy cosmic neutrinos at the IceCube Neutrino Observatory in 2013, there has been an on-going search to find suitable transient source candidates. So far, Supernovae, Blazars and GRBs are all currently disfavoured as dominant contributors to the observed neutrino flux. However, Tidal Disruption Events (TDEs) represent a promising untested source class. Various models have predicted neutrino emission from jetted, or even from non-jetted TDEs. I will present an analysis framework to test correlations between TDEs and high-energy neutrinos from several years of IceCube data. The analysis will be a time-dependent stacking analysis, incorporating TDEs overlapping the data-taking period, to improve sensitivity. Preliminary sensitivity estimates for the analysis will be shown.

T 48.6 Mi 17:45 Philo-HS1

Modeling the Extragalactic Gamma Ray Background Spectrum with Very High Energy Gamma Ray Data — •Felix Neubürger for the IceCube-Collaboration — Technische Universität Dortmund

With the origin of the astropysical neutrinos observed by IceCube not being completely resolved, a closer look at possible sources is needed.

A recent analysis by the IceCube Collaboration suggests that blazars detected by Fermi are responsible for less than a third of the observed neutrino flux.

Research by Broderick et al. considers plasma beam instabilities in a more generalised model for the EGRB leading to a more fitting blazar distribution in the unified AGN-Paradigm.

For Very High Energy Gamma-Rays this distribution leads to a diffuse flux matching the Fermi data.

The goal of the presented work is to calculate the diffuse neutrino flux supposedly generated by unresolved blazars based on the assumptions made by Broderick et al. for the Extragalactic Gamma-Ray Background using new data. This will then be compared to the diffuse flux measured by IceCube.

This talk presents an outline of the methodology used to calculate the neutrino flux from the suggested Blazar distribution.

T 48.7 Mi 18:00 Philo-HS1

Search for common sources of cosmic neutrinos and ultra-high-energy cosmic rays — •Lisa Schumacher, Christian Haack, Rene Reimann, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

Cosmic rays have been discovered a century ago, however, their sources remain unidentified. It is believed that in the same environments that accelerate cosmic rays also neutrinos are produced by hadronic interactions. Joint analyses of the IceCube Neutrino Observatory, the Pierre-Auger Observatory and the Telescope Array yielded inconclusive results for a possible directional correlation of neutrinos and ultra-high-energy cosmic rays (UHECR). This motivates a complementary analysis including UHECR information, recent galactic magnetic field models and a high-statistic neutrino data set. We present a new approach for searching common sources by using UHECR and magnetic-deflection information as a prior for a point-source analysis on a muon-neutrino track data set.

T 48.8 Mi 18:15 Philo-HS1

Ultra-High Energy Neutrino Follow-Up Searches of GW Events with the Pierre Auger Observatory—status and results — •Michael Schimp for the Pierre Auger-Collaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

The surface detector array of the Pierre Auger Observatory is sensitive to neutrinos at energies above 0.1 EeV (ultra-high energy neutrinos). Its large acceptance at this energy range makes it a complement to current neutrino telescopes, which have their peak sensitivities at lower energies. Ultra-high energy neutrinos are promising messengers to address open questions concerning the nature of ultra-high energy cosmic rays as they could be produced both at their sources and during their propagation. With the first observation of gravitational waves (GW) from a binary black hole merger (BH-BH merger) by the LIGO Collaboration in 2015, a new branch of astronomy, with the potential to contribute to resolving those open questions, has joined in. In August 2017, the LIGO/Virgo Collaborations observed for the first time a binary neutron star merger (NS-NS merger) and sent an immediate alert to pre-established partners, among which is the Pierre Auger Collaboration. We present the status and results of the ultra-high energy neutrino follow-up searches of LIGO/Virgo GW events that were performed with the Pierre Auger Observatory. These events include BH-BH merger events and the above-mentioned—so far unique—NS-NS merger event.

*Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).

T 48.9 Mi 18:30 Philo-HS1

Neutrinos and Gravitational Waves from Systems of Supermassive Black Holes — •Mario Hörbe — Ruhr-Universität Bochum

The last years in astro- and particle physics yielded two century breakthroughs for science: From the observation of very-high-energy neutrinos (HEν) by the IceCube Observatory at the Geographic South Pole up to the detection of gravitational waves (GW) by LIGO, physics has achieved in months what had been considered elusive for decades.

Joint HEν+GW observations could open up unique windows into the very deep insides of opaque astrophysical phenomena which otherwise cannot be resolved in other messengers such as charged nuclei or photons. Among the most fascinating yet mostly unexplored phenomena that can be investigated by joint HEν+GW observations are the center regions of active galaxies that host two supermassive black holes. Especially the black-hole-dynamics of such systems suggest to pose numerous HEν production sites in e.g. jets as well as GW emission in case of an imminent merger of the two nuclei.

I investigate possible correlations between these messengers within my PhD research, supported by the Studienstiftung des deutschen

Volkes, by using both analytical approaches and Monte-Carlo-simulations based on the CRPropa3 framework. The status and perspectives of my project on HEν+GW modeling of binary AGN will be presented and set in context to current detectors such as IceCube and LIGO.

T 48.10 Mi 18:45 Philo-HS1

Multi-Messenger galactic supernova analyses — •David Kappesser and Lutz Köpke for the IceCube-Collaboration — Johannes Gutenberg-Universität Mainz

Supernovae in our galaxy are rare phenomena. It is therefore essential that a core collapse supernova can be investigated by as many experiments as possible. This includes neutrino detectors, gravitational wave interferometers as well as detectors that cover the electromagnetic spectrum. A collaboration between various experiments has been established in order to develop tools for a combined analysis of neutrino data that takes the strengths of individual detectors into account. As a first step, the combination of simulated IceCube and JUNO data has been studied and a combined analysis of LIGO and IceCube has been performed. Within the SNARE(SuperNova Advance Readiness Exercise) project, a core collapse simulation with hidden features will be prepared by theorists and subsequently be transformed into signals of various detectors. The goal of this exercise is the determination of the characteristics of the supernova signal with individual detectors and to use the prepared simulated data to set up a combined analysis framework and common analysis tools.

T 49: Andere Gebiete der Physik

Zeit: Mittwoch 16:30–18:30 Raum: Philo-HS2

T 49.1 Mi 16:30 Philo-HS2

How do scientists make neutrinos party? — •Zara Bagdasarian — IKP-2 Forschungszentrum Jülich

The neutrinos are ubiquitous, billions of them pass through every square centimeter of you every second. But do they cause you any harm? Actually, the chances of them interacting with you are less than once in a few years. Being such an introvert makes neutrino both an extremely valuable source of intact information and extremely hard to detect. But we do not do things because they are easy, but because they are hard. Scientists from all around the world are going to the various extremes to make neutrinos join the physics party.

T 49.2 Mi 16:45 Philo-HS2

Notational invariance of the standard model — •Lello Boscoverde — Istituto della Fava Pazza, Garching, Germany

We present our updated investigations into the notational invariance of the standard model, including an introduction to the principles of notational invariance and the topology of underlying symmetries—continuous vs. discrete, local vs. global, etc.; and examples from application to the standard model.

T 49.3 Mi 17:00 Philo-HS2

Einst Planck hätte dies GUT geheißen — •Morguen Rotwang — Adam-Weisenhaupt-Boulevard 23, 53115 Bonn

Der Wunsch nach einer Großen Vereinheitlichten Theorie steht in antiproportionalem Verhältnis zum Erfolg eine ebensolche zu etablieren. Einstein verstand wie in seinen Zugbeispielen aufgrund seiner Arbeiten zur speziellen Relativitätstheorien in der Quantentheorie nur 'Bahnhof'. Und Heisenbergs kreativer Nimbus wurde durch den Wegfall der Cooper-Paarung mit Pauli als advocatus diaboli bestenfalls unwahrscheinlich konservativ. Bis zum heutigen Tag stehen diese Fundamente unvereinbar nebeneinander. Den Ausweg aus diesem Dilemma konnte nur Planck leisten, der jedoch durch sein Lebenswerk strahlend zumnehmend mehr in Grußformeln vertieft war. Modernere Ansätze verwirrten sich so sehr in der Pluralität der Superlative, dass nach Ende eines drei Generationen währenden Tauziehens um das Standardmodell die Superstrings der SUSY unangetastet blieben. Wir ziehen nun all dies zu Rate und bilden mit dem eigentlich fundamentalen Baustein, in Einheiten der Wirkung von Raum x Zeit quantisiert, einen Letzten Satz eines vereinheitlichten Verständnisses.

T 49.4 Mi 17:15 Philo-HS2

A new method of destination the rest masses of the elementary particles — •Norbert Sadler — Norbert Sadler; Wasserburger Str. 25a; 85540 Haar

It can be shown that at the primordial nucleosynthesis the Exceptional E-8 Symmetry Group as a suitable gauge symmetry on the energy density distributation of the universe can be applied.

The E-8 Group replaces the "omnipotent Higgs-Field"!.

The E-8 Symmetry Group percolates, filters over the 57 dimensional object the mass ernergy equivalence of the elementary particles.

Further Information: www.cosmology-harmonices-mundi.com

T 49.5 Mi 17:30 Philo-HS2

Derivation of Mass & Fine Structure Constant of a free Electron at rest — •Manfred Geilhaupt — Hochschule Niederrhein

Why this presentation might be important? Restmass and Charge of a free electron and the fine structure constant derived from a Principle Theory is still an open question in physics. Einstein: "A theory that assumes mass and charge of an electron a priori is incomplete." This holds true for Einstein's GR-Principle Theory up to now! However, GR combined with Thermodynamic (TD)-Principles is able to reveal the nature of quantized mass (me~1/Ne), defined by the Quantum Number Ne and by the theoretically calculated fine-structure constant depending on both the Einstein-metric number g44 from GR and the Einstein gamma-factor from SR. The most surprising result for me was that the Sommerfeld fine structure constant has its roots within Einsteins GR-Theory combined with Thermodynamics (GR+TD). The second surprising result is that GR+TD explains why we have only three leptons (electron-, myon-, tau-particle) due to the restricting Einstein invariance argument applied.

T 49.6 Mi 17:45 Philo-HS2

Particle masses depend on a balance of electrostatic and other interactions — •Karl Otto Greulich — Fritz Lipmann Institute, Beutenbergstr.11, D 07745 Jena

According to the alpha/beta rule (K.O.Greulich 2010 J Mod Phys, 1, 300-302, K.O. Greulich, 2016 DPG Spring meeting T 99.4) for exact calculation of particle masses, all particles can be arranged on a linear axis, where each two neighbors differ by a factor of alpha = 1/137. When ml is the mass of the lighter and mh of the heavier particle and with the definition of the fine structure (Sommerfeld) constant alpha = e**2 / 2 e0 h c one obtains mh e**2 = ml * 2 e0 hc where e is the elementary charge and e0 the dielectic constant of the vacuum. It appears that a subtle balance of electrostatic and other interactions governs the ratio of each of such two masses.

T 49.7 Mi 18:00 Philo-HS2

The Origin of Mass - A Fundamental Mechanism — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

The origin of mass is one of the basic questions in our understanding of physics. The great attention being paid to the Higgs theory is an indication of this. However, Higgs's theory does not really work. Aside from its great complexity, the necessary Higgs field is contradicted by astronomical observations; and this theory does not provide the necessary Yukawa coupling needed to determine any actual mass.

On the other hand, there is a very fundamental solution for inertia based on classical physics. If two objects are bound to each other in such a way as to maintain a certain distance from each other, then this configuration necessarily has inertia, even if the two objects do not have any mass. This is basically caused by the fact that binding fields propagate with the finite speed of light.

If this model is used to determine the mass of the electron, for example, then the result conforms precisely to the actual measurements ($< 10^{-5}$). For this evaluation, the size of the electron is determined by classical means from its magnetic moment. - This calculation also works for the other leptons, as well as for quarks, and it covers the relativistic behaviour of mass, including Einstein's famous relationship between mass and energy.

It can be shown that no other mechanism is needed in physics to explain inertia.

Further info: www.ag-physics.org/rmass

T 49.8 Mi 18:15 Philo-HS2

A Conflict Exists in De Broglie's Wavelength of a Particle — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Louis de Broglie's great accomplishment was to postulate the wave properties of all elementary particles, and this became one of the pillars of quantum mechanics.

However, when de Broglie undertook to determine the parameters of such waves, he made a serious error. He believed there was a conflict regarding the frequency assigned to a particle. The Einstein-Planck relationship E=h*f predicts an increase of frequency f of a particle in motion, whereas SR predicts a decrease due to dilation. However, de Broglie was wrong about the latter. When one particle interacts with another, the frequency of the moving particle is seen to increase due to the Doppler Effect. (And the correct use of the Lorentz transformation leads to the same result.)

Furthermore, concerning the dependency of the wavelength on momentum: lambda=h/p is neither Lorentz- nor even Galilei-invariant. It does not therefore describe physics correctly. Nevertheless, it was used by Schrödinger and by Dirac as an essential part of their wave functions.

We will explain how the problem occurred and why the results seem to be confirmed by experiments. And we will present a concept that is able to yield a correct solution.

T 50: Suche nach Supersymmetrie II

Zeit: Mittwoch 16:30–19:00 Raum: Philo-HS3

T 50.1 Mi 16:30 Philo-HS3

Sensitivity studies using multivariate techniques for the search for fully hadronic decays of top squarks with the ATLAS detector — •Nicolas Köhler, Oliver Kortner, and Jonas Graw — Max Planck Institut für Physik, München

The search for the supersymmetric partner of the top quark in final states with jets and missing transverse energy using 36.1 fb^{-1} of the LHC Run-2 dataset at $\sqrt{s} = 13\,\text{TeV}$ excludes a large range of top squark and LSP (lightest supersymmetric particle) masses with conventional cut-based event selections. In order to further increase the signal sensitivity, different multivariate analysis techniques have been investigated and compared. The achievable gain in sensitivity in the top squark-LSP mass plane with the full Run-2 dataset will be discussed.

T 50.2 Mi 16:45 Philo-HS3

Search for electroweak production of supersymmetric states in compressed mass spectra in Run 2 with the ATLAS detector — •Michael Holzbock and Alexander Mann — Ludwig-Maximilians-Universität München

Supersymmetry (SUSY) is one of the best studied and tested extensions of the Standard Model. Although there is no sign of physics beyond the Standard Model yet, SUSY could still be hiding in more challenging signatures, one of them being compressed mass spectra. These scenarios involve small mass differences between heavier SUSY particles and the lightest supersymmetric particle (LSP) leading to the appearance of soft objects in the decay chain.

A search is presented in which the lightest electroweakino states are nearly mass degenerate, leading to final states with one or more soft leptons. Usually, these events are selected using a trigger on missing transverse energy that originates from the SUSY system recoiling against a jet from initial state radiation. This trigger requires a tight cut on missing transverse energy in the offline selection, reducing the signal acceptance significantly. New dedicated triggers with lower thresholds exploiting topological information already at the lowest trigger level have been included in the 2017 data taking to recover signal efficiency in compressed scenarios.

The talk comprises studies on these multi-object triggers and the potential gain in sensitivity for the analysis when a selection based on these triggers is introduced.

T 50.3 Mi 17:00 Philo-HS3

QCD multi-jet background estimation for direct Stau searches — Christian Sander and •Krishna Kulkarni — Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

For searches after direct stau production with final states of reconstructed taus and missing transverse energy (MET), QCD multi-jet events can be an important background. In this case jets are "faking" taus and additionally MET is generated by jet mis-measurement or detector resolution effects. Previously, ABCD methods have been used to estimate the QCD background, which can face a significant non-QCD background and signal contamination in the used control regions. In this talk, we would like to propose an alternative approach based on a "Rebalance-and-Smear" technique: Inclusive jet events are re-balanced in the transverse momentum plane, and are smeared with jet response templates to get a data driven multi-jet background sample. Tau fake probabilities are then applied on the individual jets to obtain a prediction for the taus+MET final state.

T 50.4 Mi 17:15 Philo-HS3

Search for supersymmetry with tau leptons in the CMS experiment using MVA approach — •Ilya Bobovnikov[1], Alexis Kalogeropoulos[1,2], Isabell Melzer-Pellmann[1], and Alexei Raspereza[1] — [1]DESY — [2]Princeton

Supersymmetry (SUSY) is a popular theory beyond-the-standard-model. A search for SUSY in events with τ leptons in the final state using an MVA technique with 36/fb of 13 TeV data taken during 2016 is presented. Results are interpreted in terms of a direct stau-pair production model, where each stau is expected to decay to a τ lepton and the lightest SUSY particle (LSP). To optimize the sensitivity to the direct stau-pair production topology, we apply and compare various MVA approaches with different kinematic variables, based on final states with one hadronically decaying τ lepton and an electron or muon from the decay of the second τ. Finally, expected exclusion limits are calculated and compared with a cut based approach.

T 50.5 Mi 17:30 Philo-HS3

Search for direct pair production of scalar tau leptons in final states with two hadronically decaying taus with the ATLAS detector — •Ferdinand Krieter, Clara Leitgeb, and Alexander Mann — Ludwig-Maximilians-Universität München

As a proposed fundamental symmetry of nature, Supersymmetry provides elegant solutions to various open questions of the standard model by predicting superpartners of known particles, whose spins differ by one half unit. In R-parity-conserving models, these hypothetical particles are pair-produced and decay ultimately into the stable, lightest supersymmetric particle, providing a candidate for dark matter. A search for electroweak pair production of scalar tau leptons in final states with two hadronically decaying leptons, missing transverse momentum and low jet activity is presented. The simplified signal models consider scalar tau leptons decaying exclusively into a tau lepton and a stable neutralino. Such a production mode may dominate if the strongly interacting superpartners and gauginos are heavy and thus beyond the reach of currently probed energy scales. The analysis uses pp collision data at a center of mass energy of 13 TeV, recorded with the ATLAS detector from 2015 to 2017. Variables computed with the recursive jigsaw reconstruction technique are studied for the purpose of developing signal selections with optimal sensitivity. For the estimation of the multijet background a data-driven fake-factor method is presented. To allow for a measurement of the tau fake rates, a procedure to reweight data collected by a set of partially prescaled single jet triggers is used.

T 50.6 Mi 17:45 Philo-HS3

Search for R-parity violating Supersymmetry in final states with four-leptons with the ATLAS experiment — •Johannes Junggeburth, Zinonas Zinonos, and Hubert Kroha — Max-Planck-Institut für Physik

Supersymmetry is the favoured framework for providing solutions to open questions in the Standard Model. In most supersymmetric models, the discrete quantum number of R-parity is assumed to be conserved leading to a stable Lightest Supersymmetric Particle (LSP). However, it is possible that this quantum number is not conserved thus allowing for its decay into leptons. In proton collisions, multilep-

tonic final states provide a clear signature with excellent background suppression. This talk presents the latest results of a search for R-parity violating supersymmetry with the ATLAS experiment at the Large Hadron Collider using 36 fb^{-1} of data at $\sqrt{s} = 13$ TeV. The results are interpreted in terms of simplified models. Posibilities for further improvements of the analysis are also discussed.

T 50.7 Mi 18:00 Philo-HS3

Designing searches for unexplored SUSY models with the CMS detector — Peter Schleper[1], •Malte Mrowietz[1], Sam Bein[1], Jory Sonneveld[1], and Federico Ambrogi[2] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]HEPHY Vienna

Searches for Supersymmetry (SUSY) are one of the main goals of the LHC. Many of the searches for SUSY are interpreted in terms of simplified models. In this way, a large portion of the low-TeV SUSY parameter space has already been excluded. The tool *SmodelS* can be used to identify "missing" simplified models, for which no search has been performed yet. An analysis of the remaining parameter space of the low-TeV phenomenological minimal supersymmetric standard model (pMSSM) with *SmodelS* shows that models with a neutralino lightest sparticle and a nearly mass-degenerate second neutralino or chargino are among the most common missing simplified models. In this talk, the spectrum of missing simplified models is discussed and a potential search for the type of model above is presented, using data collected by the CMS detector.

T 50.8 Mi 18:15 Philo-HS3

Search for supersymmetry in multileptonic final states with collimated τ pairs with the ATLAS detector — •Marian Rendel, Zinonas Zinonos, Hubert Kroha, and Johannes Junggeburth — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

The search for supersymmetry (SUSY) is a major part of the ATLAS physics program. Due to the low Standard Model background, the search for four-lepton final states provides excellent sensitivity to R-parity violating (RPV) SUSY models where the lightest supersymmetric particle (LSP), produced in pairs, decay into final states with at least two charged leptons. For LSP decays into hadronically decaying τ lepton pairs, however, the current analysis is not sensitive if the mass difference between LSP and the next heavier NLSP is large, because the τ jet become highly collimated and the standard τ reconstruction method is not able to resolve them. A new specialized high-p_{T} τ jet pair reconstruction method has been developed for LHC run-2 at 13 TeV center-of-mass energy. In this talk, the application of the new reconstruction technique to the four-lepton RPV SUSY search is discussed as well as further improvements of the method to recover also low-p_{T} τ pairs.

T 50.9 Mi 18:30 Philo-HS3

Suche nach Top-Squark-Produktion mit Top Quarks und fehlendem Transversalimpuls im vollhadronischen Endzustand bei ATLAS — •Philipp Mogg, Christian Lüdtke und Frederik Rühr — Albert-Ludwigs-Universität Freiburg

In vielen supersymmetrischen Modellen ist der Partner des Top Quarks relativ leicht und könnte am LHC produziert werden. Dieser Beitrag stellt den aktuellen Stand der Suche nach vollhadronischen Signaturen bei ATLAS mit $36,1\,\text{fb}^{-1}$ bei $\sqrt{s} = 13\,\text{TeV}$ vor, der beim Journal of High Energy Physics eingereicht wurde. Darüber hinaus werden neue Methoden wie hadronisches Top-Tagging und die Signifikanz des fehlenden Transversalimpulses diskutiert, die benutzt werden können, um die Sensitivität der Suche zu verbessern.

T 50.10 Mi 18:45 Philo-HS3

ATLAS analyses preservation project (RECAST) and reinterpretation of specific SUSY searches for variable RPV-coupling strength. — •Simone Curcio, F. Cardillo, V. Magerl, Z. Rurikova, and P. Tornambè — Albert-Ludwigs-Universität Freiburg

Over the past several decades, many extensions and alterations to the Standard Model (SM) of particle physics have been proposed. These take the form of concrete modifications or extensions to the known particle spectrum and interactions. Searches for new physics are often sensitive to a larger class of models than they were originally designed to test. Reusing the estimates of the background and systematic uncertainties of the original search, one can “recast” the results of an existing analysis and set limits on new models. RECAST is a framework developed at CERN to facilitate the reinterpretation of new signal models. Among all the searches for BSM physics a lot of analyses were designed to search for SUperSYmmetric partners of the SM particles, assuming either R-Parity conservation (RPC), generating a stable Lightest Supersymmetric Particle (LSP) or R-parity violation (RPV). The transition between these two scenarios can be realised by varying the strength of the RPV couplings. In this talk the results of the search for strongly-produced superpartners in final states with 2 same-sign or three leptons and jets (SS3L) are presented for signals with variable RPV-coupling.

T 51: Suche nach Physik jenseits des Standardmodels III

Zeit: Mittwoch 16:30–19:05 Raum: Philo-HS4

Gruppenbericht T 51.1 Mi 16:30 Philo-HS4

Search for single production of vector-like quarks decaying into Wb in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Anjishnu Bandyopadhyay[1], Ian Brock[1], Janet Dietrich[2], Heiko Lacker[2], Dustin Biedermann[2], Ferdinand Schenk[2], Didier Alexandre[2], Sergio Grancagnolo[2], Tobias Kupfer[3], Johannes Erdmann[3], Danilo Ferreira de Lima[4], and Dennis Sperlich[2] — [1]University of Bonn — [2]Humboldt University, Berlin — [3]University of Dortmund — [4]University of Heidelberg

Vector-like quarks are coloured spin 1/2 fermions predicted by various Beyond the Standard Model (BSM) theories. A search for singly produced vector-like Q quarks, where Q can be either a T quark with charge $+2/3$ or a Y quark with charge $-4/3$, performed with 36.1 fb^{-1} of proton-proton collision data taken at the LHC at a centre-of-mass energy of 13 TeV in 2015 and 2016 recorded by the ATLAS detector will be reported in this talk. This analysis targets $Q \to Wb$ decays where the W boson decays leptonically. Here, events with one lepton and at least two jets are selected, requiring at least one b-tagged jet and at least one forward jet. The various methods and challenges encountered in this analysis will be shown in this talk. The results which are also interpreted as limits on the QWb coupling and the mixing with the Standard Model sector for a singlet T quark or a (Y, B) doublet will be presented in this talk.

T 51.2 Mi 16:50 Philo-HS4

First search for single production of vector-like B quarks in the $B \to bH$ decay channel with $H \to \gamma\gamma$ with the ATLAS detector at $\sqrt{s} = 13\,\text{TeV}$ — •Björn Wendland[1], Frederic Schröder[2], Isabel Nitsche[1], Diane Cinca[1], Johannes Erdmann[1], and Kevin Kröninger[1] — [1]TU Dortmund, Experimentelle Physik IV — [2]Bergische Universität Wuppertal

Vector-like quarks are the simplest extension of the Standard Model of particle physics (SM) with color charged fermions that is still allowed by data. The single production of vector-like B quarks, which is favored over the pair production at high masses, is considered in this analysis.

The decay of a singly produced B into a b quark and a Higgs boson with $H \to \gamma\gamma$ is studied at the LHC for the first time using data taken with the ATLAS detector at a center-of-mass energy of 13 TeV. Although the $H \to \gamma\gamma$ decay channel has a low branching ratio, this analysis benefits from the excellent mass resolution of the diphoton system.

The analysis strategy is based on the characteristic event topology with two photons with high transverse energy, one b-jet with high transverse momentum and one forward jet. The invariant mass of the B candidate is reconstructed from its decay products and used as discriminating variable against background. The main background contribution arises from non-resonant diphoton production with additional small contributions from SM Higgs boson production processes.

T 51.3 Mi 17:05 Philo-HS4

Suche nach Paarproduktion von vektorartigen Quarks im

Zerfallskanal $T/B \to Zt/b$ bei $\sqrt{s} = 13\,\text{TeV}$ am ATLAS-Experiment — •Elena Freundlich, Johannes Erdmann und Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Bei der Suche nach Physik jenseits des Standardmodells spielen Composite-Higgs-Modelle als Erweiterung des Standardmodells hin zu einer fundamentaleren Theorie eine wichtige Rolle. Diese Modelle sagen vektorartige Quarks (VLQ) voraus, deren links- und rechtshändiger Anteil die gleichen Transformationseigenschaften unter der SU(2) besitzen.

Es wird eine Analyse zur Suche nach Paarproduktion von VLQ bei $\sqrt{s} = 13\,\text{TeV}$ am ATLAS-Experiment vorgestellt. Die betrachteten Zerfälle sind $T \to Zt$ und $B \to Zb$, wobei die beiden VLQ T und B eine Ladung von $+2/3\,e$ bzw. $-1/3\,e$ tragen. Die betrachteten Ereignisse enthalten unter anderem ein hochenergetisches Z-Boson, das in ein Leptonenpaar $\ell^+\ell^-$ zerfällt, mindestens zwei Jets mit großem Radiusparameter und mindestens zwei b-Jets. Die statistische Analyse wird unter Berücksichtigung systematischer Unsicherheiten durchgeführt und es werden untere Limits auf die Massen von T und B gesetzt.

T 51.4 Mi 17:20 Philo-HS4

Search for excited bottom quarks decaying to tW with the CMS experiment — Johannes Haller, Roman Kogler, and •Alexander Fröhlich — Universität Hamburg, Institut für Experimentalphysik

We present a search for singly produced excited bottom quarks (b*) decaying to tW in pp-collisions at $\sqrt{s} = 13$ TeV. In this analysis, the muon + jets final state is studied. The W from the b* is assumed to decay into a muon and a neutrino and hence its four-momentum is reconstructed from the muon and the missing transverse energy. The W from the top quark decays hadronically. The top quark is assumed to be highly boosted and is reconstructed in a single jet. For its identification the analysis makes use of a new top tagging algorithm, the Heavy Object Tagger with Variable R (HOTVR). The adaptive cone size of this algorithm allows for a stable reconstruction efficiency over a large range of b* masses, which warrants a single analysis strategy for b* masses of 700 GeV up to a few TeV. The distribution of the reconstructed b* mass is used to search for deviations from the SM background prediction. Expected limits on the production cross-section are presented.

T 51.5 Mi 17:35 Philo-HS4

Search for VBF produced diboson resonances in the all-jets final state at $\sqrt{s} = 13$ TeV with the CMS experiment — •Irene Zoi, Robin Aggleton, and Andreas Hinzmann — Universität Hamburg

Many models of physics beyond the Standard Model (SM) predict the existence of heavy particles that decay to SM vector boson pairs. This talk presents a search for massive resonances produced through vector-boson-fusion (VBF) and decaying into a pair of vector bosons (WW, WZ or ZZ) where each boson decays to a quark anti-quark pair, extending the previously published searches optimized for production via gluon-fusion and quark anti-quark annihilation. The analysis is based on proton-proton collision data at $\sqrt{s} = 13$ TeV collected by the CMS experiment at the CERN LHC during 2016 and corresponding to an integrated luminosity of 35.9 fb^{-1}. The signals studied in this analysis are narrow resonances with masses above 1.0 TeV, that decay to energetic vector bosons, considering various spin hypotheses. The particles emerging from each vector boson are very collimated and therefore merged into a single boosted jet. Jet substructure techniques are exploited to significantly reduce the SM background.

T 51.6 Mi 17:50 Philo-HS4

Search for resonant WZ Production with the ATLAS detector at the LHC — •Joany Manjarres Ramos, Stefanie Todt, and Carsten Bittrich — TU Dresden

Heavy resonances decaying into diboson pairs, are among the most common features to search for phenomena beyond the standard model (SM). The electroweak boson pair production, is a powerful test of the spontaneously broken gauge symmetry of the SM and can be also used to search for phenomena beyond the SM. There is a wide spectrum of theoretical models predicting these kinds of resonant signatures.

In this talk the details of the search for resonant WZ production by the ATLAS detector at the LHC in the fully leptonic final state will be presented. The results will be interpreted using a parameterization of Lagrangians which incorporate a heavy vector triplet (HVT), and the Georgi-Machacek model (GM) is also used as a benchmark for a singly-charged scalar resonance.

T 51.7 Mi 18:05 Philo-HS4

Eine Suche nach exotischen Resonanzen im Zwei-Boson-Zerfallskanal mit vollhadronischem Endzustand mit dem CMS-Experiment — Matthias Mozer, Thomas Müller, Valerie Scheurer und •Daniela Schäfer — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Viele Erweiterungen des Standardmodells sagen die Existenz neuer Teilchen mit Massen im TeV-Bereich voraus, die zum Beispiel über ihren resonanten Zerfall in zwei Vektor-Bosonen nachgewiesen werden könnten. Die hier präsentierte Suche benutzt bei einer Schwerpunktsenergie von 13 TeV mit dem CMS-Detektor aufgenommene Daten, um im vollhadronischen Endzustand nach exotischen Zwei-Boson-Resonanzen zu suchen. Aufgrund der großen Masse der gesuchten Resonanzen sind ihre Zerfallsprodukte stark geboostet. Ein solches geboostetes Vektor-Boson kann nicht mehr über zwei einzelne Jets rekonstruiert werden, sondern seine Zerfallsprodukte werden stattdessen in einen einzigen "fetten" Jet geclustert. Um zwischen solchen Jets, die von stark geboosteten Vektor-Bosonen stammen, und Untergrund-Jets zu unterscheiden, werden Methoden basierend auf der Substruktur der Jets verwendet (*V-tagging*). Eine weitere Herausforderung ist die Modellierung des von QCD-Multijet Ereignissen dominierten Untergrundes. Hierfür wird eine neue Strategie verwendet, die auf einem multidimensionalen Fit im Zwei-Jet-Massenspektrum m_{jj} und den zwei Jet-Massen m_{jet1} und m_{jet2} beruht.

T 51.8 Mi 18:20 Philo-HS4

b tagging bei der Suche nach Dibosonresonanzen mit dem CMS Experiment — Matthias Mozer, Thomas Müller, Daniela Schäfer und •Valerie Scheurer — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Bei der Suche nach Dibosonresonanzen im vollhadronischen Kanal kann die Sensitivität verbessert werden, indem speziell für Z-Bosonen nach dem Zerfall in zwei b-Quarks gesucht wird. Zur Selektion dieser Zerfälle wird der „double-b tagger" verwendet, ein Werkzeug, das speziell für die Suche nach geboosteten Zerfällen des Higgs Bosons in zwei b-Quarks entwickelt wurde.
Im Votrag wird die Verwendbarkeit des „double-b taggers" für Z-Bosonen sowie die Verbesserung der Ausschlussgrenzen mithilfe der Methode gezeigt.

T 51.9 Mi 18:35 Philo-HS4

Search for a heavy resonance Z' decaying into $T't$ in lepton+jets final states at $\sqrt{s} = 13$ TeV with the CMS experiment — •Anna Benecke, Johannes Haller, Andreas Hinzmann, and Roman Kogler — Universität Hamburg

Many models of physics beyond the Standard Model predict vector-like quarks (T') and a new heavy gauge boson (Z'). While decays of the Z' and T' into Standard Model particles have been studied already, no dedicated searches for the decay $Z' \to tT'$ with $T' \to Ht$ have been performed so far. This talk presents the results of a search for a heavy spin-1 resonance Z' decaying into $T't$ at $\sqrt{s} = 13$ TeV based on data collected by the CMS experiment in 2016 corresponding to an integrated luminosity of 36 fb^{-1}. Two decay modes of the T' quark to third generation Standard Model quarks are considered: $T' \to Ht$ and $T' \to Zt$. Jet substructure techniques are used to identify the boosted hadronic decays of H or Z bosons and significantly reduce the SM backgrounds. A χ^2 method is used for the reconstruction of the Z' mass. Its distribution is used to identify possible deviations of the data from the SM background prediction. Finally, model independent exclusion limits on the production cross section are derived as well as two interpretations in the context of a heavy gauge boson Z' and a heavy gluon G* are presented.

T 51.10 Mi 18:50 Philo-HS4

A search for high-mass resonances decay to $\tau\nu$ in pp-collisions at $\sqrt{s}$ =13 TeV with the ATLAS detector — •Christos Vergis, Will Davey, and Jochen Dingfelder — Physikalisches Institut, Universität Bonn, Germany

Many models beyond the Standard Model predict the existence of new heavy charged (W') gauge bosons. In case of leptonic W' decays, the signature is a high-p_T lepton and large missing energy from the emitted neutrino. Although searches for $W' \to e/\mu$ are more sensitive than

$W' \to \tau\nu$ for universal coupling to leptons, decays to tau lepton are well suited for models in which the W' couples preferentially to third-generation fermions.

The search for heavy resonances decaying to a tau lepton and a neutrino is performed in events where the tau lepton decays hadronically, using 36.1 fb^{-1} of pp-collision data at $\sqrt{s}$ =13 TeV recorded by the ATLAS detector at the LHC. This is the first search for W' bosons in this decay channel from ATLAS. No significant excess of events over the Standard Model expectation was found and 95% CL upper limits are set on the visible $\tau\nu$ production cross section, $\sigma(pp \to \tau\nu + X) \cdot B \cdot A \cdot \epsilon$. W' bosons with masses below 3.74 TeV (SSM) and 2.1-3.76 TeV (non-universal models) are excluded, significantly improving the limits set by other searches for new gauge bosons with non-universal couplings.

In this talk, an overview of the $W' \to \tau\nu$ analysis and the current results will be given.

T 52: Suche nach dunkler Materie III

Zeit: Mittwoch 16:30–19:05 Raum: Philo-HS5

Gruppenbericht T 52.1 Mi 16:30 Philo-HS5

Searching for low-mass dark matter particles with the SuperCDMS experiment — •Belina von Krosigk — University of British Columbia, Vancouver, Canada

A compelling set of diverse astrophysical observations points to the existence of dark matter. The most popular particle dark matter candidates are Weakly Interacting Massive Particles (WIMPs). SuperCDMS, the advanced successor of the Cryogenic Dark Matter Search, is designed to directly observe galactic WIMPs via keV-scale nuclear recoils in semiconductor detectors operated at temperatures around 50 milliKelvin. The nuclear recoils are detected in the form of lattice vibrations (phonons). Additionally, electron-hole pairs produced in the biased crystals drift to the electrodes, creating further phonons. The CDMS low ionization threshold experiment (CDMSlite) modified the operation of existing SuperCDMS detectors to take advantage of this effect. A bias of 70 V applied across these detectors allows very small ionization signals to appear as larger phonon signals, which significantly reduces the energy threshold of the detectors. The most recent results will be presented, which probe a new parameter space for the spin-independent WIMP-nucleon cross section at WIMP masses as low as 1.6 to 4 GeV/c2.

T 52.2 Mi 16:50 Philo-HS5

DARWIN – The Ultimate WIMP Detector — •Fabian Kuger — Albert-Ludwigs Universität, Freiburg, Germany

The DARWIN (DARk matter WIMP search with liquid xenoN) experiment, a 40 t target mass liquid Xenon time projection chamber, will be the next-to-next generation direct search dark matter detector. It will reach a sensitivity to WIMP nuclear recoil cross-sections at the level of the "ultimate" irreducible coherent scattering background induced by solar and atmospheric neutrinos, probing the entire experimentally accessible parameter space for WIMP masses above a few GeV/c^2. Besides its excellent sensitivity to WIMP dark matter, DARWIN will explore a plethora of science channels in astroparticle and nuclear physics, e.g., the neutrinoless double beta decay of ^{136}Xe.

The DARWIN Collaboration currently performs R & D and design studies to investigate potential improvements to the detector baseline design. This talk will provide an overview on the science program of DARWIN and introduce its baseline design. The technical challenges owed to the detector size and its requirements in terms of detector backgrounds will be addressed. Some of the technological alternatives currently under study are showcased briefly.

T 52.3 Mi 17:05 Philo-HS5

Analysis of the Optical Characteristics of the DARWIN Prototype via Ray Tracing - First Results — •Marius Goetz, Guido Drexlin, Jonas Kellerer, and Daniel Hilk — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

DARWIN (**DAR**k matter **WI**mp search with liquid xeno**N**) aims to probe spin-independent WIMP-nucleon cross-sections down to $\mathcal{O}(10^{-49}\,\mathrm{cm}^2)$, using a multi-ton dual phase noble gas detector. WIMP interactions produce both an ionization and photon signal in liquid xenon (LXe). The electrons are extracted from the LXe by a drift field to the gaseous xenon, where secondary photons are created. Secondary and primary photons are measured with photosensors.

An optimized photon detection efficiency in LXe is crucial to separate signal from background. To this end, optical properties like reflectivity, absorption, detection efficiency and photomultiplier design of a prototype, to be built at KIT, and the final detector have to be investigated in detail. The impact of novel concepts such as inner electrodes also has to be investigated.

Comprehensive light collection models of the prototype at KIT are developed and implemented both into Geant4 and Comsol Multiphysics to study the implications of different detector designs on the light yield. First results of this analysis are summarized in this talk.

T 52.4 Mi 17:20 Philo-HS5

Electronic recoil background in the XENON1T experiment — •Miguel Angel Vargas — Institut für Kernphysik, WWU Münster, Germany

The XENON1T experiment aims at finding direct evidence for dark matter through the scattering of Weakly Interacting Massive Particles (WIMPs) with target nuclei in an ultra-low background dual-phase xenon Time Projection Chamber (TPC) based detector that employs about 2 tons sensitive volume of liquid xenon.

In order to reach its projected sensitivity a robust estimation of the background rate in the detector is a key ingredient. Therefore, the background sources are divided in two main classes for their analysis: electronic recoils (ER) off the atomic electrons and nuclear recoils (NR) off the Xe nuclei.

This talk focuses on the ER backgrounds sources: from radioactivity in the detector materials, sources intrinsic to the LXe (beta decay of Kr-85, of Rn-222 and its daughters, and Xe-136 double-beta decay) and from solar neutrinos scattering off electrons. Their understanding is used to predict the potential statistical leakage of ER events into the NR region, which could mimic a WIMP signal.

"This work is supported by BMBF under contract05A17PM2 and by DFG through Research Training Group 2149."

T 52.5 Mi 17:35 Philo-HS5

The radioactive backgrounds of XENONnT — •Arianna Rocchetti — XENON Collaboration

The XENON project aims at the direct detection of WIMP dark matter through the elastic scattering off xenon nuclei. It consists of a time projection chamber (TPC) filled with liquid xenon both as target and detection medium. The next step of the XENON program, the multi-ton scale XENONnT, is currently being developed by the collaboration. Its target mass of 6.0 t will improved the sensitivity to the WIMP nucleon interaction cross section to 1.6 * 10^48 cm^2 in a 20 t * y exposure. To estimatate the XENONnT sensitivity, the detailed knowledge about all possible background events is crucial. In this talk we present the detailed Monte Carlo simulations addressing the electronic and nuclear recoil backgrounds. Among the background sources are the decays of radioactive isotopes contained in the detector materials, which can lead to electronic and nuclear recoil signals. By means of Monte Carlo simulations we can reconstruct the spatial distribution of the interactions and fiducialize the target volume. We will present the results of these studies.

T 52.6 Mi 17:50 Philo-HS5

The Neutron Veto System for the XENONnT Dark Matter experiment — •Melanie Scheibelhut — Johannes Gutenberg-Universität Mainz, on behalf of the XENON Collaboration

The currently operating XENON1T experiment at the Laboratori Nazionali del Gran Sasso (LNGS) is the first ton-scale dual-phase xenon time projection chamber (TPC) aiming for the direct detection of dark matter in the form of Weakly Interacting Massive Particles (WIMPs). It has achieved world-leading sensitivity with its first science exposure of 34.2 live days, and has meanwhile taken a full year of dark matter search and calibration data. While XENON1T is exploring the WIMP spin-independent cross-section in the few 10^{-47} cm^2 regime, the collaboration is already preparing the upgraded experiment XENONnT with about 8 tons of LXe, aimed at a further

order of magnitude in sensitivity improvement. In order to maximize the fiducial volume free of nuclear recoils, we are working towards a neutron veto system based on Gd-loaded liquid scintillator. We report on Monte Carlo simulations and first validation measurements.

T 52.7 Mi 18:05 Philo-HS5

Particle Identification via Liquid Argon-Xenon Scintillation — •Andreas Himpsl[1], Walter Potzel[1], Stefan Schönert[1], Marcel Toulemonde[2], Andreas Ulrich[1], and Jochen Wieser[3] — [1]Technische Universität München, Physik Department E15, James-Franck-Str., 85748 Garching, Germany — [2]CIMAP-GANIL, Bd. Henri Becquerel BP5133 14070 Caen cedex 5, France — [3]Excitech GmbH, Branterei 33, 26419 Schortens, Germany

Two well separated scintillation light emission peaks are observed in liquid argon with a 10ppm xenon admixture: The VUV emission of the xenon excimer at 174nm, and a NIR emission with a center wavelength of 1173nm, attributed to a transition between a Wannier Mott exciton and the first excited level in xenon (A. Neumeier EPL109, 12001, 2015). The goal of this study was to test potential particle identification by measuring the NIR-to-VUV intensity ratio. Various ions from the Munich Tandem accelerator exciting the liquid with energies between 0.3 and 20 MeV/u were used for that purpose. It was found that the NIR/VUV intensity ratio depends on the projectile species and its energy. Furthermore, for detector physics, energy deposition per unit volume is important, not only linear energy transfer (LET). Superheating and boiling conditions have to be considered in the center of some of the heavy ion tracks. To explain the results the transition from LET to energy deposition per atom will be discussed.

This work was supported by the DFG Excellenzcluster Origin and Structure of the Universe and the Maier-Leibnitz-Laboratorium (Garching).

T 52.8 Mi 18:20 Philo-HS5

XEBRA - A test platform for liquid xenon detectors — •Patrick Meinhardt — Physiklalisches Institut, Freiburg, Deutschland

Dual-phase time projection chambers (TPCs) filled with liquid xenon (LXe) are a widely-used technique for the direct search for dark matter in the form of weakly interacting massive particles (WIMPs). The future DARWIN experiment will use a multi-ton LXe TPC to improve the WIMP-nucleon scattering sensitivity to the neutrino floor, defined by irreducible neutrino-nucleus interactions. In order to realize DARWIN, new detection concepts need to be developed and the background of the instrument needs to be reduced compared to the state-of-the-art. XEBRA (XEnon Based Research Apparatus) is a cryogenic test platform to investigate detection technologies and methods of background reductions relevant for the DARWIN experiment. This talk will give an overview about the XEBRA setup in Freiburg, its capabilities and ongoing R&D within the ERC-funded project ULTIMATE.

T 52.9 Mi 18:35 Philo-HS5

Improving the radiopurity of $CaWO_4$ crystals for the CRESST experiment — •A. Kinast[1], A. Erb[1,2], T. Faestermann[1], G. Korschinek[1], A. Langenkämper[1], E. Lindner[1], A. Münster[1], E. Mondragon[1], T. Ortmann[1], S. Pavetich[3], W. Potzel[1], S. Schönert[1], H. H. Trinh Thi[1], S. Wawoczny[1], A. Wallner[3], and M. Willers[1] — [1]Physik-Department, Technische Universität München, D-85748 Garching — [2]Walther-Meißner-Institut für Tieftemperaturforschung, D-85748 Garching — [3]Department of Nuclear Physics, Australian National University, Canberra, Australia

The direct dark matter search experiment CRESST uses scintillating $CaWO_4$ single crystals as targets for possible recoils of dark matter particles. For several years these $CaWO_4$ crystals are produced directly at TUM including the $CaWO_4$ powder production from the raw materials $CaCO_3$ and WO_3 as well as the crystal growth via the Czochralski method. To further increase the sensitivity of the CRESST experiment, an improvement of the crystal radiopurity is crucial. To achieve this goal, a new method for the chemical purification of the raw materials has been developed at TUM. In order to investigate the radiopurity-level achieved by this method, highly-sensitive screening methods are required. In this work Accelerator Mass Spectrometry (AMS) has been tested for $CaWO_4$ radiopurity screening and first results will be presented. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the BMBF Verbundprojekt 05A2017 CRESST-XENON and by the SFB1258.

T 52.10 Mi 18:50 Philo-HS5

Characterization of Sputtered Tungsten Thin Films for the CRESST Experiment using Transition Measurements and X-Ray Diffraction — •Tobias Ortmann, Angelina Kinast, Erik Lindner, Elizabeth Mondragón, Andrea Münster, Walter Potzel, Stefan Schönert, Andreas Ulrich, Stephan Wawoczny, and Michael Willers — Physikdepartment E15 and Excellence Cluster Universe, Technische Universität München, D-85748 Garching

The CRESST experiment (Cryogenic Rare Event Search with Superconducting Thermometers) searches for nuclear recoils events induced by elastic scattering of dark matter particles off the target nuclei within $CaWO_4$ target crystals. The detectors are operated at a temperature of $\mathcal{O}(10\,\mathrm{mK})$ and consist of the target crystal and a separate cryogenic light detector. Both heat (phonon) and light signals are read out via a tungsten TES (Transition Edge Sensor) utilizing the superconducting phase transition of tungsten to measure the energy deposited in the respective absorbers. RF-magnetron sputtering is promising method to produce the tungsten thin films for the TES. It provides a high production rate, highly tunable transition temperatures and it produces mechanically stable films. The thin film production via this method is investigated in terms of film quality reproducibility using transition measurements and x-ray diffractometry and the results of this investigation are presented. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the BMBF Verbundprojekt 05A2017 - CRESST-XENON and by the SFB1258.

T 53: Kosmische Strahlung III

Zeit: Mittwoch 16:30–19:05 Raum: Philo-HS6

Gruppenbericht T 53.1 Mi 16:30 Philo-HS6

Status and prospects of the Tunka Radio Extension (Tunka-Rex) — •Dmitriy Kostunin — Karlruhe Institute of Technology, Karlsruhe, Germany

The Tunka Radio Extension (Tunka-Rex) is a cosmic-ray experiment located in Siberia at the TAIGA facility (Tunka Advanced Instrument for cosmic rays and Gamma Astronomy). Tunka-Rex is an array of 63 antenna stations placed on 1 km^2 area and connected to the air-Cherenkov array Tunka-133 and the particle detectors Tunka-Grande, which trigger for the radio array. The antennas of Tunka-Rex detect radio pulses emitted during the development of ultra-high energy cosmic-ray air-showers in the frequency band of 30-80 MHz. The setup has been commissioned in 2012. From that time on it has achieved the number of important results, particularly that the radio technique is competitive to established techniques regarding the energy precision and can be used for cross-calibration between different cosmic ray experiments as well as for measurements of mass composition. Until now few thousands events have been detected jointly with the radio and particle setups and about more than hundred events are detected with all three setups. In the present talk I will give an overview of the Tunka-Rex instrumentation and methods, present recent results and prospects of the experiment.

T 53.2 Mi 16:50 Philo-HS6

Towards a Radio Measurements of the Energy Spectrum of Cosmic Rays with Tunka-Rex — •Vladimir Lenok for the Pierre Auger-Collaboration — Institute for Nuclear Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

The Tunka Radio Extension is a radio detector for cosmic rays placed at the TAIGA (Tunka Advanced Instrument for cosmic ray physics and Gamma Astronomy) facility near Lake Baikal. The antenna array of the detector comprises 63 antennas spread over an area of about 1 km^2 and receives triggers from co-located air-Cherenkov and particle detectors. During the last years, the experiment has evinced high resolution for the energy of cosmic rays. Our next goal in this direction is to

estimate the flux of the primary cosmic rays via radio measurements. To carry out this estimation we developed a procedure of calculation of the array aperture based on an experimental estimation of the detection threshold and simulations of the efficiency taking into account the arrival direction and core position of the shower (relative to the antenna array). In the talk details of the energy reconstruction and the calculations of aperture will be presented. Based on the results of this estimation we plan to obtain the energy spectrum of cosmic rays with a lower uncertainty than for particle detectors, but the same level of statistics as for particle detectors.

T 53.3 Mi 17:05 Philo-HS6

New Results from the KASCADE-Grande Data Analysis — •Donghwa Kang for the KASCADE-Grande-Collaboration — Karlsruhe Institute of Technology, Karlsruhe

KASCADE-Grande and its original array of KASCADE measured individual air showers of cosmic rays in the energy range of 100 TeV up to 1 EeV. The data accumulation was fully completed at the end of 2013 though, the data analysis is still in progress. Recently, we published two new results: The estimation on upper limits to the flux of ultra-high energy gamma rays, which set constraints on some fundamental astrophysical models. And the determination of the muon attenuation length by investigations on the evolution of the muon content of very-high energy air showers in the atmosphere, compared to the predictions of various hadronic interaction models.

In addition, we updated KCDC, the web-based platform where we publish the data from KASCADE and KASCADE-Grande with more than 20 years measurements. A new version of the KASCADE Cosmic Ray Data Centre (KCDC) is released, named NABOO 2.0, where we now also provide air-shower simulation data sets for three different hadronic interaction models.

In this contribution, recent results from KASCADE-Grande and the update of KCDC will be briefly discussed.

T 53.4 Mi 17:20 Philo-HS6

Recent developments from the Auger Engineering Radio Array (AERA) — •Ewa Marlen Holt for the Pierre Auger-Collaboration — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie (KIT)

The Auger Engineering Radio Array (AERA) is designed to measure the radio emission of extensive air showers initiated by cosmic rays above an energy of 10^{17} eV. The experiment is located in Mendoza, Argentina, as an extension of the Pierre Auger Observatory and is operated in coincidence with the other detectors of the observatory. Its 153 autonomous radio antenna stations are distributed over an area of 17 km^2 on a grid with a spacing ranging from 150 – 750 m. Each antenna station comprises two dipole antennas sensitive to frequencies of 30 – 80 MHz. Data taking started in 2011. Special emphasis is put on the detection of inclined air showers, which feature radio emission footprints extended over several square kilometers. The independent energy reconstruction from the radio emission has the potential to cross-check the absolute energy scale of the Pierre Auger Observatory. To reach this goal, a very precise calibration of the radio antennas has been performed. Different mass estimators are reconstructed from the radio emission such as the atmospheric depth of the shower maximum and the radio-muon ratio measured in combination with the muon detectors of the Observatory. In this talk an overview of the current status of the experiment and the latest scientific results is given.

T 53.5 Mi 17:35 Philo-HS6

Messung von horizontalen Luftschauern mit AERA * — •Marvin Gottowik für die Pierre Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Mit dem Auger-Engineering-Radio-Array (AERA) des Pierre-Auger-Observatoriums wurde die, von horizontalen Luftschauern (Zenitwinkel zwischen 60 ° und 90 °) emittierte, elektromagnetische Strahlung im Radiobereich gemessen. Im Gegensatz zu vertikalen Luftschauern kann die Emission auf einer großen Fläche von mehreren km^2 auf dem Erdboden detektiert werden. Dadurch wird die Ereignisstatistik bei den höchsten Energien im EeV Bereich erhöht. Das ist insbesondere interessant, da die Radioemission direkten Zugriff auf die Energie der elektromagnetischen Kaskade ermöglicht. In Kombination mit dem Oberflächendetektor des Pierre-Auger-Observatorium, der für horizontale Schauer hauptsächlich Muonen detektiert, kann daher die Komposition der Primärteilchen auch bei horizontalen Schauern bestimmt werden. Zusätzlich erlaubt die große Nachweisfläche die Detektion und Rekonstruktion des Lauftschauers mit einem größerem Abstand zwischen den Antennen, wie die 1,5 km zwischen den 1600 Stationen des Oberflächendetektors.

* Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).

T 53.6 Mi 17:50 Philo-HS6

Erste Analysen des AugerPrime Engineering-Arrays* — •Sonja Schröder für die Pierre Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Das Upgrade AugerPrime des Pierre-Auger-Observatoriums in Argentinien ermöglicht es, die Genauigkeit der Kompositionsmessungen der Primärteilchen von ausgedehnten Luftschauern zu verbessern. Durch Szintillationsdetektoren (SSD) oberhalb der vorhandenen Detektorstationen kann eine Separation von elektromagnetischer und myonischer Komponente eines Teilchenschauers erreicht werden. In diesem Vortrag wird die Datenqualität des SSD Engineering-Arrays analysiert. Es werden sowohl die Langzeitstabilität der Datenqualität, als auch Parameter wie die Zeitauflösung, die Signalamplitude und Temperatureffekte der Detektoren, untersucht. Ein besonderer Fokus wird auf zwei unmittelbar benachbarte (18 m) Detektorstationen gelegt. Diese Zwillingsstationen befinden sich in einer Region, in der die Abstände der Detektorstationen von 1500 m auf 433 m verringert wurden. Dadurch ergibt sich eine Herabsetzung der Energieschwelle auf $\approx 10^{16.5}$ eV, sowie eine mindestens 10 mal höhere Ereignisstatistik im Vergleich zum regulären Feld.

** Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1).*

T 53.7 Mi 18:05 Philo-HS6

Development of a universal time model for AMIGA at the Pierre Auger Observatory — •Johannes Hulsman for the Pierre Auger-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany — Instituto de Tecnologías en Detección y Astropartículas (ITeDA), Buenos Aires, Argentina

Shower Universality aims to describe the atmospheric shower development of cosmic rays by accounting for the physical properties of the secondary particles. It relies on the universal behavior of the EM and muonic longitudinal profiles. To successfully map the EAS 1-to-1, it is pertinent to properly parameterize the detector signal as a function of position and shower stage. At the Pierre Auger Collaboration, such a universal model has been developed for the timing of the surface detectors for energies between $10^{18.5}$eV and 10^{20}eV. Each shower is described with a set of global parameters (X_{max}, energy, geometry and normalized muonic component) and predicts the expected signal with 10% accuracy. Combining these results with the 100% duty cycle of the surface detectors allows for mass composition and anisotropy studies with great event statistics.

The AMIGA underground muon detector is an upgrade of the Pierre Auger Observatory and aims to directly measure the muons from air showers and extend the energy range towards 10^{17}eV. In addition to extending the time model of the surface detectors for lower energies, a dedicated time model is being developed and will account for the muonic production depth X^{μ}_{max}. Combining both will provide more insight into the air shower. Initial results will be shown.

T 53.8 Mi 18:20 Philo-HS6

Performance of the upgraded surface detector stations of the Pierre Auger Observatory — •Alexander Streich, Alvaro Taboada, Darko Veberic, Markus Roth, and Ralph Engel for the Pierre Auger-Collaboration — Karlsruher Institut für Technologie, Deutschland

In September 2016, the major phase of the AugerPrime upgrade of the Pierre Auger Observatory started with the installation of the first scintillator detectors on top of the existing water-Cherenkov tanks. By providing a complementary measurement of the different components of air shower particles the Scintillator Surface Detectors will significantly improve the analysis of cosmic rays, for example the determination of the mass composition of the primary particles. This presentation will focus on the performance of the upgraded surface detector stations deployed in the Engineering Array of the Observatory. In addition, the presentation will provide a short update on the ongoing production of the Scintillator Surface Detectors including measurements for the quality control and for the characterization of the new detectors.

T 53.9 Mi 18:35 Philo-HS6

Evaluation of SALLA Antennas for Radio Observations of Inclined Air Showers — •Vladimir Lenok for the Pierre Auger-

Collaboration — Institute for Nuclear Physics, Karlsruhe Institute of Technology, Karlsruhe, Germany

The Auger Engineering Radio Array (AERA) is a cosmic-ray experiment at the Pierre Auger Observatory in the Province of Mendoza, Argentina. The array comprises about 150 antennas of log-periodic and butterfly types spread over an area of 17 km^2 and is used for detection of radio emission from air showers of energies above 0.1 EeV in the band of 30–80 MHz. Recently, at the site of AERA three short aperiodic loaded loop antennas (SALLA) were installed. These three antennas are a pathfinder for a future radio detector aimed at the observation of inclined air showers at the Auger Observatory. Combined radio and particle measurements are sensitive to the type of the primaries, even for the inclined showers. This will enable to resolve the recently found anisotropy into heavy and light components and at the same time increase the area of observed sky. In this talk the results of a preliminary analysis will be presented.

T 53.10 Mi 18:50 Philo-HS6

A Surface Radio Array for IceCube-Gen2 — •Aswathi Balagopal V. — Karlsruhe Institute of Technology, Institute for Experimental Particle Physics, Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen

Radio detection of air showers has proven to be an effective method for extracting information of air showers and their properties. Primary particles with energies of hundreds of PeV have been successfully measured with the method of radio detection. Existing experiments measuring such air showers operate in the frequency range of 30-80 MHz. An optimization of the frequency range of operation can be done for maximizing the signal-to-noise ratio that can be achieved by an array of radio antennas at the South Pole. The prospects of using such an optimized radio array for measuring gamma-rays of PeV energies from the Galactic Center will be presented in this talk.

T 54: Gammaastronomie II

Zeit: Mittwoch 16:30–18:25 Raum: Philo-HS7

Gruppenbericht T 54.1 Mi 16:30 Philo-HS7

FACT - Results from Six Years of Monitoring at TeV Energies — •Daniela Dorner for the FACT-Collaboration — Universität Würzburg, Germany

The First G-APD Cherenkov Telescope, located on the Canary Island La Palma, is operational since more than six years. Thanks to the stable performance of its SiPM camera, it is ideally suited for long-term monitoring. With robotic operation, the data taking efficiency was maximized reaching up to 2400 h of physics data in 12 months. Monitoring a small sample of bright TeV sources, in total about 10000 hours of physics data have been collected. The bright blazars Mrk 421 and Mrk 501 have been observed for about 2000 hours each. In 2012 and 2014, extreme outbursts have been observed from Mrk 501, and Mrk 421 showed a bright flare in 2013. Another blazar, 1ES 1959+650 showed an exceptional outburst in summer 2016 after having shown no enhanced activity for 14 years. Thanks to an automatic quick look analysis, FACT alerts the community about such events with low latency triggering valuable multi-wavelength observations. Since March 2014, more than 50 alerts and five astronomer's telegrams have been issued. Following an open data policy, the FACT Collaboration not only publishes the results of the quick look analysis online, but also provides a sample of high quality raw data to the community.

The presentation summarizes results from six years of blazar monitoring with FACT and coordinated multi-wavelength studies.

T 54.2 Mi 16:50 Philo-HS7

MAGIC as a Neutrino Alert Follow-up Instrument — •Alicia Fattorini for the MAGIC-Collaboration — TU Dortmund

Despite the detection of a diffuse cosmic neutrino flux by the IceCube neutrino observatory in 2013, no neutrino point source has been detected yet. A promising approach for the first detection are the ongoing multi-messenger campaigns.

When a potential astrophysical neutrino is detected by IceCube, an alert with the reconstructed coordinates is sent among others to MAGIC, where follow-up observations are performed in search of a correlated gamma-ray flux. As the MAGIC telescopes are designed to observe sources with well-known coordinates, the analysis for discovering sources in a given region has to be modified. Different statistical methods for identifying point sources as possible neutrino sources are studied. This talk presents an overview of different techniques of deriving sky maps for point source searches.

T 54.3 Mi 17:05 Philo-HS7

FACT - Sub-Threshold Data for Correlation Studies in AMON — •Daniela Dorner[1] and Azadeh Keivani[2] for the FACT-Collaboration — [1]Universität Würzburg, Germany — [2]Pennsylvania State University, USA

In more than six years, the First G-APD Cherenkov Telescope (FACT) has collected an unprecedented data sample by continuously monitoring a small sample of blazars. Thanks to the stable performance of the system, the data taking efficiency could be maximized achieving up to 2400 hours of physics data per year. Blazars like Mrk 421, Mrk 501 and 1ES 1959+650 have been showing exceptional flaring activities. A fast quick look analysis enables the collaboration to alert the community within minutes in case of an interesting event.

To enhance the combined sensitivity of collaborating observatories to astrophysical transients, the Astrophysical Multimessenger Observatory Network (AMON) is searching for significant coincidences in sub-threshold data provided by the individual observatories. FACT joined AMON both as triggering and follow-up observatory.

Trigger criteria for the FACT sub-threshold events have been defined, and the data are sent to AMON in real-time. These alerts will be analyzed in coincidence with sub-threshold triggers of other AMON partner observatories. In case a significant coincidence is found, an AMON alert will be issued, enabling rapid multi-wavelength follow-up observations. Such multi-messenger searches will enable us to address many important questions in high energy astrophysics, including the emission and acceleration mechanisms in high energy sources.

T 54.4 Mi 17:20 Philo-HS7

Classification of unassociated 3FGL sources with Machine Learning — •Simone Mender, Kai Brügge, Maximilian Nöthe, and Kevin Schmidt — TU Dortmund, Lehrstuhl für Experimentelle Physik Vb, Otto-Hahn-Straße 4a, 44227 Dortmund

Active Galactic Nuclei (AGN) are astrophysical objects, whose emission range covers the entire electromagnetic spectrum. The AGN unification model includes numerous subclasses. The most powerful of them are the blazars, which are subdivided into BL Lac and Flat Spectrum Radio Quasars. To explore their phenomenology and their cosmological evolution it is interesting to look at average spectral energy distributions for the different classes.

The aim is to classify as many objects as possible so that they can be included in the calculation of average spectral energy distributions. To perform this classification Machine Learning can be used. In this talk, ongoing work based on the Fermi 3FGL catalog will be presented. It will be shown how unassociated sources and blazar candidates of uncertain type can be classified. For this purpose, methods of supervised and unsupervised learning are compared.

Gruppenbericht T 54.5 Mi 17:35 Philo-HS7

M@TE - Extending the Coverage of TeV Monitoring — •Daniela Dorner[1] and Thomas Bretz[2] for the MATE-Collaboration — [1]Universität Würzburg, Germany — [2]RWTH Aachen, Germany

Monitoring at TeV Energies (M@TE) is a joint project of German and Mexican universities which aims at extending the blazar monitoring to so far unexplored time ranges.

Emitting radiation across the electromagnetic spectrum, blazars are highly variable objects. At TeV energies variability on time scales from minutes to years have been measured. To study typical variability time scales of few hours to one day, continuous observations are crucial.

Long-term monitoring at TeV energies is carried out by the FACT project sucessfully since more than six years. Being limited to one site, gaps due to the rotation of the Earth remain in the measured light curves. To allow for systematic studies using continuous observations covering up to 12 hours, a second telescope is being installed in Mexico.

A mount from a previous experiment is being refurbished and will be equipped with a new SiPM camera. Providing an excellent and stable performance, these silicon based photo sensors are ideal for long-term monitoring. The mount, a new drive system and new mirrors are already available and with the observatory of San Pedro Martir, an excellent site has been chosen.

In the presentation, the overview of the project will be given and its status discussed.

T 54.6 Mi 17:55 Philo-HS7

Transient simulations for ground-based detection — •Jana Moschner, Lena Linhoff, and Kai Brügge — TU Dortmund

Gamma-ray bursts (GRBs) are high energy transient phenomena in the gamma-ray band which show incomparable brightness for very short time scales. Despite many detections and follow-up observations in different wavelengths, there remain unsolved questions on GRBs. With their unprecedented sensitivity, fast slewing capacity and wide field of view, the next generation of ground-based Cherenkov telescopes like CTA will be able to detect and follow-up transients like GRBs. To analyze these short transient, we are currently working on a tool which detects transients during the regular data taking. A wavelet transform makes it possible to find transient events in the field of view of a steady source. Therefore a steady source, the cosmic background and a transient are simulated by using toy models. Instead of that, we now need realistic models to develop and evaluate the methods for transient detection. Due to the low number of ground-based transient observations, there is a need for physically wise simulations of spectra and lightcurves of short transients in the energy range of Cherenkov telescopes. This talk will give an introduction to different simulation models for transients like GRBs based on data from the Fermi and Swift satellites.

T 54.7 Mi 18:10 Philo-HS7

Wavelet Denoising for Transient Search — •Lena Linhoff, Kai Brügge, and Jana Moschner — TU Dortmund

Astrophysical transient events are phenomena where a huge amount of high energy radiation is emitted over short timescales (a few minutes) such as gamma ray bursts, supernovae or transits. Cherenkov telescopes like CTA in its final setup will be able to see such short flares in the gamma ray regime on unknown positions. Since transients appear in an unpredictable manner, it necessary to detect these short events during the regular data taking. Due to very limited observation time the data taken from transient events is very noisy and dominated by background events and steady sources in the field of view. A wavelet transform is an application known from digital image processing to denoise images and is used in this context to find transient events in the field of view of Chrerenkov telescopes.

T 55: Neutrinophysik VII

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - HS 0.001

T 55.1 Mi 16:30 Z6 - HS 0.001

Investigating the transmission function of KATRIN using gaseous ^{83m}Krypton — •Lutz Schimpf for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) aims to measure $m(\nu_e)$ with a sensitivity of 200 meV at 90 % confidence level. To determine the neutrino mass an integrated spectrum of the electron energy close to the endpoint is measured and a fit to the data containing the neutrino mass as a free parameter is performed. The measured beta spectrum is affected by various systematics, with the transmission function properties of the MAC-E filter spectrometer playing a major role. Although the transmission function of a MAC-E filter can be analytically calculated its shape is broadened and distorted by two main systematics. One is the short-term high voltage stability of the retardation potential in the main spectrometer, which is in the millivolts range. The other main systematic is the emission of synchrotron radiation while the electrons are magnetically guided from their origin in the tritium source towards the spectrometer and detector section. The usage of ^{83m}Krypton as source gas allows to study the above described transmission function properties, since the discrete energy spectrum of krypton provides monoenergetic electrons with line widths in the range of 1 eV and below. Both the influences on the transmission function as well as its influence on the measured linewidth of the krypton spectrum will be presented. This work has been supported by BMBF (05A17VK2), KSETA and the Helmholtz Association (VH-NG-1055).

T 55.2 Mi 16:45 Z6 - HS 0.001

Commissioning measurements of the CKrS with KATRIN — •Alexander Fulst for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The **KA**rlsruhe **TRI**tium **N**eutrino Experiment (KATRIN) is a model-independent measurement of the neutrino mass from the kinematics of tritium β-decay, aiming for a sensitivity of 0.2 eV/c^2 (90% C.L.). It uses an electrostatic spectrometer working in MAC-E-filter mode to analyze energies of beta-electrons generated in a windowless gaseous tritium source (WGTS). The experiment uses several sources for absolute energy calibration, monitoring and precise determination of the transmission function of the spectrometer. One of them is the ***C**ondensed **Kr**ypton **S**ource* (*CKrS*) developed in Münster which utilizes nearly monoenergetic conversion electrons from an adsorbed ^{83m}Kr layer on a graphite (HOPG) substrate. The substrate with the frozen ^{83m}Kr layer can be moved mechanically over the complete flux tube area at its position in the KATRIN beamline and therefore allows for per-pixel calibration of the KATRIN focal plane detector (FPD). The cleanliness of the substrate and the quality of the frozen radioactive films are crucial for the stability and reproducibility of the conversion electron spectrum and both are monitored by means of laser ellipsometry.

The source was recently installed at the KATRIN Cryogenic Pumping Section (CPS) and was successfully used in the KATRIN commissioning measurements in the summer 2017. Measurements regarding characterization of the source and spectroscopy with the CKrS are presented. This work is supported under BMBF contract 05A17PM3.

T 55.3 Mi 17:00 Z6 - HS 0.001

Pixel-resolved transmission and alignment analysis in KATRIN using ^{83m}Krypton — •Wonqook Choi for the KATRIN-Collaboration — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

The goal of the **KA**rlsruhe **TRI**tium **N**eutrino (KATRIN) experiment is the determination of the electron neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ (90% C.L.) by measuring an integrated energy spectrum of electrons from tritium β-decay. The experiment uses a MAC-E filter where electrons that have sufficient kinetic energy pass an electrostatic barrier and arrive at the focal plane detector (FPD) where they are counted. An essential characteristic of the experiment concerns the transmission properties of the spectrometer, which are affected by inhomogeneities in the electrostatic and magnetic fields. These can be modeled by simulations which require precise knowledge of the FPD and beamline alignment. A major milestone during the preparation of KATRIN for tritium measurements was the krypton data-taking campaign in summer 2017. During this period we investigated electrons from gaseous and condensed ^{83m}Kr sources. Since ^{83m}Kr features several sharp conversion lines, it is ideally suited for comissioning measurements. The talk reports analysis results of ^{83m}Kr conversion electron measurements and demonstrates the investigation of transmission and alignment properties of the KATRIN beamline. This project is supported by BMBF (05A17VK2), the Helmholtz Young Investigators Group (YIG) VH-NG-1055 and the Helmholtz Association.

T 55.4 Mi 17:15 Z6 - HS 0.001

Forward Beam Monitor data from the KATRIN krypton measurement phase — •Stephanie Hickford for the KATRIN-Collaboration — Bergische Universität Wuppertal

The KATRIN collaboration aims to measure the neutrino mass with a sensitivity of 200 meV. This will be done by observing the β-electron spectrum from the decay of tritium. The tritium source properties need to be stable, and known to a high precision, in order to accurately measure the neutrino mass. For this reason the source will undergo extensive measurements from several monitoring systems. The *Forward*

Beam Monitor (FBM) is one such monitoring system.

A KATRIN krypton measurement phase took place during July 2017. The gaseous ^{83m}Kr part of this measurement phase involved the entire KATRIN beamline, including the source section and the FBM. Initial krypton spectra were measured using the FBM pin diode detectors, the magnetic fluxtube was mapped, and early temperature impacts on the system operation were observed. These results, and related progress since the krypton measurement phase, are presented in this talk.

T 55.5 Mi 17:30 Z6 - HS 0.001

Analysis of the first Krypton-83m KATRIN Data — •Lisa Schlüter for the KATRIN-Collaboration — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Föhringer Ring 6, 80805 München

The KArlsruhe TRItium Neutrino (KATRIN) experiment is designed to determine the effective mass of the electron-antineutrino with an sensitivity of 200 meV/c^2 (90% C.L.) in a direct and model-independent way. The neutrino mass can be inferred from the shape of the endpoint region of the tritium β-decay spectrum, which is measured using a MAC-E filter and a Windowless Gaseous Tritium Source (WGTS). For calibration purposes and the investigation of systematic effects, in July 2017 the WGTS was operated in the Krypton mode, in which well characterized gaseous ^{83m}Kr is filled in the WGTS. ^{83m}Kr emits electrons via inner conversion in the few tens of keV range and with a natural line width in the eV range. This talk presents an analysis of the KATRIN Krypton run, including systematic effects based on the covariance matrix approach, using the Samak simulation analysis package.

T 55.6 Mi 17:45 Z6 - HS 0.001

High voltage monitoring and calibration at the KATRIN experiment — •Caroline Rodenbeck and KATRIN Collaboration for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe; Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) aims to measure the rest mass of the electron-antineutrinos with a sensitivity of 0.2 eV/c^2 (90% C.L.). For this the tritium beta spectrum is measured in the endpoint region with an integrating spectrometer using the MAC-E-filter principle. To reach this high sensitivity the voltage which is used to create the electrostatic energy barrier for the beta electrons, needs to be precisely set and known. The KATRIN high voltage system meets these requirements with high precision power supplies and high precision monitoring using purpose-built high voltage dividers.

For reliable high voltage monitoring, calibrations need to be performed on a regular basis. The reliability of the high voltage monitoring system has been thoroughly tested and verified in the last years e.g. during commissioning measurements with conversion electrons of Krypton-83m. This talk will present the performance of the high voltage system over the last years and especially with regard to the requirements needed for the neutrino mass measurements.

This work was supported by BMBF (05A17VK2) and the HGF.

T 55.7 Mi 18:00 Z6 - HS 0.001

Background measurements at KATRIN — •Anna Pollithy for the KATRIN-Collaboration — Technische Universität München (TUM), Fakultät für Physik, 85748 Garching

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of m$_\nu$=0.2 eV/c^2 (90 % C.L.) in a model-independent way by investigating the energy spectrum of tritium beta decay electrons near the endpoint. For the full neutrino mass sensitivity, a background level of 10^{-2} cps is required. One way to characterize the residual background in KATRIN is by determining its energy spectrum. This background information enables to verify the current "Rydberg" background hypothesis which predicts low energy electrons originating from highly excited atoms as a potential background source. In this contribution, two dedicated measurement methods to investigate the "Rydberg" background as well as first results will be presented. This work is supported by the SFB1258 and the Max Planck Society.

T 55.8 Mi 18:15 Z6 - HS 0.001

Plasma Investigations for the KATRIN experiment — •Jonas Kellerer for the KATRIN-Collaboration — Karlsruhe Institut of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The Karlsruhe Tritium Neutrino (KATRIN) experiment aims to determine the effective neutrino mass with a sensitivity of $m_\nu = 0.2$ eV/c^2 (90% C.L.) in a direct approach using the β-decay of molecular tritium and a MAC-E filter spectrometer. The neutrino mass is extracted from a fit of modelled beta decay spectra to the measured electron spectrum. Hence, a complete investigation of the processes influencing the electron energy is necessary. The potential energy of the emitted electrons is set by the electrostatic potential at the position of β-decay in the windowless gaseous tritium source (WGTS). The potential distribution in the WGTS is determined by a cold low-density plasma that forms inside the strong magnetic field of the WGTS through β-decay and secondary ionizations. A comprehensive fluid plasma model has been developed to investigate the properties of the plasma. The model includes creation, annihilation and motion of electrons and ions in a steady flow of neutral gas and confined by a longitudinal magnetic field. Diverse creation and annihilation rates were studied and implications on the systematics of the neutrino mass measurement were deduced. Supported by BMBF (05A17VK2), KSETA and the Helmholtz Association.

T 55.9 Mi 18:30 Z6 - HS 0.001

Characterization of the KATRIN Pre-Spectrometer for operational mode — •Johannes Heizmann for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), ETP, Postfach 3640, 76021 Karlsruhe

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment has the ambitious goal to determine the effective neutrino mass with a sensitivity of $m_\nu = 0.2\,\mathrm{eV/c^2}$ at 90% C.L. using electrons originating from tritium β-decay. These electrons are guided magnetically from the source section along the beam line of the transport and pumping section to the spectrometer and detector section (SDS). The SDS, consisting of the pre- and main spectrometer, and a silicon detector, is responsible for filtering and analyzing the energy of the β-electrons utilizing the MAC-E filter principle. Positive ions created by the large flux of β-electrons along the KATRIN beamline can enter the main spectrometer where they produce background via the ionization of residual gas molecules. In order to minimize this background, the pre-spectrometer will electrostatically filter electrons with energies lower than 18.3 keV and remove positive ions from the flux tube. At the same time it will guide β-electrons adiabatically to the main spectrometer. Moreover, the pre-spectrometer can be configured to detect tritium decays.
This talk will present results of recent pre-spectrometer background measurements in preparation of the upcoming tritium operation of KATRIN. Furthermore results of simulations to define the optimum electro-magnetic configuration of the pre-spectrometer for regular operation will be presented.

T 55.10 Mi 18:45 Z6 - HS 0.001

Bestimmung und Modellierung der Transmissionseigenschaften des KATRIN-Hauptspektrometers — •Jan David Behrens für die KATRIN-Kollaboration — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie (KIT), Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

Das **KA**rlsruhe **TRI**tium **N**eutrino-Experiment soll die Masse des Elektron-Antineutrinos mit einer Sensitivität von 0.2 eV/c^2 (90% C.L.) bestimmen. Die Vermessung der Form des Tritium-β-Spektrums im Endpunktbereich ermöglicht eine modellunabhängige Bestimmung der absoluten Neutrinomassenskala.

Das Experiment verwendet eine gasförmige Tritiumquelle, von der die Zerfallselektronen magnetisch zum Detektor geführt werden. Die Energieanalyse der Elektronen erfolgt in einem elektrostatischen Spektrometer, das nach dem Prinzip des MAC-E-Filters arbeitet. Eine präzise Beschreibung des gemessenen integralen Energiespektrums erfordert genaue Kenntnis der elektromagnetischen Felder im Spektrometer. Hierzu werden verschiedene Methoden kombiniert: detaillierte Feldberechnungen mit Hilfe des Software-Frameworks KASPER, direkte Bestimmung der Transmissionseigenschaften durch Kalibrationsquellen sowie kontinuierliche Überwachung durch magnetische Feldsensoren.

Der Vortrag beschreibt die Bestimmung der Transmissionseigenschaften und die Modellierung der elektromagnetischen Felder am Hauptspektrometer. Dieses Projekt wird gefördert durch das BMBF (Projekt 05A17VK2), die Helmholtz-Hochschul-Nachwuchsgruppe (YIG) VH-NG-1055 und die Helmholtz-Gemeinschaft.

T 56: Pixel-Detektoren II

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - HS 0.002

T 56.1 Mi 16:30 Z6 - HS 0.002

Entwicklung und Qualifizierung von Testsystemen für die Modulproduktion für das Atlas Upgrade — •Helge C. Beck, Jörn Grosse-Knetter, Arnulf Quadt und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Im Rahmen des *Large Hadron Collider* (LHC) Upgrades zum HL-LHC wird der Inner Detector (ID) des Atlasdetektors gegen den Inner Tracker (ITk) ausgetauscht. Der ITk wird aus Silizium Modulen bestehen aufgeteilt in Streifen- und Pixellagen. Für die hybriden Pixelmodule wird ein neuer Auslesechip verwendet.

Für den Aufbau der Module und die Qualifizierung des selben werden unter anderem in Göttingen Testsysteme entwickelt. Wichtige Messungen sind IV-Kurven der Sensoren, Temperaturbeständigkeit und deponierte Ladung durch Teilchen. Die Tests müssen bei verschiedenen Temperaturen durchgeführt werden, besonders bei ähnlichen Bedingungen wie im Detektor. Ein Teststand benötigt deswegen ein Kühlsystem, Abschirmung der verwendeten radioaktiven Quellen nach außen und die Messapparaturen wie Spannungs- und Strommultimeter sowie die Datenauslese für die Module. Generell wird eine größt mögliche Automatisierung der Erfassung und Verwaltung der Daten angestrebt, da eine große Anzahl an Modulen in begrenzter Zeit getestet werden muss.

Ergebnisse der Tests und das System selber werden hier vorgestellt.

T 56.2 Mi 16:45 Z6 - HS 0.002

ATLAS Pixel Teststrahlkampagnen — •Tobias Bisanz, Jorn Grosse-Knetter, Arnulf Quadt und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Für das Upgrade zum High-Luminosity-LHC wird ebenso der ATLAS Detektor überarbeitet. Die erhöhte Luminosität erfordert sowohl strahlenhärtere Komponenten, als auch eine neue Auslese um mit den höheren Okkupanzen umzugehen. Durch die Nähe zum Interaktionspunkt sind diese Anforderungen besonders für den Pixeldetektor eine Herausforderung. Um Module und Sensoren für das Upgrade zu charakterisieren und zu testen, werden neben Labormessungen auch Teststrahlstudien durchgeführt.

Der Vortrag beschäftigt sich mit der Rekonstruktion und Analyse dieser Teststrahlmessungen. Fokus wird auf Messungen der sogenannten In-Time Effizienz des aktuellen ATLAS Pixel Auslesechip (FE-I4) gelegt, welche mittels des General-Broken-Line Algorithmus mit Teststrahldaten, welche am Deutschen Elektronen Synchrotron bei verhältnismäßig niedrigen Energien von 4-5 GeV gesammt wurden, durchgeführt wurden. Bei solchen niedrigen Energien spielt Coulombstreuung eine wichtige Rolle, daher muss das Materialbudget in der Rekonstruktion korrekt berücksichtigt werden.

T 56.3 Mi 17:00 Z6 - HS 0.002

Test beam measurements at the new external beam line at ELSA with a Mimosa26 telescope — •Yannick Dieter, Tomasz Hemperek, Toko Hirono, Fabian Hügging, Jens Janssen, Hans Krüger, David-Leon Pohl, Norbert Wermes, and Jochen Dingfelder — Physikalisches Institut der Universität Bonn

The new external beam line at the electron accelerator ELSA in Bonn provides a dedicated test beam area for detector test. The accelerator delivers a primary electron beam of a variable energy of up to 3.2 GeV with a variable beam rate of up to about 600 MHz. To test new detectors the ANEMONE (A Nice Eudet Mimosa Bonn Telescope) beam telescope which was developed within the EUDET project is installed. It consists of six Mimosa26 sensors which allow for high-resolution tracking. Combined with an ATLAS FE-I4 pixel module also a high-rate time stamping is possible. Moreover, a new readout-system was developed which features trigger-less and continuous data taking of the Mimosa26 sensors. This makes the new test beam setup suitable to test and characterize new detector prototypes precisely. In this talk, the test beam setup as well as the performance of the beam telescope at the new external beam line in a 2.5 GeV electron beam will be presented.

T 56.4 Mi 17:15 Z6 - HS 0.002

Testbeamergebnisse modifizierter Pixelimplantation — Silke Altenheiner[1], Sascha Dungs[1,2], Andreas Gisen[1], Claus Gössling[1], Valerie Hohm[1], Reiner Klingenberg[1], Kevin Kröninger[1], Raphael Michallek[1], Anna-Katharina Raytarowski[1] und •Mareike Weers[1] — [1]TU Dortmund, Experimentelle Physik IV — [2]CERN

Für das Upgrade des LHCs zum High Luminosity LHC werden neue Spurdetektoren für das ATLAS-Experiment benötigt, um der höheren instantanen Luminosität und dem höheren Teilchenfluss gerecht zu werden. Dazu wird ein neuer Tracker, der sogenannte Inner Tracker (ITk), entwickelt.

Die dafür verwendeten Silizium-Pixeldetektoren müssen eine hohe Effizienz beim Nachweis von Teilchen aufweisen. Zur Untersuchung des Einflusses der Struktur der Pixelimplantation auf die Effizienz wurden sechs verschiedene Pixeldesigns für planare n^+-in-n-Silizium-Pixelsensoren entwickelt.

Bei der Charakterisierung der einzelnen Designs wird vor allem die Strahlenhärte berücksichtigt. In diesem Vortrag werden die Ergebnisse der Datenanalyse von verschiedenen Testbeams am DESY und CERN dieser sechs verschiedenen Pixeldesigns präsentiert. Es werden dabei Daten von unbestrahlten Sensoren und mit Protonen bzw. Neutronen bestrahlten Sensoren bei verschiedenen Spannungen und Tunings verwendet.

T 56.5 Mi 17:30 Z6 - HS 0.002

Testbeam- und Labormessungen von Pixeln mit modifizierten Designs — Silke Altenheiner[1], Sascha Dungs[1,2], Andreas Gisen[1], Claus Gössling[1], •Valerie Hohm[1], Reiner Klingenberg[1], Kevin Kröninger[1], Anna-Katharina Raytarowski[1] und Mareike Weers[1] — [1]TU Dortmund, Lehrstuhl für Experimentelle Physik IV — [2]CERN

Beim nächsten Upgrade des LHCs zum High Luminosity LHC wird ein neuer Spurdetektor, der sogenannte Inner Tracker (ITk), in das ATLAS-Experiment eingebaut. Dies ist nötig, um der höheren instantanen Luminosität und dem höheren Teilchenfluss gerecht zu werden.

Die unter anderem dazu verwendeten Silizium-Pixeldetektoren müssen eine hohe Nachweiseffizienz für Teilchendurchgänge aufweisen. Es wurden verschiedene unterschiedliche Designs für planare Silizium-Pixeldetektoren entwickelt, um ihren Einfluss auf die Effizienz zu untersuchen.

Sowohl unbestrahlte als auch bestrahlte Sensoren wurden in Testbeammessungen am CERN und DESY und mit Labormessungen untersucht. Die Ergebnisse dieser Messungen werden in diesem Vortrag präsentiert.

T 56.6 Mi 17:45 Z6 - HS 0.002

Lorentz angle measurements in irriadiated CMS pixel detector modules — •Paul Schütze and Daniel Pitzl — Deutsches Elektronen-Synchrotron DESY, Hamburg, Deutschland

Since the replacement of the CMS experiment's pixel detector in the extended 2016/17 shutdown, the detector modules have already been exposed to a significant dose of radiation. The modules' built-in readout chips and silicon sensors are designed for operation at LHC design luminosity without efficiency losses and are tested to be fully functioning up to radiation doses above the expected lifetime dose. However, the ongoing irradiation of the modules during the operation leads to significant changes in several properties of the sensors and the readout chips.

For this contribution, several pixel detector modules of different irradiation fluence were measured, with the main focus on measurements of the Lorentz angle. A setup of four CMS barrel pixel detector modules was commissioned at the DESY Test Beam Facility, to enable particle tracking in the available 1.3 T magnetic field. For the use of irradiated detector modules a cooling system was provided, enabling the measurement of the Lorentz angle as a function of fluence, bias voltage and temperature.

The experimental setup is presented together with measurement results and comparisons with simulations.

T 56.7 Mi 18:00 Z6 - HS 0.002

Efficiency and Charge Sharing of Planar Pixel Sensors for the CMS Phase 2 Upgrade — •Finn Feindt[1], Aliakbar Ebrahimi[1], Erika Garutti[1], Caroline Niemeyer[1], Daniel Pitzl[2], Georg Steinbrück[1], Jörn Schwandt[1], and Irene Zoi[1] — [1]Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149,

D-22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron, Notkestraße 85, D-22607 Hamburg, Germany

The high luminosity upgrade of the LHC will lead to an increased multiplicity of proton-proton interactions, with up to 200 events per beam bunch crossing, in the CMS experiment. Furthermore, the 1 MeV neutron equivalent fluence will reach 2.3×10^{16} neq/cm^2 after an integrated luminosity of 3000 fb^{-1} in the innermost part of the CMS pixel detector.
To build a pixel detector with good performance for these conditions, many variants of new n$^+$p, planar pixel sensors with pixel sizes of 50×50 μm^2 and 100×25 μm^2 have been designed and manufactured with an active thickness of 150 μm. Apart from the pixel size, the design variants differ with respect to the implantation and metalization geometry as well as the pixel isolation and biasing scheme.
To select the most promising design for the future CMS pixel detector, a campaign of measurements on non-irradiated sensors and sensors irradiated to an 1 MeV neutron equivalent fluence of 2×10^{15} neq/cm^2 is ongoing at the DESY test beam facility.
In this talk, studies of the efficiency, charge collection and charge sharing of the new pixel sensors will be presented.

T 56.8 Mi 18:15 Z6 - HS 0.002

RD53A: A Large Prototype of Pixel Readout Chip for ATLAS and CMS Pixel Upgrades — •Tomasz Hemperek, Hans Krüger, Piotr Rymaszewski, Marco Vogt, Tianyang Wang, and Norbert Wermes — Universität Bonn, Bonn, Germany

The RD53 collaboration was established to develop a new generation of pixel chip for extremely high rates (3GHz/cm2) and very high radiation levels (500Mrad) for ATLAS and CMS phase 2 upgrades. Small-scale demonstrators with 64x64 array of 50x50 um2 pixels containing complex digital architectures have been produced and proven operating at a very small noise and in-time thresholds. A large-scale prototype in 65nm CMOS technology (20mm x 12 mm) called RD53A has been designed and successfully delivered in 2017. RD53A is a complex mixed-signal chip with multiple analog and digital blocks that have been qualified to sustain high levels of radiation. The main concepts of RD53A are described including specification, design and verification process. The plans to develop final pixel chips for the two experiments will be discussed.

T 56.9 Mi 18:30 Z6 - HS 0.002

BDAQ53, a Verification and Characterization Environment for the ATLAS Pixel Readout Chip RD53A — Michael Daas, Jochen Dingfelder, Tomasz Hemperek, Jens Janssen, Hans Krüger, David-Leon Pohl, •Marco Vogt, and Norbert Wermes — Physikalisches Institut der Universität Bonn

For the High Luminosity upgrade of the LHC at CERN in 2025, new readout chips for the ATLAS and CMS pixel detectors are required. Due to the drastically increased instantaneous luminosity, they will have to deliver much higher data rates compared to the current FE-I4 generation and ensure unprecedented radiation tolerance, especially close to the interaction point.

The large-scale prototype chip RD53A has been designed and manufactured by the RD53 collaboration in a 65 nm CMOS process, suitable for the inner layers of both the ATLAS and the CMS experiment. The test and data acquisition environment BDAQ53 has been developed to verify the digital design and to characterize the prototype chips.

In this talk, the implementation of BDAQ53 and first measurements of RD53A will be shown.

T 56.10 Mi 18:45 Z6 - HS 0.002

First measurements of the new readout ASIC for the ATLAS Inner Tracker: RD53A — •Michael Daas, Jochen Dingfelder, Tomasz Hemperek, Fabian Hügging, Hans Krüger, David-Leon Pohl, Mark Standke, Marco Vogt, and Norbert Wermes — Physikalisches Institut der Universität Bonn

The Large Hadron Collider (LHC) at CERN will be upgraded to deliver higher luminosities in 2025. This High-Luminosity LHC (HL-LHC) poses new demanding requirements for its detectors.

In this talk, first measurements of the RD53A pixel detector readout chip are shown. It was developed by the RD53 collaboration, a joint research and development initiative of the ATLAS and CMS experiments. As successor to the FE-I4, the RD53A readout chip features a smaller pixel pitch of $50 \times 50 \mu m$, higher data rate capabilities and better radiation tolerance. This enables the chip to cope with the very high occupancy, that is expected close to the interaction points of the upgraded HL-LHC due to the higher luminosity.

The readout system BDAQ53 for this chip was developed in Bonn, based on chip simulations. When the chip arrived at the end of 2017, first measurements could be conducted right away. Since then, further steps towards a first characterization of the chip have been taken and are presented in this talk.

T 57: Higgs III

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - HS 0.004

T 57.1 Mi 16:30 Z6 - HS 0.004

Search for Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ fully hadronic final state at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Alessandra Betti, Florian Beisiegel, Tatjana Lenz, Alexander Melzer, and Norbert Wermes — Physikalisches Institut, Universität Bonn

In the Standard Model (SM) Higgs bosons can be produced in pairs via top quark loops or the Higgs trilinear self-interaction. Although the SM cross-section for Higgs pair production is very small, in several extensions of the SM this cross-section can be enhanced. Non-resonant Higgs pair production can be significantly enhanced by modifications of the triple Higgs self-coupling λ_{hhh}. Other theories predict heavy resonances that could decay into a pair of Higgs bosons, such as a neutral scalar heavy Higgs in the two Higgs doublet model and spin-2 Kaluza-Klein excitations of the graviton in the bulk Randall-Sundrum model. In the assumption of Higgs bosons with m=125 GeV decaying with branching fractions according to the SM predictions, the $b\bar{b}\tau^+\tau^-$ channel of the di-Higgs decay has the third largest branching fraction (7.4%). The status of the search for resonant and non-resonant Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ final state with the ATLAS detector will be presented in this talk. Main focus will be on the fully hadronic final state $b\bar{b}\tau^+_{had}\tau^-_{had}$.

T 57.2 Mi 16:45 Z6 - HS 0.004

Evidence for the associated production of the Higgs boson and a top quark pair with the ATLAS detector: same-charge lepton pair plus tau channel — •Andre Sopczak[1], Babar Ali[1], Simonetta Gentile[2], and Marine Kuna[2] — [1]IEAP CTU in Prague — [2]Dipartimento di Fisica "G.Marconi" Universita di Roma, Sapienza

After the discovery of a Higgs boson, the measurements of its properties are at the forefront of research. The determination of the associated production of a Higgs boson and a pair of top quarks is of particular importance as the ttH Yukawa coupling is large, and thus a probe for physics beyond the Standard Model. Recently evidence for the coupling has been established.

The ttH production was analysed in the final state with two same-sign light leptions (electrons or muons) and a hadronically decaying tau lepton: ttH $\rightarrow 2\ell + 1\tau_{\mathrm{had}}$. The analysis was based on data taken by the ATLAS experiment recorded from 13 TeV proton-proton collisions. It contributed to the combined ATLAS results of the multi-lepton final state analyses. These results were further combined with other ATLAS ttH analyses where H $\rightarrow \gamma\gamma$ and H $\rightarrow$ b$\bar{\mathrm{b}}$. The combined results are consistent with the Standard Model (SM) expectation allowing models beyond the SM to be constrained.

T 57.3 Mi 17:00 Z6 - HS 0.004

Measuring the branching ratio of $h \rightarrow \mu^+\mu^-$ at the International Linear Collider — •Shin-ichi Kawada, Jenny List, and Mikael Berggren — DESY, Notkestrasse 85, 22607 Hamburg, Germany

After the discovery of a Higgs boson at the LHC, the precise characterization of this particle is one of the most important topics in particle physics. Any deviation from the Standard Model (SM) prediction of its properties would indicate the existence of physics beyond the SM. In this talk, we will present the prospects measuring the branching ratio of $h \rightarrow \mu^+\mu^-$ at the International Linear Collider (ILC). The analy-

sis is performed using Geant4-based full detector simulation assuming 2 ab^{-1} at the center-of-mass energy of 250 GeV and 4 ab^{-1} at 500 GeV, as foreseen in the official running scenario. The results will be discussed with the prospects for operating the HL-LHC. We will also discuss the impact of detector design and its effect for this study.

T 57.4 Mi 17:15 Z6 - HS 0.004

Search for dimuon Higgs decays in the SM — Adrian Perieanu, •Oliver Rieger, and Peter Schleper — Universität Hamburg

A search for the standard model Higgs boson decaying into two muons is described. The analysis is based on 2016 LHC data recorded by the CMS detector in proton-proton collisions at a center-of-mass energy of 13 TeV. The dataset corresponds to an integrated luminosity of 35.9 fb^{-1}. A Boosted Decision Tree (BDT) is used to distinguish the kinematics of signal and background events. All events are categorized according to their BDT response and dimuon mass resolution. Limits are set on the cross section of the Higgs boson decaying into two muons for mass hypotheses between 120 and 130 GeV. Furthermore, first studies of the 2017 dataset are presented.

T 57.5 Mi 17:30 Z6 - HS 0.004

Measurement of Higgs CP properties in fermionic couplings with the CMS Detector — David Brunner, Jordy Degens, Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and •Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

The discovery of CP violation in the Higgs sector would be a clear indication for physics beyond the standard model. While recent results exclude that the Higgs boson of mass 125 GeV is a pure pseudoscalar particle, a small admixture of scalar and pseudoscalar contributions is still a valid scenario. This talk presents an analysis dedicated to the measurement of the scalar and pseudoscalar couplings of the discovered Higgs boson. The search for small pseudoscalar contributions is motivated in terms of an effective field theory where scalar and pseudoscalar contributions enter at the same pertubative order in gluon-gluon-fusion Higgs production. The azimuthal angle difference $\Delta\phi_{jj}$ between initial state jets produced in $gg \to Hjj$ events is sensitive to the underlying pseudoscalar γ^5 tensor structure. A statistical analysis based on $\Delta\phi_{jj}$ is performed, providing an expected analysis sensitivity to CP properties for an integrated luminosity of $\mathcal{L} = 35.9\,fb^{-1}$ at $\sqrt{s} = 13\,TeV$ collected with the CMS Detector in 2016.

T 57.6 Mi 17:45 Z6 - HS 0.004

Test of CP Invariance in vector-boson fusion production of the Higgs boson using the Optimal Observable method in the decay $H \to \tau_l\tau_h$ with the ATLAS detector at $\sqrt{s} = 13$ TeV — Elias Coniavitis, •Dirk Sammel, and Markus Schumacher — Albert-Ludwigs-Universität Freiburg

C and CP violation are one of the three Sakharov conditions needed to explain the observed baryon asymmetry of the universe. The amount of CP violation in the quark sector, introduced via the CKM matrix, is however not sufficient to explain the baryon asymmetry in the context of the Standard Model.
Additional sources of CP violation could be present in the production and decay of the Higgs boson. The production via vector-boson fusion allows to study the CP structure of the Higgs-boson coupling to electroweak gauge bosons. In this talk, first studies performed with the CP-odd *Optimale Observable* with Run-2 LHC data are presented.
The analyis uses the decay $H \to \tau_l\tau_h$ and data collected with the ATLAS detector in 2015 and 2016 at $\sqrt{s} = 13\,TeV$, corresponding to an integrated luminosity of $\int \mathcal{L} = 36.5\,fb^{-1}$.

T 57.7 Mi 18:00 Z6 - HS 0.004

Test of CP invariance in vector-boson fusion production of the Higgs boson in $H \to \tau_{lep}\tau_{lep}$ decays at $\sqrt{s} = 13$ TeV with the ATLAS detector — Elias Coniavitis[1], •Alena Lösle[1], Ulrike Schnoor[2], and Markus Schumacher[1] — [1]Physikalisches Institut, Universität Freiburg — [2]CERN

Violation of CP invariance is one of the Sakharov conditions to explain the observed baryon asymmetry in our universe. While CP violation is already realised in the Standard Model via the CKM matrix, it is not sufficient to explain the amount of observed baryon asymmetry. Hence, it is interesting to search for new sources of CP violation in the Higgs sector. The vector-boson fusion production allows to investigate the CP structure of the Higgs-boson coupling to electroweak gauge bosons and to test CP invariance in this interaction.
The analysis discussed in this talk is performed in the $H \to \tau_{lep}\tau_{lep}$ decay channel and uses the CP-odd *Optimal Observable*. First studies based on data taken by the ATLAS detector in 2015 and 2016 at $\sqrt{s} = 13\,TeV$ corresponding to an integrated luminosity of $36.1\,fb^{-1}$ are presented.

T 57.8 Mi 18:15 Z6 - HS 0.004

Search for lepton-flavour violating decays of the Higgs-boson using the asymmetry method with the ATLAS experiment at $\sqrt{s} = 13$ TeV — •Katharina Schleicher[1], Duc Bao Ta[2], and Markus Schumacher[1] — [1]Albert-Ludwigs-Universität Freiburg — [2]Johannes Gutenberg-Universität Mainz

One interesting topic after the discovery of the Higgs-boson is the search for lepton-flavour violating (LFV) couplings. These are predicted in several models, including supersymmetric extensions of the standard model (SM) and the general two-higgs-dublet model. In nature, LFV was already observed in form of neutrino oscillations.

Possible LFV decays in the Higgs-sector are $H \to e\mu$, $H \to \tau e$ and $H \to \tau\mu$. In this analysis only the decays of $H \to \tau e$ and $H \to \tau\mu$ with leptonic τ-decays leading to $e\mu + X$ final states are considered. For background estimation the asymmetry method is utilized. It exploits two facts. First, SM backgrounds with prompt leptons are symmetric w.r.t. a replacement of electrons with muons and vice versa. And second, this symmetry is broken when assuming that the branching ratios of the two considered LFV decays are of different orders of magnitude.

One challenge is to maintain this symmetry despite experimental differences of electrons and muons. Another challenge is to enhance the sensitivity. Therefore, a multivariate analysis is developed by training boosted decision trees.

The analysis is performed on the full 2015 and 2016 run-2 data set in proton-proton collisions ($L = 36.07 fb^{-1}$) taken with the ATLAS detector at $\sqrt{s} = 13$ TeV.

T 57.9 Mi 18:30 Z6 - HS 0.004

Messung der Higgs–Gluon–Tensorkopplung in Zerfällen $H \to ZZ^* \to 4\ell$ mit dem ATLAS–Detektor — •Maxim Sinner, Katharina Ecker, Oliver Kortner, Sandra Kortner, Hubert Kroha und Verena Walbrecht — Max–Planck–Institut für Physik, München

Das Standardmodell der Teilchenphysik beschreibt das Higgsteilchen als skalares Boson mit positiven Ladungskonjugations– und Paritätsquantenzahlen: $J^{PC} = 0^{++}$. In vielen Modellen jenseits des Standardmodells wird ein erweiterter Higgssektor angenommen, wodurch kleine CP–ungerade Beimischungen in der Higgskopplung entstehen können. Diese sind durch die Run–1–Messungen nicht ausgeschlossen. Ein sensitiver Kanal zur Untersuchung CP–ungerader Beimischungen in der Higgs–Gluon–Kopplung bei der dominanten Higgs–Produktion durch Gluon–Fusion ist der Higgs–Zerfall in zwei Z–Bosonen, die jeweils in ein e^+e^-– oder $\mu^+\mu^-$–Paar zerfallen.
In diesem Vortrag wird die Untersuchung der Tensorstruktur der Higgs–Gluon–Kopplung im Zerfallskanal $pp \to H \to ZZ^* \to 4\ell$ mit den Run–2–Daten des ATLAS–Detektors vorgestellt. Insbesondere werden für die Messung die Eigenschaften der Jets eingesetzt, die durch reelle Emissionskorrekturen zur Gluon–Fusion erzeugt werden.

T 57.10 Mi 18:45 Z6 - HS 0.004

Messung der HZZ-Tensor-Kopplung in $pp \to H \to ZZ^* \to 4\ell$ - Zerfällen mit dem ATLAS-Detektor — •Verena Walbrecht, Katharina Ecker, Maxim Sinner, Sandra Kortner, Oliver Kortner und Hubert Kroha — Max-Planck-Institut für Physik

Nach der Entdeckung des Higgs-Bosons am LHC ist es wichtig, die Eigenschaften dieses Teilchens präzise zu vermessen und somit nach möglichen Abweichungen von den Vorhersagen des Standardmodells zu suchen. Ein wichtiger Zerfallsprozess für die Entdeckung und Messung der Eigenschaften des Higgs-Bosons ist der in zwei Z-Bosonen, die jeweils in ein e^+e^-- oder $\mu^+\mu^-$-Paar zerfallen, $pp \to H \to ZZ^* \to 4\ell$.

Im Standardmodell wird das Higgs-Boson als Spin-0-Teilchen mit positiver CP-Quantenzahl vorhergesagt. Diese Hypothese wird auch von den Run-I-Daten bevorzugt. Dabei sind kleine Beimischungen anomaler, möglicherweise auch CP-verletzender Kopplungen mit geänderter Tensorstruktur nicht ausgeschlossen, die von Theorien jenseits des Standardmodells vorhergesagt werden. In diesem Vortrag wird die Messung der Higgs-Boson-Produktion und der Tensorstruktur der Higgs-Bosonkopplung an Z-Bosonen mit den Run-II-Daten des ATLAS-Detektors im Kanal $pp \to H \to ZZ^* \to 4\ell$ vorgestellt.

T 58: Top-Quarks: Eigenschaften II

Zeit: Mittwoch 16:30–18:35 Raum: Z6 - SR 1.002

T 58.1 Mi 16:30 Z6 - SR 1.002

Studien zur Klassifikation von Photonen im Prozess der Produktion von Top-Quark-Paaren in Assoziation mit einem Photon — •Andreas Kirchhoff, Thomas Peiffer, Arnulf Quadt, Elizaveta Shabalina, Joshua Wyatt Smith, Royer Edson Ticse Torres und Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Um die elektrische Ladung des Top-Quarks direkt zu messen, muss die Kopplung des Photons an das Top-Quark untersucht werden. Am ATLAS-Experiment am LHC erfolgt dies durch die Messung des Wirkungsquerschnitts der Produktion von Top-Quark-Paaren in Assoziation mit einem Photon. Das Teilchen, von dem das Photon abgestrahlt wird, kann in einem einzelnen Ereignis aber nicht mit absoluter Sicherheit bestimmt werden. Eine mögliche Unterscheidung ist allerdings von großer Wichtigkeit, da nur so irreduzibler Untergrund (Photonen, die nicht vom Top-Quark stammen) unterdrückt werden kann. Bisher werden lediglich die vom W-Boson und seiner geladenen leptonischen Zerfallsprodukte emittierten Photonen durch Isolationskriterien, die einen Mindestabstand zwischen Photon und Lepton fordern, unterdrückt. Um diese Photonen auf statistischer Basis unterscheidbar zu machen, können multivariate Analysemethoden genutzt werden. In diesem Vortrag werden Ergebnisse von Studien präsentiert, in denen überwachtes Lernen von tiefen neuronalen Netzen zur Unterscheidung eingesetzt wird.

T 58.2 Mi 16:45 Z6 - SR 1.002

Constraining dimension-six effective operators through the combination of top quark measurements using EFTfitter — •Cornelius Grunwald, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

In the search for physics beyond the Standard Model, effective field theories allow for model-independent probes of large energy scales by introducing higher dimensional operators. The coupling strengths of these effective operators are expressed by the so-called Wilson coefficients.

In this talk, a multidimensional fit constraining the Wilson coefficients of five dimension-six operators is presented. The model describing the observables in terms of Wilson coefficients is determined from Monte Carlo computations. Measurements of top quark cross sections and W boson helicity fractions, performed by the ATLAS collaboration, are combined using the EFTfitter tool. It is demonstrated that correlations between the uncertainties of measurements need to be taken into account in the fit, since they might significantly impact the resulting constraints.

T 58.3 Mi 17:00 Z6 - SR 1.002

Probing the $t\bar{t}\gamma$ process at $\sqrt{s} = 13$ TeV with ATLAS using object and event based neural networks — Andreas Kirchhoff, Thomas Peiffer, Arnulf Quadt, Elizaveta Shabalina, •Joshua Wyatt Smith, Royer Edson Ticse Torres, and Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Through the associated production of the $t\bar{t} + \gamma$ process we can measure the strength of the electromagnetic coupling of the top quark and the photon. Any deviation from the Standard Model (SM) prediction would be an indication of Beyond SM physics. Evidence of this process was seen at CDF with $\sqrt{s} = 1.96$ TeV, while observation occurred at the LHC at $\sqrt{s} = 7$ and $\sqrt{s} = 8$ TeV, with increasing precision. In the 13 TeV analysis a requirement that photons be isolated is introduced. Thus, the most significant backgrounds in the single lepton channels come from electrons misidentified as prompt photons, as well as misidentified photons from hadrons or hadronic decays. In the dilepton channels the largest backgrounds are prompt photons from single top processes and $Z \to l^+l^-\gamma$ decays. A neural network is trained on signal and the sum of backgrounds using object and event level information to maximise the separation. This response is used as the discriminating variable in the maximum likelihood fit to extract the $t\bar{t}\gamma$ cross-section. The event and object based neural network is presented, with initial fit results and a discussion on the largest systematic uncertainties.

Gruppenbericht T 58.4 Mi 17:15 Z6 - SR 1.002

Determination of the top-quark mass and the strong coupling constant using tt events with the CMS experiment at 13 TeV — Till Arndt[1], •Matteo Defranchis[1], Jan Kieseler[2], Katerina Lipka[1], and Andreas Meyer[1] — [1]DESY, Hamburg, Germany — [2]CERN, Geneva, Switzerland

A determination of the top-quark mass and the strong coupling constant is performed using proton-proton collisions data recorded by the CMS detector during 2016 data taking at the centre-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 36/fb. A chi square fit to multiple differential distributions of final state observables is performed to constrain systematic uncertainties in situ and to extract the visible tt production cross section simultaneously with the top MC mass. The observed cross section is then compared to theory predictions at next-to-next-to-leading order in order to extract the top-quark mass in the MS and on-shell schemes and the strong coupling constant.

T 58.5 Mi 17:35 Z6 - SR 1.002

Precision measurement of W helicity fractions from top-quark decays in $\sqrt{s} = 13$ TeV with the ATLAS detector — Thomas Peiffer, •Ishan Pokharel, Arnulf Quadt, Elizaveta Shabalina, and Royer Ticse Torres — II. Physikalisches Institut, Georg-August-Universität Göttingen

The top quark, the heaviest quark in the Standard Model (SM), was discovered at the Tevatron in 1995. Due to its large mass, the top quark decays before hadronisation. This provides a unique opportunity to study the properties of a bare quark. The top quark decays almost exclusively into a bottom quark and a W boson (Wtb vertex), with the W boson decaying leptonically or hadronically. Due to the large mass difference between the top and the bottom quark and the V-A structure of the interaction, the W boson from top quark decays are highly polarized in the SM.
This analysis focuses on the leptonic decay of the W boson from top quark decays. To this end, the single lepton and di-lepton channels of $t\bar{t}$ decays are considered. The neutrino and b-jet reconstruction plays a very important role in the reconstruction of the top quark. The observable $\cos\theta^*$ defined as the angle between the momentum direction of the charged lepton and the reverse direction of the b-quark, is used to distinguish the different helicity fractions. To extract helicity fractions of the W boson from top decays, a template fit to the $\cos\theta^*$ distribution is performed.

T 58.6 Mi 17:50 Z6 - SR 1.002

Studien zur Ereignisselektion mit maschinellem Lernen zur Verbesserung der $t\bar{t}$-Rekonstruktion mit dem KLFitter-Algorithmus — •Stella Oppermann, Johannes Erdmann, Olaf Nackenhorst und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Am Large Hadron Collider (LHC) werden Protonen mit einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV zur Kollision gebracht und produzierte Teilchen mit dem ATLAS-Experiment detektiert, wobei Top-Quarks im Wesentlichen in Paaren erzeugt werden. Das KLFitter-Framework verwendet einen auf der Maximum-Likelihood-Methode basierenden Algorithmus für die Rekonstruktion solcher $t\bar{t}$-Ereignisse. Es gibt verschiedene mögliche Zuordnungen von gemessenen Jets zu den Endzustandsteilchen aus dem $t\bar{t}$-Zerfall, wobei bei der Rekonstruktion mit KLFitter die Zuordnung mit dem maximalen Likelihoodwert gewählt wird. KLFitter hat für Ereignisse, bei denen jedem Teilchen auf Generator-Level ein Jet zugeordnet werden kann, eine hohe Rekonstruktionseffizienz. Vorgestellt werden Studien mit dem Ziel, den Anteil solcher Ereignisse durch maschinelles Lernen zu erhöhen, um die Rekonstruktion auf diese Ereignisse zu beschränken und somit die Rekonstruktionseffizienz insgesamt zu verbessern.

T 58.7 Mi 18:05 Z6 - SR 1.002

Search for charged lepton flavour violation in top quark decays — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], •Carlo A. Gottardo[1], Sebastian Heer[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

Lepton flavour violation is not allowed by the Standard Model (SM), yet it has been observed in neutrinos. The physics responsible for

neutrino oscillations and masses is still unknown and it may allow charged lepton flavour violation (CLFV). Evidence for CLFV processes, strongly suppressed according to the SM, would shed light on the nature of New Physics.
Studies towards a search for CLFV will be presented using 13 TeV data collected between 2015 and 2017 by the ATLAS detector.
The analysis investigates the decay of a top quark into a pair of opposite-sign different-flavour leptons and a up-type quark. The search, never performed before in this channel, benefits from the clear signature and the large top-quark pair production cross section in proton–proton collision at the Large Hadron Collider. The theoretical description is given in the framework of an effective field theory, allowing for a model-independent search.

T 58.8 Mi 18:20 Z6 - SR 1.002

Constraints on EFT operators through a measurement of top pair spin density matrix in the dileptonic channel by the CMS experiment — •Afiq Anuar, Kelly Beernaert, Alexander Grohsjean, Gerrit Van Onsem, and Christian Schwanenberger — Deutsches Elektronen Synchrotron (DESY), Notkestraße 85, D-22607 Hamburg

The negative results obtained by searches for heavy new resonances are excluding ever more of the potential phase space where they could be directly produced at the LHC, hinting that they might be out of reach given our current facilities. This in turn makes the Effective Field Theory (EFT) description increasingly attractive as a way to explore the physics beyond the Standard Model (SM). In this approach the focus is on precision measurements and constraints are set on the EFT operators in terms of deviations with respect to SM predictions. In this talk, the basics of the EFT approach and operators will be discussed, with an emphasis on those affecting the top pair production process and how are they constrained through a measurement of the top pair spin density matrix in the dileptonic channel by the CMS experiment.

T 59: Elektroschwache Wechselwirkung I

Zeit: Mittwoch 16:30–18:20 Raum: Z6 - SR 1.005

Gruppenbericht T 59.1 Mi 16:30 Z6 - SR 1.005

Muonic X-ray measurements at the Paul Scherrer Institute — •Frederik Wauters — Johannes Gutenberg-Universität Mainz

Muonic X-ray measurements at the Paul Scherrer Institute

Negative muons at rest quickly get captured by nearby atoms in highly exited atomic states. These muonic atoms subsequently de-exite via radiative and Auger transitions until the muon ends up in the 1s orbital. At the lower orbits, there is substantial overlap between the muon wave function and the nucleus, making this system an excellent laboratory to study the interaction between the muon and atomic nucleus. MuX is a renewed effort at the Paul Scherrer to measure muonic X-rays in medium- and high-Z nuclei, fully exploiting the coverage and multiplicity of a germanium detector array and the high yield of negative muons available. The physics program focuses on atomic parity violation (APV). A measurement of the charge radius of 226Ra, derived from the 2s-1s transition energy, will serve as crucial input for an upcoming APV experiment with a single Ra ion. A second measurement program is exploring the possibility of measuring APV directly in muonic atoms. We focus on Z=30 nuclei, where a measurable branching ratio of the single photon 2s-1s transition is expected. APV arrises from the mixing of the opposite parity 2p and 2s atomic states. In the summer of 2017, we successfully commissioned a novel target for the 226Ra charge radius measurement, which is planned to run in 2018. In addition, 2 weeks of beam time were dedicated to observe the 2s-1s transition for the first time, and quantify the background.

T 59.2 Mi 16:50 Z6 - SR 1.005

Studien zum hadronischen Rückstoß für die Bestimmung der Masse des W-Bosons mit dem ATLAS Experiment — •Verena Herget und Raimund Ströhmer — Universität Würzburg

Die Messung der Masse des W-Bosons ist ein zentraler Bestandteil von Präzisionstests des Standardmodells. Mit der Analyse der Daten des ATLAS Experiments bei 7 TeV wurde bereits ein sehr präziser Wert von $m_W = 80.370 \pm 19$ MeV erreicht. Die Präzision kann nun verbessert werden, indem die weiteren Datennahmekampagnen des ATLAS Experiments mit unterschiedlichen Luminositäten und PileUp Profilen ausgenutzt werden, um die systematischen Unsicherheiten zu verbessern. Die Auflösung des hadronischen Rückstoßes, welcher eine Messung der Zerfallskinematik ermöglicht, hat einen großen Einfluss auf den Gesamtfehler. Deswegen ist ein sehr detailliertes Verständnis des hadronischen Rückstoßes essenziell. Durch Ereignisse mit Z-Bosonen kann der Einfluss des PileUps und des Underlying Events auf die verschiedenen Algorithmen zur Messung des hadronischen Rückstoßes untersucht werden. Die unterschiedliche Sensitivität der Algorithmen wird genutzt, um Effekte von PileUp und Underlying Event zu separieren. Außerdem kann eine Kalibrierung der Monte Carlo Simulationen durchgeführt werden, um das gleiche Verhalten, das die Daten zeigen, in der Simulation präzise zu modellieren.

In diesem Vortrag soll ein Einblick in den Zusammenhang zwischen PileUp, Underlying Event und hadronischem Rückstoß gegeben werden und diesbezügliche Unterschiede in Daten und Monte Carlo Simulationen vorgestellt werden.

T 59.3 Mi 17:05 Z6 - SR 1.005

Search for anomalous quartic gauge couplings in the all-jets final state at $\sqrt{s} = 13$ TeV with the CMS experiment — •Steffen Albrecht, Robin Aggleton, and Andreas Hinzmann — University of Hamburg

This talk presents a search for new physics analysing the scattering of weak bosons ($VV \to VV$, where V denotes a $W^\pm$ or a Z boson) produced in association with two jets in pp-collisions at $\sqrt{s} = 13$ TeV. The study of vector boson scattering can help to extend the understanding in the mechanism behind electroweak symmetry breaking and to find new physics by precisely measuring gauge boson couplings.

In this analysis we constrain the anomalous quartic gauge couplings in terms of a framework of dimension-eight effective field theory operators. The all-jets final state at di-boson invariant masses larger than 1 TeV is explored for the first time. The two bosons are highly boosted and each form a single jet, allowing for significant reduction of SM backgrounds.

T 59.4 Mi 17:20 Z6 - SR 1.005

Study of the electroweak $W^\pm W^\pm jj$ process and its experimental challenges — •Giulia Gonella and Karsten Köneke — Albert-Ludwigs-Universität Freiburg

Measurements of the electroweak sector of the Standard Model are a way to probe the mechanism of electroweak symmetry breaking at LHC, and to detect small deviations from the theoretical predictions, through which the effect of new physics could manifest itself. In this context the scattering of vector bosons is a key process. In particular the production of W bosons pairs is a vital test of the mechanism, since its scattering amplitude would increase at high energies violating unitarity, without cancellations of divergences due to exchange involving Z or Higgs boson. The talk will give an overview of the measurements of the WW production of two W bosons with the same electric charge in the signature of two leptons, missing transverse energy and two jets with the ATLAS experiment at the LHC. The same-charge requirement leads to a better suppression of the QCD background, but is experimentally more challenging due to the contributions from opposite-charge di-lepton production processes, where the charge of one electron is wrongly reconstructed. The talk will finally focuse on the procedure and techinques applied to estimate this intrumental background using data, and will illustrate its challenges and its impact on the measurement of WW scattering.

T 59.5 Mi 17:35 Z6 - SR 1.005

Reconstruction of the $\tau\tau$ system for Higgs and Z boson property measurements — David Brunner, Jordy Degens, Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, •Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

When reconstructing characteristics of particles decaying into a pair of two τ leptons, the four-momenta need to be accessed. These quan-

tities need to be reconstructed, which poses challenges because of undetectable neutrinos. The currently used algorithm in CMS for the reconstruction of these quantities in $H \to \tau\tau$ and $Z \to \tau\tau$ events is updated with a new version, where improvements were implemented, e.g. a constraint on the boson mass, which will lead to an improvement in resolution. Comparison studies were performed to evaluate the performance gain and will be presented in this talk. A small outlook on further developments of the algorithm is presented additionally.
Polarisation of τ leptons is a particularly interesting measurement, as it allows to access the weak mixing angle $\sin\theta_W$. This requires access to the spin information of the τ leptons, which in turn depends on the ability to reconstruct angular quantities of the τ leptons, which will be provided by the algorithm described above and will make great use of the implemented improvements. The knowledge gained in such a polarisation measurement might also prove fruitfull in a $H \to \tau\tau$ CP analyses.

T 59.6 Mi 17:50 Z6 - SR 1.005

Search for the production of *WVZ* processes in leptonic final states at 13 TeV in ATLAS — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], Carlo A. Gottardo[1], Sebastian Heer[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and •Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

The triboson production is one of the key processes for studying quartic gauge couplings. Next-to-leading order corrections are mandatory to reduce theoretical uncertainties: the QCD correction is about 100%.

I will discuss the development of a new ATLAS analysis aiming to measure on-shell *WWZ* and *WZZ* cross-sections, as the production of triboson processes is becoming accessible at LHC Run 2. The analysis selects events with three or four reconstructed light leptons. The main challenge is the reduction of main backgrounds, i.e. *WZ* in the three-lepton channel and *ZZ* in the four-lepton final state. Multivariate techniques are explored, as well as data-driven methods, to estimate the contribution of non-prompt and fake leptons.

T 59.7 Mi 18:05 Z6 - SR 1.005

Measurement of the scattering of electroweak gauge bosons in the like-charge WWjj final state with the ATLAS detector at the LHC — •Stefanie Todt, Franziska Iltzsche, Joany Manjarres, Carsten Bittrich, Tim Herrmann, and Michael Kobel — IKTP, TU Dresden

Since the discovery of a SM-like Higgs boson, the scattering of massive weak vector bosons (VBS) has been a further yet missing piece in the Standard Model puzzle. Due to the best signal to background ratio, the $W^\pm W^\pm$jj channel is the most favourable final state for studying VBS at a hadron collider such as the LHC. VBS in this channel contains processes with triple and quartic electro-weak (EWK) couplings, as well as Higgs exchange processes. The Higgs contribution is crucial as it ensures unitarity of the scattering amplitude of VBS. Therefore it represents an optimal physics process to probe the non-abelian structure of the EWK Standard Model and at the same time serves as complementary approach to study the EWK symmetry breaking mechanism. We present the analysis of $W^\pm W^\pm$jj VBS conducted at the ATLAS experiment with data taken at $\sqrt{s} = 13$ TeV in Run-2 of the LHC. Major goals include the observation of the scattering process. A further aim is the measurement of the fiducial cross section of the EWK process which involves the development of a decent understanding of the theoretical predictions. A further critical analysis component constitutes the estimate of major backgrounds. These include instrumental mismeasurements which are insufficiently described by simulations and therefore need the employment of data-driven approaches.

T 60: Theorie: Higgs / BSM I

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 1.010

T 60.1 Mi 16:30 Z6 - SR 1.010

Searching for BSM physics with top quarks using an effective field theory approach — •Stefan Bissmann — Fakultät Physik, TU Dortmund, Otto-Hahn-Str.4, D-44221 Dortmund, Germany

We perform a model-independent analysis of t-channel single top production at the LHC (ATLAS and CMS). We investigate the influence of correlations of the experimental uncertainties and determine the individual impacts of different datasets (differential and total cross sections). The constraints on the Wilson coefficient are currently in good agreement with the Standard Model, but with all statistical uncertainties scaled to the luminosity of future scenarios (LHC Run 3, HL-LHC, FCC) the bounds can show significant deviations.

T 60.2 Mi 16:45 Z6 - SR 1.010

Higgs boson pair production in the Electroweak Chiral Langrangian framework — •Matteo Capozi — Max-Planck-Institut für Physik, Föhringer Ring 6 D-80805 München, Germany

We calculate the full NLO QCD corrections to Higgs boson pair production within the Electroweak Chiral Langrangian framework, parametrizing BSM effects in a non linear EFT description. We show the effects of BSM-couplings in the Higgs sector on various distributions.

T 60.3 Mi 17:00 Z6 - SR 1.010

Probing New Physics in the Higgs sector — •Simone Blasi[1], Florian Goertz[1], Tommi Alanne[1], Stefania De Curtis[2], and Kei Yagyu[2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland — [2]INFN - Sezione di Firenze, Via G. Sansone 1, 50019 Sesto Fiorentino, Italy

The discovery of the $h(125)$ Higgs boson confirms the Standard Model picture of a scalar particle in charge of the electroweak symmetry breaking. However, the structure of the Higgs sector and its actual role are still unknown. In the spirit of the High Luminosity program at the LHC, we first constrain New Physics scenarios with an extended Higgs sector by inputting a deviation in the $h(125)$ couplings to Standard Model particles. Our aim is to consistently extract the mass scale of the new scalars by imposing theoretical and experimental constraints in three benchmark models: the Higgs Singlet Model, the Two Higgs Doublet Model and the Georgi Machacek Model. Finally, we elaborate on the possible connection between the scalar sector and some of the most compelling open questions in the Standard Model: Dark Matter, strong CP problem and Flavour puzzle.

T 60.4 Mi 17:15 Z6 - SR 1.010

The charged Higgs decay $H^\pm \to W^\pm h$ at one-loop order in the NMSSM — Thi Nhung Dao[1], •Lukas Fritz[2], Margarete Mühlleitner[2], and Shruti Patel[2] — [1]IFIRSE, Quy Nhon, Vietnam — [2]KIT, Karlsruhe, Deutschland

Charged Higgs bosons appear in extended Higgs sectors beyond the Standard Model (SM) like e.g. the Next-to-Minimal Supersymmetric extension (NMSSM). They are of special phenomenological interest because their detection would be an immediate sign of beyond-the-SM physics. Depending on the parameter choice the decay of the charged Higgs boson into a W-Boson and a neutral Higgs boson, $H^\pm \to W^\pm h$, is one of dominant decay channels and be exploited to search for the charged Higgs boson at the LHC. The NMSSM belongs to the most intensely studied supersymmetric models and is motivated, besides the solution of the μ-problem, by its interesting phenomenology and the possibility of generating a 125 GeV SM-like Higgs boson without the need of very heavy stops or large stop mixing. We compute the one-loop corrections to the decay $H^\pm \to W^\pm h$ in the NMSSM. We investigate the numerical impact of the higher order corrections and give an estimate of the remaining theoretical uncertainty. We compare our findings to the case of the Minimal Supersymmetric Extension (MSSM) and discuss the implications for LHC phenomenology.

T 60.5 Mi 17:30 Z6 - SR 1.010

NLO Matching Conditions in Extended Higgs Sectors — •Martin Gabelmann, Margarete Mühlleitner, and Florian Staub — Karlsruhe Institute of Technology, ITP

The absence of new physics in current LHC searches leads to increasing interest in a variety of non-minimal extensions of the Standard Model (SM). Also the scale of new physics in widely studied models is pushed to higher energies. Automation tools such as SARAH allow for comprehensive studies of a wider class of models with potentially complicated mass spectra and couplings. Not only the tree level values but also NLO and NNLO corrections to mass spectra can be studied

within a reasonable amount of time. However, large mass gaps can lead to problematic large logarithms increasing the uncertainty in fixed order calculations. The use of effective field theories (EFTs) is a common tool to resum these large logs. Thus, precise matching conditions between an EFT and UV complete -or intermediate- theories are needed. I discuss various aspects important for a generic implementation of NLO matching conditions to scalar couplings such as systematic cancellations of infrared divergences and contributions from mixed loops containing heavy and light fields.

T 60.6 Mi 17:45 Z6 - SR 1.010

Precision prediction of the Higgs mass in the MSSM at three-loop level — Robert V. Harlander, •Jonas Klappert, and Alexander Voigt — RWTH Aachen University, Aachen, Germany

In the MSSM, sizable corrections to the light Higgs mass can be observed up to three-loop order. Since the latter are not implemented in most spectrum generators, we present a `C++` implementation of these contributions into the package `Himalaya`. `Himalaya` can be linked to existing codes, thus allowing for the elevation of these codes to the three-loop level. We present the first full $\overline{\text{DR}}$ study of the three-loop effects by linking `Himalaya` to `FlexibleSUSY` and compare our results to fixed-order two-loop calculations, as well as to the result based on an EFT approach. We also present a result for the Higgs mass with consistent matching between the three-loop fixed-order expression and an EFT approach.

T 60.7 Mi 18:00 Z6 - SR 1.010

The CP-Violating 2HDM in Light of a Strong First Order Electroweak Phase Transition and Implications for Higgs Pair Production — •Philipp Basler[1], Margarete Mühlleitner[1], and Jonas Wittbrodt[2] — [1]Karlsruher Institut für Technologie, ITP, Karlsruhe, Deutschland — [2]DESY, Hamburg, Deutschland

The generation of the observed matter-antimatter asymmetry in the universe through baryogenesis cannot be explained in the Standard Model. We therefore investigate the possibility of a strong first order phase transition in the CP-Violating 2-Higgs-Doublet Model (C2HDM) after imposing theoretical and experimental constraints. We study the type I and II C2HDM where one of the neutral Higgs bosons can be the Standard Model-like Higgs boson. Our results show that there is a strong interplay between the requirement of a strong phase transition and collider phenomenology with testable implications for searches at the LHC. We find additional preferred mass hierarchies compared to those of the CP-conserving 2HDM. We also use our results to investigate the interplay between a strong phase transition and the size of the trilinear Higgs self-couplings.

T 60.8 Mi 18:15 Z6 - SR 1.010

Impact of CP-violating phases on MSSM Higgs searches — •Shruti Patel — ITP and IKP, Karlsruhe Institute of Technology

We study the effects of CP-violating phases on the phenomenology of the MSSM Higgs sector. Complex parameters in the MSSM give rise to CP-violating mixing between the tree-level neutral Higgs mass eigenstates, leading to three new CP-admixed loop-corrected mass eigenstates $\{h_1, h_2, h_3\}$. In scenarios where the lightest Higgs h_1 is SM-like and the two other Higgs states are much heavier and nearly mass degenerate, complex parameters induce a large admixture between the two heavy Higgs states. In this talk, we study the impact of CP-violating interference effects between h_2 and h_3 in an example process of $b\bar{b} \to \tau^+\tau^-$. We demonstrate that large destructive interference effects modify the LHC exclusion bounds such that parts of the parameter space that would be excluded by MSSM Higgs searches under the assumption of CP-conservation open up when the possibility of CP-violation in the Higgs sector is accounted for.

T 60.9 Mi 18:30 Z6 - SR 1.010

Phenomenological Implications of the Dark Phases of the N2HDM — •Isabell Engeln[1], Margarete Mühlleitner[1], Rui Santos[2,3,4], and Jonas Wittbrodt[5] — [1]ITP, Karlsruher Institut für Technologie (KIT), Karlsruhe, Germany — [2]ISEL, Instituto Politécnico de Lisboa, Lisboa, Portugal — [3]CFTC, Universidade de Lisboa, Lisboa, Portugal — [4]LIP, Departamento de Física, Universidade do Minho, Braga, Portugal — [5]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany

The N2HDM is based on the CP-conserving 2HDM extended by a real scalar singlet field. This model allows for three different dark phases with either one of the two doublets or the singlet being inert, or both. This gives rise to dark matter candidates that originate from different sectors. In this talk, we compare the phenomenology of the inert doublet and the inert singlet phase based on parameter scans of both phases, considering all applicable theoretical and experimental constraints. We discuss differences and similarities and point out possible ways to distinguish between the phases at current or future collider experiments.

T 60.10 Mi 18:45 Z6 - SR 1.010

Modelling of the interference between New Physics and Standard Model processes — •Didier Alexandre — Humboldt Universität zu Berlin

In searches for new physics (NP), one important consideration is the interference of the theoretical processes with Standard Model (SM) processes that yield the same final states. The effect of an interference wave on the shape of the invariant mass is to distort the distribution asymetrically, shifting the peak with respect to the value of the mass of the particle. It is important to take this effect into account in the Monte Carlo modelling of the NP signals. In this talk, we discuss the interference effect related to the searches for the vector-like quark decays T(2/3)→Wb and Y(4/3)→W$\bar{b}$, which alters the signal distributions significantly. With the help of simulations performed with MadGraph, an overview of the sizes of the effect according to different model parameter settings is presented. We discuss a strategy for taking into account the interference with the SM in the cross-section limit setting procedure. Finally, a general procedure is proposed for NP searches.

T 61: Experimentelle Methoden II

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 1.013

T 61.1 Mi 16:30 Z6 - SR 1.013

Jet energy scale corrections in the CMS experiment in pp collisions at 13 TeV — Johannes Haller, Anastasia Karavdina, Arne Reimers, and •Jens Multhaup — Institut für Experimentalphysik, Universität Hamburg

For almost all data analyses in CMS, a precise knowledge of the jet energies is of high importance. In this talk an overview is given of the jet energy calibration (JEC) procedure employed in CMS, which factories into pile-up, detector response and residual corrections. Emphasis is given on the residual corrections obtained for pp-collision data recorded by CMS during 2016.

T 61.2 Mi 16:45 Z6 - SR 1.013

Jet Resolution Correction with 2017 Di-Jet Data at CMS — •Christoph Garbers, Anastasia Karavdina, Jens Multhaup, Arne Reimers, and Peter Schleper — Institut für Experimentalphysik, Universität Hamburg, Hamburg, Germany

For most CMS analysis precise knowledge of the jet energies is of high importance. This is achieved by calibration of the reconstructed jet energies in different detector parts. The calibration is done with simulation as well as with data. In this talk the relative residual correction with di-jet events for the CMS pp-collision data recorded during 2017 is presented. The preparation of data for the analysis and tools introduced for monitoring of residual corrections are discussed in detail.

T 61.3 Mi 17:00 Z6 - SR 1.013

Measuring the Jet Energy Resolution with the Bisector Method in ATLAS — •Tanja Holm and Ian C. Brock — Physikalisches Institut Universität Bonn, Bonn, Germany

Jets play an important role in many physics processes at the LHC. Therefore a precise knowledge of its jet energy resolution (JER) is important. It is defined as the width of the energy distribution of a reconstructed jet with respect to its true energy.

The bisector method is one way of estimating the JER. It is a geo-

metric approach to separate particle-level from detector-level contributions to the transverse momentum imbalance in dijet events. Particle-level imbalances mostly originate from initial-state radiation and therefore are expected to be isotropic in the transverse plane. Detector-level imbalances only occur in the direction of the jets. For this reason the imbalance vector is decomposed into a perpendicular and a parallel component with respect to the average direction of the jets ("jet axis"). The resolution perpendicular to the jet axis (particle level) is subtracted quadratically from the resolution parallel to the jet axis (particle + detector level), remaining therefore with the resolution originating from the detector. This talk will discuss the bisector method and its implementation for Run 2 of the LHC at ATLAS, where especially the enlarged number of pile-up events has to be considered.

T 61.4 Mi 17:15 Z6 - SR 1.013

Kalibrierung der Jet-Energie mit Z+Jet-Ereignissen am CMS-Experiment — Thomas Berger, Christoph Heidecker, •Daniel Savoiu und Klaus Rabbertz — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie (KIT)

Viele Physikanalysen erfordern eine genaue Vermessung von Teilchenjets. Insbesondere bei der Messung der Jet-Energie tritt dabei eine Vielzahl von Störeffekten auf, die eine Korrektur erforderlich machen.

Als letzter von mehreren Schritten werden am CMS-Experiment Korrekturen der Jet-Energie aus dem Vergleich zu einem präzise rekonstruierten Objekt bestimmt. Durch die Auswahl von Ereignissen, bei denen ein Jet transversal gegen ein Z-Boson balanciert wird, kann die absolute Jet-Energieskala kalibriert werden.

In diesem Vortrag wird der aktuelle Status der Jet-Energie-Kalibrierung vorgestellt. Betrachtet werden dabei die in den Jahren 2016 und 2017 bei einer Schwerpunktsenergie von 13 TeV aufgezeichneten Daten, die aufgrund der hohen Ereigniszahlen eine präzise Bestimmung der Jet-Energie ermöglichen. Eine zentrale Herausforderung bildet dabei die vergrößerte Anzahl von Pile-Up-Ereignissen, verursacht durch die erhöhte instantane Luminosität.

T 61.5 Mi 17:30 Z6 - SR 1.013

Jet mass scale calibration for large-radius jets and variable-radius jets in ATLAS — •Xuanhong Lou[1], Johannes Balz[2], and Katharina Behr[1] — [1]Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg — [2]Johannes Gutenberg Universitaet Mainz, Saarstraße 21, 55122 Mainz

Jets are widely used in ATLAS physics analyses and a proper jet calibration is essential in the case of both high-precision measurements of known particles and searches of new physics. During the calibration, the Monte Carlo based correction factors are used to correct, on average, the reconstructed jet properties to particle-level and account for various detector effects. The Jet Mass Scale (JMS) calibration is carefully studied and efforts have been made to improve the mass response closure for groomed large-radius jets and variable-radius jets. A dedicated framework is developed and will be used to derive the official recommendation of calibration factors for the upcoming release 21 analyses.

T 61.6 Mi 17:45 Z6 - SR 1.013

Extrapolation of in-situ calibrations of large-radius jets to high p_T at ATLAS — •Eftychia Tzovara, Lucia Masetti, and Peter Berta — Institute of Physics, JGU Mainz, Germany

Data-based, so called "in-situ", methods are used to correct the jet energy and mass calibrations and to determine their systematic uncertainties. A very successful technique for extracting the jet mass scale and resolution, from resonance decays (e.g. W/Z, H, top) reconstructed in a single large-radius jet, is the "forward-folding" method. It is used to extract the relative difference in the jet mass response between data and simulation, by using non-parametric shapes for both the particle-level distribution and the response function, derived from the simulation. In order to use this method to set a systematic uncertainty on the jet mass scale and jet mass resolution for beyond Standard Model searches, an extrapolation to high p_T regions is necessary.

Monte Carlo (MC) simulations can be used to extrapolate the large-radius jet forward-folding results from the phase space region where it is performed (e.g. at low p_T), to regions that are inaccessible to the measurement in data. Particular attention is given to the MC modeling systematics that are expected to dominate the total uncertainty. In this talk, results from the extrapolation of the large-radius jet calibrations and their uncertainties to high p_T, at ATLAS for a center-of-mass energy of 13 TeV, are presented.

T 61.7 Mi 18:00 Z6 - SR 1.013

Performance of pileup mitigation in jets using Constituent Subtraction at the ATLAS experiment — •Peter Berta and Lucia Masetti — Institut für Physik, JGU Mainz, Staudingerweg 7, Mainz, Germany

The ability to correct jet kinematics and substructure for simultaneous proton-proton interactions (pileup) largely determines the precision of measurements and searches at the Large Hadron Collider.

In this talk, the performance of the Constituent Subtraction method for pileup mitigation in jets at the ATLAS experiment will be presented. This novel method corrects the jet inputs from the whole event before jet clustering based on the average pileup density in the event. Phenomenological studies showed potential for sizable improvements in performance for small- and large-radius jets compared to the previously used methods. Large-radius jets are particularly interesting when they contain highly boosted hadronic decays of W bosons and top quarks. They can be recognized using jet substructure variables whose performance is also expected to profit from the new method.

T 61.8 Mi 18:15 Z6 - SR 1.013

Measurement of the Photon Identification Efficiency in the ATLAS Experiment using the Electron Extrapolation Method — •Früd Braren — DESY, Hamburg

The detection and identification of photons in high-energy collisions is important for the physics program of the ATLAS experiment at the Large Hadron Collider. Photons produced in collisions in the ATLAS detector are relevant as a probe of QCD and the Standard Model processes in general, as well as the decay of the Higgs boson to a pair of photons. Also signatures of physics beyond the Standard Model may include photons. For measurements and searches involving photons it is vital to know the efficiency with which photons are being identified as such with high precision. The identification of photons is based on the shape of the electromagnetic shower in the calorimeter and its efficiency needs to be measured using collision data. One of the three currently employed methods for measuring the photon identification efficiency is based on electrons from Z-boson decays using a Tag-and-Probe method. The electron showers, which are subsequently transformed into photon-like objects using shower-shape information from electron- and photon Monte-Carlo samples, can be used to measure the photon identification efficiency in the transverse-momentum range from about 25 GeV to about 150 GeV. This contribution presents the method and results of this measurement, using data corresponding to an integrated luminosity of 79.9 fb^{-1}, collected at a center-of-mass energy of $\sqrt{s} = 13$ TeV.

T 61.9 Mi 18:30 Z6 - SR 1.013

Optimization of the photon identification in the ATLAS experiment — •Jan-Hendrik Arling — Deutsches Elektronen-Synchrotron DESY, ATLAS group, Hamburg — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Dortmund

A key ingredient for the physics program of the ATLAS experiment at the Large Hadron Collider is the efficient reconstruction and identification of photons in the high-energy pp collisions.
Photons play an important role in many measurements, such as the production of photons in Standard Model processes or Higgs boson decays into two photons ($H \to \gamma\gamma$), and searches for physics beyond the Standard Model. In each of these, it is important to identify photons with a high efficiency while keeping the number of misidentified photons at a low rate.
Photons are identified by defining independent requirements on variables describing the shape of electromagnetic showers inside the ATLAS calorimeter. This approach can be challenged by more sophisticated methods, such as machine learning algorithms, to improve the identification performance further. A newly developed framework helps to study these multivariate-analysis techniques and compare the performance between different tuning approaches.
This talk will show the current development stage of the optimization framework for the photon identification in the ATLAS experiment.

T 61.10 Mi 18:45 Z6 - SR 1.013

Studien zur Optimierung der Photon-Identifikation am ATLAS-Experiment mithilfe eines tiefen neuronalen Netzwerkes — •Marius Nagel, Gregor Gessner, Isabel Nitsche, Johannes Erdmann, Olaf Nackenhorst und Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4 a, 44227 Dortmund

Bei den am Large Hadron Collider stattfindenden Proton-Proton-Kollisionen entstehen unter anderem Photonen, die aus elementaren Streuprozessen stammen. Solche Photonen werden am ATLAS-Experiment aus Informationen aus dem inneren Detektor und dem elektromagnetischen Kalorimeter rekonstruiert. Die Aufgabe von Photonidentifikationsalgorithmen ist es dabei, zwischen Photonen aus den elementaren Streuprozessen, den Signalphotonen, und fehlerhaft als Photonen rekonstruierten Objekten zu unterscheiden.

Bei der Photonidentifikation werden Variablen zur Charakterisierung von Photonen untersucht, welche zur Unterscheidung zwischen Signalphotonen und fehlerhaft rekonstruierten Objekten dienen. Im Vergleich zu den typischerweise verwendeten multidimensionalen Schnitten auf diese Variablen können tiefe Neuronale Netzwerke auch komplexe nicht lineare Zusammenhänge dieser Variablen lernen und somit die Klassifizierung verbessern. Im Vortrag werden Studien zur Optimierung der Photonidentifikation mithilfe eines tiefen neuronalen Netzwerkes vorgestellt.

T 62: Myondetektoren

Zeit: Mittwoch 16:30–18:35 Raum: Z6 - SR 2.002

Gruppenbericht T 62.1 Mi 16:30 Z6 - SR 2.002

CMS muon chambers - status and upgrade — Thomas Hebbeker, Carsten Heidemann, Kerstin Hoepfner, Markus Merschmeyer, and •Daniel Teyssier — III. Physikalisches Institut A, RWTH Aachen University

The CMS muon system uses three different technologies to trigger, identify muons and measure their momentum. Even after 10 years of operation the performance is very high. The Drift Tube (DT) chambers located in the barrel show a very good behavior and have a coverage up to $\eta = 1.2$. The Cathode Strip Chambers (CSC) are able to work in an inhomogeneous B field environment and cover the endcaps region up to $\eta = 2.4$. In addition the Resistive Plate Chambers (RPC) are present in both barrel and endcaps, in order to give a better time resolution. The living channels fraction for all these detectors is still very high at the end of 2017 and the redundancy of the system allows a very good muon identification efficiency.

The HL (High Lumi)-LHC program is challenging for the muon system, as it will compel to deal with new background and rate conditions. The electronics of all three DT, CSC and RPC systems will be modified. Some new Gas Electron Multiplier (GEM) and RPC detectors will be installed to extend the current coverage up to $\eta = 2.8$ and also to reinforce the redundancy in the forward region. Several tests of longevity are on-going to qualify the new components.

This talk will present the status of the current muon system and the capacity to improve and extend the system for HL-LHC.

T 62.2 Mi 16:50 Z6 - SR 2.002

CMS DT muon chambers upgrade — •Carsten Heidemann, Thomas Hebbeker, Markus Merschmeyer, and Daniel Teyssier — III. Physikalisches Institut A RWTH Aachen University, Aachen

The CMS Drift Tubes (DT) muon chambers in the barrel will cope with higher pile-up as well as higher background conditions in the next High Luminosity (HL) LHC program. The failure rate of the detector itself is very low and there is no need to replace the chambers themselves for HL-LHC. The increased trigger rates and the radiation environment requires an exchange of the frontend electronics mounted on the chambers. A new mini crate (MiC2) is currently designed to replace the old electronics and move the level-1 trigger functionality to the better accessible service cavern. The longevity studies of the chambers are ongoing using the Gamma Irradiation Facility (GIF++) to re-enact the conditions of three times the HL-LHC equivalent dose.

T 62.3 Mi 17:05 Z6 - SR 2.002

Bau von small-diameter Muon Drift Tube (sMDT)-Kammern für das ATLAS-Myonspektrometer — •Verena Walbrecht, Korbinian Schmidt-Sommerfeld, Patrick Rieck, Oliver Kortner und Hubert Kroha — Max-Planck-Institut für Physik, München

Im zweiten Long Shutdown des Large Hadron Colliders, 2019-2020, werden die Monitored Drift Tube (MDT)-Kammern an den Enden der inneren Barrellage durch 16 neue small-diameter Muon Drift Tube (sMDT)-Kammern mit dem halben Rohrdurchmesser ersetzt, die mit neuen thin-gap RPC-Triggerkammern integriert sind. Die Kammerproduktion hat im Januar 2018 begonnen und soll bis Dezember des Jahres abgeschlossen sein. Wie bei den MDT-Kammern muss auch beim Bau der sMDT-Kammern eine hohe Positioniergenauigkeit der Zähldrähte von mindestens 0.02 mm erreicht werden.
In dem Vortrag wird über die Driftrohrproduktion, die Montage und Vermessung der Kammern und deren mechanische und elektrische Eigenschaften berichtet.

T 62.4 Mi 17:20 Z6 - SR 2.002

High rate studies of the ATLAS MDT chambers in LHC Run-2 — •Nicolas Köhler, Oliver Kortner, Hubert Kroha, and Robert Richter — Max Planck Institut für Physik

In 2017, the Large Hadron Collider for the first time delivered instantaneous luminosities near $2 \cdot 10^{34}\,\mathrm{cm^{-2}s^{-1}}$, twice the design luminosity. Under the so far highest neutron and γ background fluences in the ATLAS muon spectrometer at this luminosity, the high counting rate behaviour of the ATLAS precision muon tracking chambers, the Monitored Drift Tube (MDT) chambers , has been studied, especially in the inner endcap layer where the background rates are highest. The data are used to obtain new estimates of the limitations for the operation of the chambers under realistic conditions.

T 62.5 Mi 17:35 Z6 - SR 2.002

Quality control of GEM detectors for the Upgrade of the CMS Muon Forward system — •Giovanni Mocellin, Henning Keller, Kerstin Hoepfner, and Thomas Hebbeker — III. Physikalisches Institut A, RWTH Aachen University, Germany

With the increase of the instantaneous luminosity delivered to the experiments by the LHC accelerator, reaching a value of $5{\times}10^{34}\,\mathrm{cm^{-2}s^{-1}}$ after the Long Shutdown 3 in 2025, the detectors have to be upgraded to improve the performance and to sustain higher particle fluxes. The forward regions, corresponding to the endcaps of the detectors, are the most affected parts. In the CMS experiment, to cope with the higher event rates and larger radiation doses, triple-layer Gas Electron Multipliers (GEM) will be installed in the Muon Endcaps. For the first time, such detectors will have large sizes of the order of 1-2 $\mathrm{m^2}$, thus high requirements on the uniformity across the detector are needed. Triple-GEM chambers will complement the existing Cathode Strip Chambers, leading to a better identification of the muon tracks and a reduction of the trigger rate due to the suppression of fake candidates. In addition, the forward coverage will be further extended. Before the final installation in the CMS detector, to test their integrity, quality and performance, the GEM chambers undergo eight Quality Control tests (QC1-QC8). One of the sites in which these operations are performed is Aachen. This talk gives an introduction to GEM detectors and presents results of the performance tests.

T 62.6 Mi 17:50 Z6 - SR 2.002

Effects of humidity on the gas gain in MicroMegas detectors — •Thorwald Klapdor-Kleingrothaus, Stephanie Zimmermann, and Ulrich Landgraf — Universität Freiburg

The Micro-Mesh-Gaseous Detectors (MicroMegas) are planar and high-rate capable detectors with a very good spatial resolution. In the recent years, the MM technology was intensively studied in view of replacing the innermost station of the ATLAS endcap muon spectrometer. The new detector assembly is known as the New Small Wheel (NSW) Upgrade and will be installed in the next long LHC shutdown in 2019/20. The NSW will use the MicroMegas technology as well as small strip-Thin-Gap-Chambers (sTGC) for triggering and track reconstruction. In this context, small MicroMegas prototypes (10x10cm) were developed to study their performance and their behavior. The presented work uses a cosmic muon test setup with two of these prototypes in combination with a scalable readout system. Influences on the detector performance caused by variations in the pressure of the operation gas or by changes in the humidity at the low ppm level are investigated. These parameters will affect the later design of detector-slow-control system at the NSW in ATLAS. The results of the first measurements and corresponding simulation studies are presented.

T 62.7 Mi 18:05 Z6 - SR 2.002

Measurement of Position Inaccuracies in Large Micromegas Chambers — •Patrick Scholer, Ulrich Landgraf, and Stefanie Zimmermann — Universität Freiburg

In the next long shutdown of the LHC in 2019/20, the innermost part of the end cap Muon Spectrometer of the ATLAS detector will be replaced. The new system is called New Small Wheel (NSW). It will use Micro Mesh Gaseous Detectors (Micromegas, MM) and small-strip Thin Gap Chambers (sTGCs) as its detector technologies; both providing a high spatial resolution achieved by a strip like segmented read-out structure.

The mechanical production tolerances on the strip alignment have a direct impact on the spatial resolution of the detector. In order to guarantee the tight requirements, a high precision optical measurement tool was developed allowing for measurements of the strip pattern and geometry over the large dimensions of the NSW PCBs of up to 2 m. It is based on a camera and a telecentric objective joined to a coordinate measurement machine. Specific optical object detection libraries were developed to allow for multiple object detection. The system reaches a precision of 30 μm within a spatial measurement range of 6.5 m x 1.4 m.

In this talk, the setup of the measurement system is discussed and first measurement results are presented.

T 62.8 Mi 18:20 Z6 - SR 2.002

Investigation of square meter sized Micromegas Quadruplets with Cosmic Muons — •Maximilian Herrmann, Otmar Biebel, Bernhard Flierl, Ralf Hertenberger, Felix Klitzner, Philipp Lösel, Ralph Müller, and Chrysostomos Valderanis — LMU München

Square meter sized Micromegas quadruplets will be used in collision experiments for muon tracking. The Cosmic Ray Test Facility (CRF) in Garching is well suited for the investigation of these detectors with cosmic muons. The CRF consists of two Monitored Drift Tube Chambers (MDTs) for precise tracking in one dimension. A trigger and a coarse segmentation in the direction along the tubes is achieved via a scintillator hodoscope. A quadruplet with an active area of about 2 m^2 fits well in the 9 m^2 active area of the CRF and can be investigated with tracks inclined between $\pm$ 30 degrees to the zenith angle.
We present results for the performance of Micromegas quadruplets based on measurements done in the CRF. Geometrical properties of the segmented readout anodes are reconstructed from the deviations to track predictions of the MDTs. The position resolution is investigated to estimate the track prediction accuracy. Homogeneity in pulse height and efficiency will be discussed.

T 63: Outreach II

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.005

T 63.1 Mi 16:30 Z6 - SR 2.005

Praktikumsversuch: Suche nach $t\bar{t}$-Resonanzen mit ATLAS-Daten — •Isabel Nitsche, Sonja Zeissner, Johannes Erdmann und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

In diesem Praktikumsversuch haben Studierende die Möglichkeit grundlegende Techniken der Datenanalyse in der Teilchenphysik zu lernen. Als Beispiel dient eine Suche nach neuer Physik mit ATLAS-Daten, die im CERN Open Data Portal veröffentlicht wurden. Die Studierenden suchen nach einer $t\bar{t}$-Resonanz, welche durch den Zerfall eines hypothetischen schweren Z'-Bosons erzeugt wird. Dabei werden die wichtigsten Schritte für solch eine Analyse durchlaufen.

Im ersten Schritt werden die Eigenschaften der rekonstruierten Objekte in Monte-Carlo-Simulationen (MC) untersucht, um ein Verständnis für die Signatur der verschiedenen Prozesse im Detektor zu erlangen. Darauf aufbauend wird eine Ereignisselektion entwickelt und die Zurückweisung der verschiedenen Untergrundprozesse untersucht. Nach der Identifizierung des Hauptuntergrundes werden verschiedene Größen aus den Vierervektoren der Objekte berechnet. Aus diesen Größen wählen die Studenten eine finale Diskriminante aus, welche eine gute Trennung zwischen Signal und Hauptuntergrund aufweist. Nachdem eine gute Übereinstimmung zwischen Daten und MC sichergestellt wurde, wird schließlich eine einfache statistische Analyse durchgeführt und ein 95% CL Limit auf die Masse des Z'-Bosons bestimmt.

T 63.2 Mi 16:45 Z6 - SR 2.005

Das FSP-Pilotprojekt "Spitzenforschung, Erkenntnisvermittlung und Nachwuchsgewinnung aus einer Hand" — •Uta Bilow und Michael Kobel für die Netzwerk Teilchenwelt-Kollaboration — IKTP, Technische Universität Dresden

Im Rahmen eines Pilotprojekts erproben die vier FSPs (ATLAS, ALICE, CMS, LHCb) der Verbundforschung am LHC neue Strukturen und Maßnahmen zur Wissenschaftsvermittlung und Nachwuchsgewinnung. Das Pilotprojekt basiert auf Netzwerk Teilchenwelt, einem Zusammenschluss von 29 Forschungseinrichtungen in Deutschland, in dem Wissenschaftler/innen über mobile Programmangebote Astroteilchen- und Teilchenphysik an Jugendliche und Lehrkräfte vermitteln. Jugendliche analysieren Originaldatensätze aus den Forschungsfeldern der Teilchen- und Astroteilchenphysik oder befassen sich über Vertiefungsangebote, darunter Experimente mit speziellen Detektoren zur Messung kosmischer Teilchen oder Workshops am CERN, intensiver mit der Wissenschaft bis hin zu eigenen Forschungsarbeiten.

Neuer Baustein im Pilotprojekt ist ein Fellow-Programm. In diesem Programm werden Abiturienten und junge Studierende, die an den Angeboten von Netzwerk Teilchenwelt teilgenommen haben, weiter begleitet. Die an den FSPs beteiligten Forschungseinrichtungen erhalten somit über die Strukturen von Netzwerk Teilchenwelt unmittelbaren Zugang zu hoch motiviertem und engagiertem Nachwuchs. Sie können frühzeitig Kontakt mit diesen an Teilchenphysik interessierten Studierenden aufnehmen und sie bereits in der frühen Studienphase als Fellows fördernd einbinden.

T 63.3 Mi 17:00 Z6 - SR 2.005

IceCube-VR - virtualle Realität in der Neutrinoastronomie — •Peter Peiffer, Michael Gödel, Alessandro Guttrof, Frederic Kirstein, Christian Schneider, Elmar Schömer, Sebastian Böser und Steffen Eiden für die IceCube-Gen2-Kollaboration — Universität Mainz, Deutschland

Eine der Herausforderungen der Grundlagenforschung ist die Veranschaulichung der Experimente für Laien. IceCube ist derzeit der größte Neutrinodetektor der Welt. Im Rahmen der Öffentlichkeitsarbeit wurde für IceCube ein Virtual Reality (VR)-Spiel entwickelt, das unter Zuhilfenahme einer Oculus-Rift VR-Brille einerseits den Detektor anschaulich visualisiert und andererseits den Spieler in die Rolle des Auslesecomputers versetzt. Der Spieler wird virtuell in den Detektor hineinversetzt und sieht die optischen Module aufleuchten, wenn sie Licht detektiert haben. Seine Aufgabe ist es dann, anhand von vorher kommunizierten Kriterien, zu entscheiden, ob es sich bei dem Ereignis um ein Neutrino oder um ein Myon handelt. Dies vermittelt auf spielerische Weise einen Eindruck des Detektors sowie ein Gefühl für die Herausforderungen der Datenanalyse. In dem Vortag wird das Spiel selbst vorgestellt sowie über erste Erfahrungen mit dessen Einsatz in der Öffentlichkeitsarbeit berichtet.

T 63.4 Mi 17:15 Z6 - SR 2.005

Methodische Überlegungen zur Bestimmung der Myonlebensdauer in der Schule — •Thomas Hildebrand — Physikalisches Institut der Universität Bonn

Mit dem bekannten Experiment "Kamiokanne" können auch in der Schule mittels Cherenkovstrahlung kosmische Myonen nachgewiesen werden. Die einfache experimentelle Apparatur besteht aus Thermoskanne und Photomultiplier. Aus detektierten Doppelpulsen der Myonenzerfälle wird die Lebensdauer der Myonen bestimmt. Durch den Einsatz eines Speicheroszilloskops können die einzelnen Ereignisse betrachtet und als Bilddateien zur Auswertung herangezogen werden. Die digitalisierten Doppelpulse können mit geeigneter Software ausgewertet werden. Eine Vereinfachung der Auswertung kann dadurch erreicht werden, dass vorausgewählte Bilddateien betrachtet werden. Dies kann genutzt werden, um auf Schulniveau die Lebensdauer der Myonen zu bestimmen. Es ist beabsichtigt, die Bilddateien in einer genügend großen Anzahl im Internet zur Verfügung zu stellen, die als Unterrichtsmaterial genutzt werden können.

T 63.5 Mi 17:30 Z6 - SR 2.005

Datenanalyse von Myon-Detektoren und Mini-Neutron-Monitoren installiert auf dem Forschungsschiff Polarstern

und auf der Antarktisstation Neumayer III mit Cosmic@Web — •Michael Walter[3], Bernd Heber[1], Helena Krüger[2] und Carolin Schwerdt[3] — [1]Christian-Albrechts-Universität zu Kiel, Germany — [2]Center for Space Research, North-West University, Potchefstroom, South Africa — [3]Deutsches Elektronen Synchrotron DESY, Zeuthen, Germany

Eine Kollaboration von DESY und den Universitäten Kiel und Potchefstroom hat auf dem Forschungsschiff Polarstern und auf der Antarktisstation Neumayer III jeweils einen Myon-Detektor und einen Mini-Neutron-Monitor installiert. Ziel ist die Messung kosmischer Teilchen in Abhängigkeit vom Erdmagnetfeld und von der Sonnenaktivität. Es werden die Funktionsweise der beiden transportablen Detektorsysteme beschrieben und Ergebnisse von Untersuchungen der Sensitivität der Detektoren präsentiert. Die Daten sind über die Internetplattform Cosmic@Web verfügbar und können dort von Schülern analysiert werden. Einleitende Texte, detaillierte Hintergrundinformationen und Anleitungen ermöglichen die Nutzung des Outreach-Projekts auch ohne direkten Kontakt zu den Forschungseinrichtungen. Verschiedene Aufgabenstellungen werden anhand von Analysebeispielen diskutiert.

T 63.6 Mi 17:45 Z6 - SR 2.005

Jugendliche erforschen das Unsichtbare mit CosMO — •Carolin Schwerdt, Michael Walter, Timo Karg und Marcel Usner — Deutsches Elektronen-Synchrotron DESY, 15738 Zeuthen, Deutschland

Arbeiten wie ein/e Wissenschaftler/in – das wünschen sich viele Jugendliche. Auch für die Nachwuchsgewinnung im Bereich der Forschung ist dies ein immer wesentlicheres Element. Netzwerk Teilchenwelt schafft dafür Angebote. Jugendliche können an der Forschung zu den kleinsten Teilchen teilhaben und eigene Forschungsaufgaben bearbeiten. DESY in Zeuthen hat im Netzwerk Teilchenwelt das CosMO-Experiment und die Webplattform Cosmic@Web entwickelt. Jugendliche können damit die uns permanent durchdringende kosmische Strahlung selbstständig untersuchen. Voraussetzung sind allgemeines Wissen und Interesse am Fachgebiet. Im Vortrag werden der Detektor, Beispiel für damit durchführbare Messungen, wie z.B. die Kalibration von Detektoren oder die Bestimmung der Lebensdauer von Myonen, und Cosmic@Web vorgestellt. Zusammen mit rund 20 anderen Instituten im Netzwerk Teilchenwelt stellt DESY das CosMO-Experiment bundesweit für Schülerprojekte zur Verfügung, sowohl an den jeweiligen Instituten als auch an anderen Lernorten.

T 63.7 Mi 18:00 Z6 - SR 2.005

Die Auger-Masterclass - Jugendliche analysieren Daten des Pierre-Auger-Observatoriums — •Julian Rautenberg[1], Maria Krause[2], Annelie Schulz[2] und Carolin Schwerdt[2] — [1]Bergische Universität Wuppertal, Gaußstr. 20, D-42119 Wuppertal — [2]DESY, Platanenallee 6, D-15738 Zeuthen

Die Pierre-Auger-Kollaboration stellt 1% der Daten auf einer Webseite zur detaillierten Betrachtung zur Verfügung. Die Messdaten der einzelnen Detektoren zu einem gemessenen Luftschauer sowie die Ereignisliste mit den Luftschauerinformation können als Textdatei heruntergeladen werden. Mithilfe dieser Daten werden Schüler in der Auger-Masterclass angeleitet einzelne Ereignisse zu rekonstruieren. Dabei werden die Stationsdaten analysiert um z.B. eine Richtungsinformation zu bestimmen. Dies wird mit einer Tabellenkalkulation durchgeführt ohne weitere technische Hilfsmittel einzuführen. Jugendliche bekommen in der Masterclass einen authentischen Einblick in die wissenschaftliche Arbeitsweise, wie aus Messdaten wissenschaftliche Aussagen gewonnen werden. Das Konzept der Auger-Masterclass wird vorgestellt und Erfahrungen aus der Durchführung mit Schülergruppen werden berichtet.

T 63.8 Mi 18:15 Z6 - SR 2.005

Energetic particle data from space and in the atmosphere — •B. Heber — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel, Germany

The Extraterrestrial Physics division of the University of Kiel (CAU), Germany has more than 50 years of experience in building and analyzing energetic particle instruments for space missions. A wealth of energetic particle data from different interplanetary missions like Ulysses, SOHO and STEREO are available. In addition our group runs a neutron monitor as well as a muon telescope on ground and performed several measurements in aircraft and on balloons. Here we discuss different projects that could be realized based on such data sets. Among them are the determination of the Pfotzer maximum from Balloon measurements, the dependence of the measured particle flux on the geomagnetic latitude at sea level and at flight altitudes and the impact of solar activity on energetic particles and cosmic rays.

T 63.9 Mi 18:30 Z6 - SR 2.005

Herausforderungen bei der Messung der Myonlebensdauer mit einem einfachen Cherenkov-Detektor — •Barbara Valeriani-Kaminski — Physikalisches Institut der Universität Bonn

Um im Schulunterricht den Zerfall kurzlebiger Teilchen und die Messung ihrer Lebensdauer zu behandeln, können Myonen aus der kosmischen Strahlung und ihre Zerfälle mittels des Cherenkov-Effekts nachgewiesen werden. In diesem Vortrag werden die Ergebnisse verschiedener Versuche vorgestellt, die Lebensdauer des Myons mit einem einfachen Cherenkov-Detektor zu untersuchen. Ziel dieser Versuche ist es, eine Messapparatur aufzubauen, die innerhalb weniger Tage eine ausreichende Zahl an Myonzerfällen nachweist und ausführliche Informationen zu diesen Zerfällen liefert. Gleichzeitig soll das Experiment so einfach sein, dass es auch im Schulunterricht eingesetzt werden kann. Der Messaufbau besteht deswegen nur aus einem mit Wasser gefüllten lichtdichten Gefäß, einem Photomultiplier und einem Oszilloskop zur Speicherung der Doppelpulsbilder der Myonzerfälle. Unterschiedliche Wasservolumen und Photomultiplier wurden dabei eingesetzt, um sowohl die Rate der Myonzerfälle im Wasser als auch das Signal-zu-Untergrund-Verhältnis zu erhöhen. Die Analyse der vom Oszilloskop gespeicherten Bilder ermöglicht es, nicht nur die Zeitdifferenz der Doppelpulse zu berechnen, sondern auch die Bestimmung der Lebensdauer durch den Einsatz geeigneter Selektionskriterien zu verbessern.

T 63.10 Mi 18:45 Z6 - SR 2.005

Entwicklung von mechanischen Streuexperimenten zur Durchführung von Schulklassenprojekten — •Christian Schneider, Karl Geib, Anna Arent, Johanna Schneider, Sebastian Böser und Frank Fiedler — Exzellenzcluster PRISMA und Institut für Physik, Johannes Gutenberg-Universität Mainz

Die Vermittlung von experimenteller Kern- und Teilchenphysik an Schülerinnen und Schüler im Rahmen von Outreach-Programmen ist aufgrund der mangelnden Verfügbarkeit passender Experimente oftmals schwierig. Experimente sind oftmals zu groß, komplex oder teuer, um sinnvoll in Schulen eingesetzt werden zu können. Dieses Problem ist umso gravierender, wenn in Kleingruppen experimentiert werden soll und somit mehrere Experimente verfügbar sein müssen. Dazu kommt, dass Vorkenntnisse zur Kern- und Teilchenphysik je nach Lehrplan und Schwerpunktsetzung erst in der Oberstufe oder sogar überhaupt nicht vorausgesetzt werden können.

In dem Vortrag wird ein neu entwickeltes Klassenset von Streuexperimenten präsentiert. Dieses rein mechanische Analogiemodell erlaubt es, Grundkonzepte der Kern- und Teilchenphysik wie Streuung, statistische Messmethoden oder auch Monte-Carlo-Verfahren im Rahmen von Schulklassenprojekten zu vermitteln. Die Experimente sind für den Einsatz ab der Orientierungsstufe konzipiert, um früh die Faszination für die Physik, speziell die Kern- und Teilchenphysik wecken sowie die Motivation im Fach Physik steigern zu können. Grundgedanken für an die verschiedenen Altersstufen individuell angepasste Unterrichtsmaterialien zu den Experimenten werden im Vortrag vorgestellt.

T 64: Flavor Physik II

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.006

T 64.1 Mi 16:30 Z6 - SR 2.006

Measurement of the ratio $R_{K^{*0}}$ using Run 2 data of the LHCb experiment — •Stephan Escher, Sarah Beranek, Christoph Langenbruch, Stefan Schael, and Eluned Smith — RWTH Aachen

In the Standard Model (SM) of particle physics flavour-changing neutral-current processes are forbidden at tree-level and can only occur in electroweak loop diagrams. Therefore, $b \to s$ decays are rare

and sensitive to heavy particles beyond the SM that can significantly contribute. In this model the coupling of gauge bosons to leptons are independent of their flavour, which is known as lepton flavour universality (LFU).
Thus, the $R_{K^{*0}}$ ratio, defined as
$R_{K^{*0}} = \mathcal{B}(B^0 \to K^{*0}\mu^+\mu^-)/\mathcal{B}(B^0 \to K^{*0}e^+e^-)$, is predicted to be unity by the SM. The existence of a new particle, that couples differently to electrons and muons, could influence the $R_{K^{*0}}$ ratio and lead to deviations from theory.

To this date, the most precise analysis of $R_{K^{*0}}$ is performed by the LHCb collaboration using Run 1 data and shows a $2.4-2.5\,\sigma$ deviation from the SM. An update of this analysis including the Run 2 data of LHCb will further increase the precision of the measurement.

This presentation will give an insight into the analysis strategy of the analysis of the combined Run 1 and 2 LHCb data with particular emphasis on the study and control of backgrounds.

T 64.2 Mi 16:45 Z6 - SR 2.006

Messung des relativen Verzweigungsverhältnisses $\mathcal{B}(\Lambda_b^0 \to \psi(2S)\Lambda^0)/\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)$ mit dem LHCb-Experiment — Vukan Jevtic, •Patrick Mackowiak, Vanessa Müller und Ramon Niet — Experimentelle Physik 5, TU Dortmund

Eine Messung der ATLAS-Kollaboration des relativen Verzweigungsverhältnisses $\mathcal{B}(\Lambda_b^0 \to \psi(2S)\Lambda^0)/\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)$ stellt eine Abweichung zu einer Theorievorhersage fest. Mit den Daten des LHCb-Experiments wird eine genauere Messung erwartet. Das Ziel der Analyse ist die Messung des relativen Verzweigungsverhältnisses $\mathcal{B}(\Lambda_b^0 \to \psi(2S)\Lambda^0)/\mathcal{B}(\Lambda_b^0 \to J/\psi\Lambda^0)$, wobei die Rekonstruktion jeweils über die Zerfälle $\psi(2S)$ bzw. $J/\psi \to \mu\mu$ und $\Lambda^0 \to p\pi$ erfolgt. Durch die Normierung auf den Zerfall $\Lambda_b^0 \to J/\psi\Lambda^0$ kürzen sich systematische Unsicherheiten, sowie Unsicherheiten auf Luminosität und Fragmentation. In diesem Vortrag wird der Stand der Analyse mit dem Run I Datensatz des LHCb-Experiments, dessen Größe einer integrierten Luminosität von 3 fb^{-1} entspricht, vorgestellt.

T 64.3 Mi 17:00 Z6 - SR 2.006

Measurement of the inclusive semileptonic branching fraction of B mesons — Jochen Dingfelder[1], Florian Bernlochner[2], Stephan Duell[1], and •Tarek El Rabbat[1] — [1]Rheinische Friedrich-Wilhelms-Universität Bonn — [2]Karlsruher Institut für Technologie

In this talk, we present an analysis of semileptonic B decays to measure the inclusive branching fraction $\mathcal{B}(B \to Xl\nu)$. The analysis uses events with two semileptonic B decays. Charge and angular correlations between a high momentum lepton and the second lepton are used to separate semileptonic B decays from secondary leptons. The analysis is based on the full data sample (711.0 fb^{-1}) collected at the $\Upsilon(4S)$ resonance with the Belle detector at the KEKB collider. The analysis is performed using the Belle II Analysis Software Framework (BASF2). We will present the status of the analysis and the expected precision of the branching fraction measurement.

T 64.4 Mi 17:15 Z6 - SR 2.006

Measurement of $K^+ \to \pi^+\nu\bar{\nu}$ with the NA62 experiment — •Radoslav Marchevski — JGU, Mainz, Germany

NA62 is a fixed target experiment at CERN, which operates since 2015 on the 400 GeV proton beam supplied by the CERN SPS accelerator. The main physics task of the experiment is a precise measurement of the rare kaon decay $K^+ \to \pi^+\nu\bar{\nu}$ using a decay-in-flight technique. In the Standard Model this channel is strongly suppressed to $\mathcal{O}(10^{-10})$ and therefore is very sensitive to new physics, which could modify the decay rate. To measure this rare decay the experiment has to achieve a challenging background suppression of 10^{12}. The background rejection capabilities as well as signal expectation for the 2016 dataset will be presented.

T 64.5 Mi 17:30 Z6 - SR 2.006

Measurement of the Differential Branching Fraction of $B_s^0 \to \phi\mu^-\mu^+$ using LHCb data — •Sophie Kretzschmar, Christoph Langenbruch, and Eluned Smith — RWTH Aachen

The LHCb detector at CERN is an experiment dedicated to study b-quarks which are produced copiously in the proton-proton collisions at the Large Hadron Collider (LHC). Rare decay processes of a b-quark into an s-quark are of particular interest. In the Standard Model (SM), these decays occur only via higher order loop corrections and thus can be significantly affected by new heavy particles beyond the SM.

The rare decay $B_s^0 \to \phi\mu^-\mu^+$ where a B_s^0 meson decays into a ϕ meson and two oppositely charged muons has been previously analysed by the LHCb collaboration using data taken in 2011 and 2012 during LHC Run 1. The branching fraction of this decay was measured and found to be more than $3\,\sigma$ below the SM expectation. Since 2015, the LHCb experiment has taken additional data during the LHC Run 2 which will be used to perform an updated analysis that will allow to give more insight as to whether this tension is only a statistical fluctuation or a possible hint of new physics.

This talk will give an overview of the analysis strategy to measure the branching fraction of the decay $B_s^0 \to \phi\mu^-\mu^+$ and present the current status of the on-going analysis of the combined Run 1 and 2 LHCb data sample.

T 64.6 Mi 17:45 Z6 - SR 2.006

Messung des inklusiven $B \to X_s\gamma$ Verzweigungsverhältnisses und spektraler Momente mit dem Belle-Datensatz — Luis Pesantez, •Mario Arndt und Jochen Dingfelder — Rheinische Friedrich-Wilhelms-Universität Bonn, Physikalisches Institut, Deutschland

Mit dem am KEKB, einem asymmetrischen e^+e^--Kollider, gelegenen Belle-Detektor wurden 770 x 10^6 $B\bar{B}$ Paare bei einer Schwerpunktenergie von 10.58 GeV aufgenommen. Die hier vorgestellte Analyse befasst sich mit der Messung der radiativen B-Zerfälle $B \to X_s\gamma$. Diese Zerfälle sind im Standardmodell unterdrückt und nur durch Prozesse höherer Ordnung möglich, die sensitiv auf Beiträge neuer Physik sind. Das vermessene Verzweigungsverhältnis liefert z.B. Einschränkungen auf Modelle mit geladenen Higgs-Bosonen (2HDM). Es werden die Ergebnisse der Analyse vorgestellt: die Messung des E_γ-Spektrums, der spektralen Momente und der partiellen Verzweigungsverhältnisse, sowie die Extraktion der HQE-Parameter m_b und μ_π^2.

T 64.7 Mi 18:00 Z6 - SR 2.006

Messung des Verzweigungsverhältnisses im Zerfallskanal $B_s^0 \to K_S^0K_S^0$ am LHCb-Experiment — Moritz Demmer und •Timon Schmelzer — Experimentelle Physik 5, TU Dortmund

Die Zerfallskanäle $h_b \to h^0h^{(\prime)0}$ wurden bisher in keinem hadronischen Teilchenbeschleuniger vermessen. Dabei ist speziell der Zerfallskanal $B_s^0 \to K_S^0K_S^0$ interessant. Dieser findet im Standardmodell der Teilchenphysik in führender Ordnung über einen $b \to s\bar{d}d$-Pinguinprozess statt und hat ein theoretisches Verzweigungsverhältnis von $\mathcal{BR}(B_s^0 \to K_S^0K_S^0) = (16-27)\times 10^{-6}$. Abweichungen dieser Vorhersage könnten Hinweise auf Physik jenseits des Standardmodells bieten. Eine Messung des Belle-Experiments ergab ein Verzweigungsverhältnis von $\mathcal{BR}(B_s^0 \to K_S^0K_S^0) = \left[19.6^{+5.8}_{-5.1}(\text{stat.}) \pm 1.0(\text{sys.}) \pm 2.0\ \left(N_{B_s^0\overline{B_s^0}}\right)\right] \times 10^{-6}$. Herausforderungen der Selektion bei LHCb sind der Endzustand in vier geladenen Pionen in einer hadronischen Umgebung und die lange Zerfallszeit der K_S^0-Mesonen, weshalb die Analyse in Abhängigkeit des Zerfallsvertex der Kaonen durchgeführt wird.

Der zugrundeliegende Datensatz entspricht etwa 5fb^{-1} Proton-Proton-Kollisionen, aufgenommen mit dem LHCb-Experiment in den Jahren 2011 ($\sqrt{s} = 7$TeV), 2012 ($\sqrt{s} = 8$TeV), 2015 und 2016 (jeweils $\sqrt{s} = 13$TeV). Dieser Vortrag fasst den aktuellen Stand dieser Analyse zusammen.

T 64.8 Mi 18:15 Z6 - SR 2.006

Messung des Verzweigungsverhältnisses des Zerfalls $B_s^0 \to D^{*\pm}D^{\mp}$ relativ zu $B^0 \to D^{*\pm}D^{\mp}$ mit dem LHCb-Experiment — Philipp Ibis, •Antje Mödden und Margarete Schellenberg — Experimentelle Physik 5, TU Dortmund

Der Zerfall $B_s^0 \to D^{*\pm}D^{\mp}$ wurde bisher nicht experimentell nachgewiesen. Jedoch wurden in einer Analyse der *CP*-Verletzung im Zerfallskanal $B^0 \to D^{*\pm}D^{\mp}$ Untergrundkandidaten beobachtet, die von dem $B_s^0 \to D^{*\pm}D^{\mp}$-Zerfall stammen könnten. Durch eine relative Messung der Zerfallsbreiten beider Kanäle heben sich aufgrund der Ähnlichkeit der Zerfälle dominante Unsicherheiten auf.

In diesem Vortrag wird der Stand der Analyse des Verzweigungsverhältnisses des Zerfalls $B_s^0 \to D^{*\pm}D^{\mp}$ vorgestellt, die auf Datensätzen des LHCb-Experiments, entsprechend einer integrierten Luminosität von insgesamt $5\,\text{fb}^{-1}$, beruht.

T 64.9 Mi 18:30 Z6 - SR 2.006

Analyse von $B \to X_u\ell\nu$ Zerfällen in Abhängigkeit der Endzustandmultiplizität — •Alexander Ermakov — School of Physics, University of Melbourne — Physikalisches Institut, Rheinische Friedrich-Wilhelms Universität Bonn

Der große Datensatz an B-Mesonen mit einer integrierten Luminosi-

tät von 711 fb^{-1} aus e^+e^--Kollisionen des Belle-Experimentes erlaubt die Untersuchung von charmlosen semileptonischen B-Mesonzerfällen mit einem up-Quark im hadronischen Endzustand. Diese Zerfälle sind interessant, da sie eine Bestimmung des Betrages des CKM-Matrixelementes V_{ub} erlauben. Inklusive und exklusive Messungen dieser Zerfälle liefern bisher verschiedene Ergebnisse für $|V_{ub}|$ ($\approx 3\sigma$). Eine große Unsicherheit in der Messung inklusiver $B \to X_u \ell\nu$-Zerfälle liegt in der Modellierung der Zerfälle. Da die Rekonstruktions- und Selektionseffizienzen von den Endzustandsmultiplizitäten abhängen, kann die damit verbundene Unsicherheit der $|V_{ub}|$-Bestimmung reduziert werden, indem die Analyse abhängig von der Endzustandsmultiplizität durchgeführt wird. Dies erlaubt eine Analyse, in der die resonant und nicht-resonant modellierten Signalanteile simultan studiert werden können.

Der Vortrag beschreibt die Selektion von $B \to X_u \ell\nu$ Zerfällen, die Untersuchung von Variablen zur Untergrundunterdrückung und Signalextraktion, die Analyse der unterschiedlichen Multiplizitäts-Signalkomponenten und die Bestimmung von $|V_{ub}|$.

T 64.10 Mi 18:45 Z6 - SR 2.006

Test der Isospinsymmetrie bei $\Upsilon(4S) \to B\bar{B}$ am Belle-Experiment — •Pascal Schmolz — Ludwig-Maximilians-Universität München

An B-Fabriken ist es im Gegensatz zu Hadronbeschleunigern möglich, absolute Verzweigungsverhältnisse zu bestimmen. Am Belle-Experiment (und dessen Nachfolger Belle II) werden $\Upsilon(4S)$-Zerfälle in Paare geladener oder neutraler B-Mesonen untersucht.

Bei der Produktion der B-Mesonen wird dabei häufig von der Erhaltung des starken Isospins ausgegangen, wodurch B^+B^- und $B^0\bar{B}^0$-Paare mit der gleichen Rate erzeugt würden. Durch Quark-Massen und elektroschwache Wechselwirkungen gebrochen, ist der Isospin allerdings nur eine ungefähre Symmetrie. In einigen bisherigen Messungen der Verzweigungsverhältnisse f_{+-} ($\mathcal{BR}[\Upsilon(4S) \to B^+B^-]$) und f_{00} ($\mathcal{BR}[\Upsilon(4S) \to B^0\bar{B}^0]$) wurde für die Zerfälle der B-Mesonen von der Isospinsymmetrie ausgegangen, was hier eine unzulässige Annahme ist.

Es wird eine Analyse vorgestellt, in der f_{+-} und f_{00} unabhängig von der Annahme der Isospinsymmetrie bestimmt werden.

T 65: Detektorsysteme II

Zeit: Mittwoch 16:30–19:05 Raum: Z6 - SR 2.007

T 65.1 Mi 16:30 Z6 - SR 2.007

Pulse shape discrimination with stilbene scintillators for a neutron camera — Oliver Pooth, Christian Teichrib, Simon Weingarten, and •Christian Wysotzki — III. Physikalisches Institut B, RWTH Aachen University

In a feasibility study the Physics Institute III B develops a neutron detector for a radiography system using fast neutrons, which can be used to improve probe analyses in extractive industries.

The aim is to build a 4x4 pixel camera prototype, consisting of 16 stilbene scintillator crystals, coupled to silicon photomultipliers. The main challenge is the discrimination between scintillation signals from neutrons and gamma-rays, which are produced by radioactive neutron sources as well as neutron generators. The separation of the signals is achieved by exploiting different pulse shapes, due to longer decay time components for neutron induced excitations in stilbene. This pulse shape discrimination technique is presented for individual stilbene crystals as well as the optimisation of important parameters.

T 65.2 Mi 16:45 Z6 - SR 2.007

Pulse shape discrimination using machine learning techniques for neutron detectors — Oliver Pooth, •Christian Teichrib, Simon Weingarten, and Christian Wysotzki — III. Physikalisches Institut B, RWTH Aachen University

The Physics Insitute III B is working on the development of a detector for fast neutrons based on stilbene sctintillator crystals and silicon photomultipliers. It is to be used for neutron tomography in future probe analyses in extractive industries. For this purpose the proper distinction of neutrons from photons originating from a radioactive neutron source is critical. Classical separation techniques utilise a pulse shape discrimination variable relying on a longer decay time component in neutron induced signals in order to distinguish between the neutron signal and photon background. One major weakness of this method lies in the difficulty of separating low energetic events.

An alternative approach using machine learning can extract more complex features out of pulse shapes allowing a potentially better discrimination between neutrons and photons. The performance of this method is discussed with regard to its advantages and disadvantages compared to the classical approach.

T 65.3 Mi 17:00 Z6 - SR 2.007

Entwicklung und Test eines auf szintillierenden Fasern basierenden Spurdetektors für das LHCb-Experiment — •Damian Iwanicki, Roman Greim, Waclaw Karpinski, Thomas Kirn, Simon Nieswand, Stefan Schael, Arndt Schultz von Dratzig, Georg Schwering und Michael Wlochal — I. Physikalisches Institut, RWTH Aachen University

Aufgrund der Erhöhung der Luminosität des LHCs sowie des Übergangs zu einem 40 MHz Softwaretrigger nach dem Long Shutdown 2 in 2018/19, müssen Teile des LHCb-Detektors ausgetauscht und verbessert werden. Zu diesem Zweck wird derzeit ein neues, modulares Spurdetektorsystem entwickelt, welches auf szintillierenden Fasern (250 um Durchmesser) basiert, die durch Silizium-Photomultiplier-Arrays ausgelesen werden. Dieses Spurdetektorsystem wird den aktuellen Downstream-Tracker ersetzen. Die Fasern werden an vier Standorten zu sechslagigen Fasermatten weiterverarbeitet. Für das modulare Spurdetektorsystem werden insgesamt 1024 Fasermatten (10.000 km) benötigt.

In diesem Vortrag werden die Produktion der Fasermatten mit detailierter Qualitätskontrolle vorgestellt. Anschliessend wird eine optische Ankopplungen von Fasermatten präsentiert. Diese Ankopplung mit Fasermatten aus klaren Fasern ist weiterführend Teil eines Konzeptes zur Instrumentalisierung des LHCb-Magnetbereiches mit einem Spurdetektor. Hierzu werden Konzept und Ergebnisse vorgestellt.

T 65.4 Mi 17:15 Z6 - SR 2.007

Untersuchung und Simulation des Übersprechens zwischen szintillierenden Fasern für den SciFi-Tracker des LHCb-Upgrades — Martin Bieker, •Jan Broll und Robert Ekelhof — Experimentelle Physik 5, TU Dortmund

Aufgrund des für das Jahr 2019 geplanten Upgrades des LHCb-Detektors werden die bisher verwendeten Trackingstationen durch den SciFi-Tracker ersetzt. Dieser verwendet Module, die aus mehreren Schichten verklebten szintillierenden Fasern mit einem Durchmesser von 0,25 mm bestehen. An den Enden der Module sind Silicon Photomultiplier(SiPM) installiert, welche die von den Fasern erzeugten Photonen registrieren.
Mit Hilfe von eigens für die Fasermodule entwickelten Simulationen soll das Verhalten der Fasern besser verstanden und der Tracker optimiert werden. Ein wichtiger Punkt ist hierbei die Interaktion der Fasern untereinander. In einer Faser entstehende Photonen besitzen eine Wahrscheinlichkeit diese radial zu verlassen, von einer anderen Faser eingefangen und zu dem dazugehörigen SiPM geleitet zu werden. Um dieses sogenannte Übersprechen zu verringern, wird TiO_2 dem eigentlich transparenten Kleber hinzugegeben, damit dessen Abschwächung erhöht wird. In diesem Vortrag werden Ergebnisse zu der Änderung der Abschwächung des Klebers, so wie Auswirkungen auf den Crosstalk vorgestellt.

T 65.5 Mi 17:30 Z6 - SR 2.007

Winkelabhängige Abschwächung von Photonen in szintillierenden Fasern — Robert Ekelhof, •Robin Manderfeld und Janine Müller — Experimentelle Physik 5, TU Dortmund

Szintillierende Fasern finden in der Wissenschaft heutzutage vermehrt Anwendung. So auch am LHC, wo in den kommenden Jahren ein Teil des Spurfindungssystems des LHCb-Detektors durch einen Detektor aus 0,25 mm durchmessenden, 2,5 m langen szintillierenden Fasern mit Silizium-Photomultiplier-Auslese ersetzt wird. Das von den Fasern erzeugte Licht wird dabei mittels Totalreflexion zum Faserende transportiert. Durch verschiedene Mechanismen kommt es hierbei zu Verlusten, die von der Wellenlänge und dem Winkel des Photons abhängen. Ein detailliertes Verständnis von diesen Prozessen ermöglicht den Vergleich der Ergebnisse unterschiedlicher Messungen und präzise Simulations-

vorhersagen.
In diesem Vortrag werden diese Verlustmechanismen kurz vorgestellt und bisherige Ergebnisse in der winkelabhängigen Intensitätsmessung präsentiert.

Gruppenbericht T 65.6 Mi 17:45 Z6 - SR 2.007

The SHiP Liquid Scintillator-Based Surrounding Background Tagger — •Annika Hollnagel for the SHiP LScin SBT-Collaboration — JGU Mainz

The SHiP experiment has been proposed as a general-purpose fixed-target facility at the CERN SPS North Area. Consisting of a two-fold detector, it combines the Search for Hidden Particles (SHiP), such as Heavy Neutral Leptons (HNL), with a search for light dark-matter particles and studies of tau neutrino physics.

The impact of the 400 GeV proton beam on the upstream target may create HNL and other weakly interacting particles of masses $m \sim 10\,\mathrm{GeV/c^2}$. After a hadron absorber and an active muon shield, these particles are supposed to decay inside a large vacuum vessel which is followed by a magnetic spectrometer and calorimeter. To discriminate against external particle interactions, the decay vessel will be covered by the Surrounding Background Tagger (SBT).

This talk will give an overview of the current design of and ongoing R&D on the segmented liquid scintillator option for the SBT detector.

T 65.7 Mi 18:05 Z6 - SR 2.007

Test Beam Measurements with a Liquid-Scintillator Detector Prototype for the SHiP Surrounding Background Tagger — •Ievgen Korol for the SHiP LScin SBT-Collaboration — HU Berlin, Berlin; Deutschland

The SHiP experiment is proposed as a new general-purpose fixed-target facility at the CERN SPS 400 GeV accelerator complex. Its goal is to search for "hidden particles", such as Heavy Neutral Leptons (HNL), dark photons, axion-like particles etc. The decay volume of the SHIP detector facility will be covered by the Surrounding Background Tagger (SBT) which is based on liquid-scintillator cells read out by either PMTs or SiPMs using the wavelength-shifting optical modules.

The performance of liquid-scintillator detector prototype was studied with e^- (20 GeV), μ^+ (150 GeV) and π^+ (150 GeV) from the CERN SPS North Area test beams. Details of the beam test setup, data taking and efficiency measurements of the liquid-scintillator prototype will be presented.

T 65.8 Mi 18:20 Z6 - SR 2.007

Detektorantwort eines Flüssigszintillatordetektors mit WOM-Auslese — •Linus Shihora für die SHiP LScin SBT-Kollaboration — HU Berlin, Berlin, Deutschland

SHiP ist ein Vorschlag, in einem Beamdump-Experiment, am CERN SPS-Beschleunigerkomplex nach sehr schwach wechselwirkenden, neutralen Teilchen im Massenbereich von 0,1 GeV - 10 GeV zu suchen. Hadronen aus den Proton-Proton-Kollisionen werden absorbiert und Myonen durch ein Magnetsystem ausgelenkt, so dass neben Neutrinos nur noch andere neutrale Teilchen in einem etwa 50m langen Volumen vorhanden sind und in diesem zerfallen können. Dieses Zerfallsvolumen soll mit Flüssigszintillator umgeben sein (Surrounding Background Tagger = SBT), um Untergrund unterdrücken zu können. Die Szintillationsphotonen sollen mit sogenannten Wavelength-Shifting-Optical-Modules (WOMs), die an Photosensoren angekoppelt werden, nachgewiesen werden.

Im Vortrag wird die Detektor-Response eines Flüssigszintillatordetektors mit WOM-Auslese, welcher am SPS-Beschleuniger vermessen wurde, analysiert und diskutiert.

T 65.9 Mi 18:35 Z6 - SR 2.007

Zeitauflösung eines Flüssigszintillatordetektors mit WOM-Auslese — •Maximilian Ehlert für die SHiP LScin SBT-Kollaboration — Humboldt-Universität zu Berlin, Institut für Physik

SHiP ist ein Vorschlag, in einem Beamdump-Experiment, am CERN SPS-Beschleunigerkomplex nach sehr schwach wechselwirkenden, neutralen Teilchen im Massenbereich von 0,1 GeV - 10 GeV zu suchen. Hadronen aus den Proton-Proton- Kollisionen werden absorbiert und Myonen durch ein Magnetsystem ausgelenkt, so dass neben Neutrinos nur noch andere neutrale Teilchen in einem etwa 50m langen Volumen vorhanden sind und in diesem zerfallen können. Dieses Zerfallsvolumen soll mit Flüssigszintillator umgeben sein (Surrounding Background Tagger = SBT), um Untergrund unterdrücken zu können. Die Szintillationsphotonen sollen mit sogenannten Wavelength-Shifting-Optical-Modules (WOMs), die an Photosensoren angekoppelt werden, nachgewiesen werden.
Im Vortag wird die Zeitauflösung eines Flüssigszintillatordetektors mit WOM-Auslese, welcher am SPS-Beschleuniger vermessen wurde, analysiert und diskutiert.

T 65.10 Mi 18:50 Z6 - SR 2.007

Nuclear Interaction Studies with the CMS Tracking Detector — •Melanie Eich and Gregor Kasieczka — Institut für Experimentalphysik, Universität Hamburg

The identification of jets coming from b quarks (b-tagging) is important for many analyses using data from the CMS detector. For b-tagging, among others, the vertex displacement of b quark induced jets is used. Such displaced vertices can also be mimicked by the interaction of hadrons with nucleons of the detector material, so called nuclear interactions. Knowledge about the fraction of misidentified b jets is important and allows to reject these jets. Previous studies of nuclear interactions were done using data recorded in CMS Run I. The study used vertex finding algorithms in combination with truth matching procedures in simulation, to calculate, amongst others, b tag efficiencies of the CSV algorithm. In this talk the status of the nuclear interaction study is presented, using data recorded with the CMS detector in 2017.

T 66: Halbleiterdetektoren / Strahlenhärte II

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.010

T 66.1 Mi 16:30 Z6 - SR 2.010

Temperature and frequency dependent CV measurements of highly irradiated ALTAS strip detectors — •Sven Mägdefessel[1], Riccardo Mori[1], Eva Sicking[2], and Ulrich Parzefall[1] — [1]Albert-Ludwigs-Universität Freiburg, Germany — [2]CERN, Switzerland

Highly irradiated strip detectors do not show the typical behaviour of unirradiated sensors - used to determine the depletion voltage - anymore. Radiation damage related defects contribute to the measurable capacitance and superimpose the capacitance change due to depletion.

We use a dedicated set-up constructed for running the sensors at temperatures down to -40°C and present CV measurements performed at different temperatures and frequencies. Furthermore we show which informations can be derived out of these.

T 66.2 Mi 16:45 Z6 - SR 2.010

Studie zur Strahlenhärte von n-in-p Siliziumstreifensensoren für das Phase-2-Upgrade des CMS-Experiments — Thomas Müller, Alexander Dierlamm, Marius Metzler, •Jan-Ole Gosewisch, Pia Steck und Felix Bögelspacher — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Der LHC wird mit dem nächsten Upgrade eine deutlich höhere Luminosität haben. Damit steigt auch die Strahlenbelastung auf die Detektoren. Dieser Vortrag ist auf die Siliziumstreifensensoren im äußeren Spurdetektor des CMS-Experiments fokussiert. Um die bestmöglichen Eigenschaften nach Bestrahlung zu erhalten, wird nach der optimalen Sensordicke gesucht. Die Dicke wirkt sich u.a. wesentlich auf den Leckstrom und die Ladungssammlung der Sensoren aus. Favorisiert sind aktive Dicken von 200 μm und 240 μm. Beim HL-LHC wird eine Fluenz von bis zu $10^{15}\mathrm{n_{eq}/cm^2}$ erwartet. Um entsprechende Strahlenschäden zu simulieren, wurden Testsensoren mit Protonen und Neutronen mit einer Fluenz zwischen $10^{13}\mathrm{n_{eq}/cm^2}$ und $10^{15}\mathrm{n_{eq}/cm^2}$ bestrahlt. Es werden Messungen zu den Sensoreigenschaften, wie beispielsweise IV/CV-Charakteristik, Streifenparameter und Ladungssammlung vorgestellt.

T 66.3 Mi 17:00 Z6 - SR 2.010

Untersuchung der Kapazität hochbestrahlter n^+-in-n Dioden

— Silke Altenheiner, Andreas Gisen, Claus Gössling, Marius Hötting, Jonas Lönker, Reiner Klingenberg, Kevin Kröninger und •Felix Wizemann — TU Dortmund, Experimentelle Physik IV

Im Zuge des High-Luminosity Upgrades des LHCs entstehen für die Siliziumspurdetektoren der LHC Experimente erhöhte Anforderungen an Strahlenhärte. Die durch Strahlenbelastung entstandenen Schäden am Kristallgitter verändern die Eigenschaften der Detektoren wie die Ladungssammlungseffizienz als auch die benötigte Betriebsspannung.

Zum Verständnis der Auswirkungen dieser Schäden werden unter anderem bestrahlte Dioden untersucht. Eine Methode zur Bestimmung von Parametern wie der effektiven Dopingkonzentration ist die Messung der Kapazität in Abhängigkeit der Spannung

Vorgestellt werden Messungen der Kapazität bestrahlter Dioden unter Variation verschiedener Parameter wie Annealingdauer, Messfrequenz und Temperatur.

T 66.4 Mi 17:15 Z6 - SR 2.010

Vergleich von n- und p-artigem Bulkmaterial für Siliziumsensoren — Silke Altenheiner[1], Sascha Dungs[1,2], Andreas Gisen[1], Claus Gössling[1], Marius Hötting[1], Reiner Klingenberg[1], Kevin Kröninger[1], •Jonas Lönker[1] und Felix Wizemann[1] — [1]TU Dortmund, Lehrstuhl für Experimentelle Physik IV — [2]CERN

Für Trackingdetektoren aus Silizium bieten sich, je nach Anforderung, drei sinnvolle Möglichkeiten an: n-dotierte Ausleseelektroden in entweder n- oder p-dotiertem Bulkmaterial sowie p-dotierte Strukturen in n-dotiertem Bulk (n-in-p).
In der Vergangenheit konnte produktionsbedingt häufig nur n-dotiertes Bulkmaterial verwendet werden. Mittlerweile ist es ebenfalls möglich, qualitativ hochwertiges p-dotiertes Silizium zu fertigen. Die Produktion von n-in-n Wafern erfordert eine beidseitige Prozessierung der Wafer und ist somit aufwendiger und teurer. Da n-artige Ausleseelektroden Elektronen sammeln, die im Vergleich zu Löchern eine höhere Mobilität aufweisen, wird p-in-n häufig nicht mehr verwendet. n-in-p vereinigt also die vorteilhaften Eigenschaften der drei genannten Varianten.
Für Dortmund werden in drei verschiedenen Produktionen sowohl n-in-n als auch n-in-p Wafer produziert, auf denen neben diversen Teststrukturen auch Pixel- und Streifensensoren platziert wurden. Präsentiert werden Ergebnisse der vergleichenden Charakterisierung unbestrahlter Strukturen.

T 66.5 Mi 17:30 Z6 - SR 2.010

Temperaturabhängigkeit des Ladungsträgertransports in Germaniumdetektoren — •Martin Schuster — Max-Planck Institut für Physik, München

Ein weitreichendes Verständnis von Germaniumdetektoren ist notwendig für den Einsatz in Experimenten, die nach sehr seltenen Ereignissen suchen. Die Temperaturabhängigkeit des Ladungsträgertransports und damit zusammenhängender Effekte der Kristallaxen werden von der GeDet Gruppe am Max-Planck-Institut für Physik untersucht. Ergebnisse von Untersuchungen an einem segmentierten Punktkontaktdetektor werden vorgestellt. Der Detektor ist in einem elektrisch gekühleten Kryostaten installiert, welcher eine stabile Temperaturregelung ermöglicht. Es wird der unterschiedliche Einfluss der Temperatur auf den Ladungsträgertransport entlang der verschiedenen Kristallachsen diskutiert. Ausserdem werden Ergebnisse zur Temperaturabhängigkeit von Ladungsträgerverlusten in der Nähe des Kontaktes präsentiert.

T 66.6 Mi 17:45 Z6 - SR 2.010

Oberflächencharakterisierung von Germaniumdetektoren mit α-Teilchen — •Lukas Hauertmann — Max Planck Institut für Physik

Kontamination durch α-Strahler ist ein wichtiger Untergrund beim Einsatz von Germaniumdetektoren für die Suche nach seltenen Ereignissen. Das Verständnis von α-induzierten Ereignissen und ihre Identifikation ist ein Forschungsziel der GeDet Gruppe am MPI für Physik. Der Teststand GALATEA, in dem Detektoren mit α- und β-Teilchen kollimiert bestrahlt werden können, wurde hierfür konzipiert. Ergebnisse von Abtastmessungen mit α-Teilchen auf einem segmentierten koaxialen Detektor werden vorgestellt. Insbesondere werden der Einfluss von Passivierungen ("dead layers") und Segmentgrenzen diskutiert.

T 66.7 Mi 18:00 Z6 - SR 2.010

Testbeam-Messungen mit Diamantsensoren und FE-I4 Auslesechip — •Helge C. Beck, Arnulf Quadt und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Spurdetektoren an zukünftigen Hochenergieexperimenten werden eine hohe Strahlenbeständigkeit benötigen. Diamant ist unter diesen Bedingungen ein guter Kandidat als Sensormaterial. Das im Vergleich zu Silizium kleinere Signal und der Ladungseinfang könnte mit einer dreidimensionalen Anordnung von Elektroden im Material aufgefangen werden. Leitende Graphitsäulen können im Diamant mit Femtosekunden-Laserpulsen erzeugt werden. Mit einer Metallisierung und Bump-Bonding zu einem Auslesechip kann ein Pixeldetektor produziert werden.

In Zusammenarbeit mit Instituten der ATLAS Kollaboration wird ein Prototyp eines Diamantpixeldetektors entwickelt. Als Auslesechip wird der ATLAS FE-I4 verwendet. Ergebnisse aus Testbeam-Messungen am DESY und Labormessungen werden vorgestellt.

T 66.8 Mi 18:15 Z6 - SR 2.010

Betrieb des ATLAS Diamond Beam Monitor — •Ben Brüers, Jörn Grosse-Knetter, Arnulf Quadt und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Zur Messung der instantanen Luminosität, sowie zur Überwachung des Wechselwirkungspunktes des ATLAS Detektors, wurde für Run-II des LHC der ATLAS Diamond Beam Monitor (DBM) installiert. DBM besteht aus vier Teleskopstationen auf jeder Seite des Wechselwirkungspunktes, wobei jedes Teleskop aus drei einzelnen Detektormodulen aufgebaut ist. Die Module bestehen aus pixelierten, polykristallinen CVD Diamantsensoren, welche von FE-I4B Chips ausgelesen werden.

Nach Problemen bei der Inbetriebnahme und einer daraus resultierenden Betriebspause, ist DBM seit 2017 wieder in den ATLAS Auslesestrom integriert.

Im Vortrag werden das Detektorsystem, dessen Inbetriebnahme sowie Herausforderungen im Jahr 2017 vorgestellt.

T 66.9 Mi 18:30 Z6 - SR 2.010

Radiation damage in highly irradiated silicon sensors — •Christian Scharf, Robert Klanner, Eckhart Fretwurst, Jörn Schwandt, and Erika Garutti — Institute of Experimental Physics, Hamburg University, Luruper Chaussee 149, 22761 Hamburg, Germany

After hadron fluences above 10^{15} n_{eq}/cm^2 initially high-ohmic silicon sensors show very different characteristics than before irradiation, independent of the initial doping concentration and type for phosphorous and boron doping.

We performed a systematic study of the I/V characteristics of initially p- and n-type diodes irradiated with 23 GeV protons to (0.9-13)·10^{15} n_{eq}/cm^2. The results are compared to edge Transient Current Technique measurements of irradiated strip sensors and capacitance measurements of the diodes.

Under forward bias and at low reverse bias voltages the diodes behave like a resistor of intrinsic silicon with a very high resistivity and constant electric field. Under larger reverse bias a space-charge region slowly establishes which has a high effective p-type doping and high electric field. But, there is also a sizable electric field in the non-depleted high-resistive bulk.

We will present an in-depth discussion of the I/V and empirical models as a function of the fluence and diode dimension. Also, the decrease of the carrier mobilities as a function of the fluence will be discussed.

T 66.10 Mi 18:45 Z6 - SR 2.010

Das NitroStrip Projekt - Strahlenharte Streifendetektoren für zukünftige Experimente — •Jan Cedric Hönig, Karl Jakobs, Franziska Moos, Riccardo Mori, Ulrich Parzefall, Moritz Wiehe, Liv Wiik-Fuchs und Marc Hauser — Universität Freiburg

Die Leistungsfähigkeit von Siliziumdetektoren in der Teilchenphysik ist limitiert durch ihre Fähigkeit radioaktiver Strahlung zu widerstehen. Strahlenschäden bewirken einen erhöhten Leckstrom, eine verschlechterte Ladungssammlung und verändern die Feldkonfiguration im Sensor. Daher ist die Forschung zur Verbesserung der Strahlenhärte von zentraler Bedeutung in der Entwicklung neuartiger Siliziumdetektoren. Ein Ansatz die Strahlenhärte von Silizium zu verbessern ist das gezielte einbringen von Fremdatomen. Im Rahmen des NitroStrip Projekts wird die Strahlenhärte von Streifensensoren, die mit Stickstoff angereichert wurden, untersucht. Es stehen Vergleichsgruppen von Sensoren zur Verfügung die mit unterschiedlichen Verfahren beziehungsweise unter Anreicherung mit Sauerstoff hergestellt wurden. In diesem Vortrag werden Ergebnisse vergleichender Messungen von bestrahlen und unbestrahlten Sensoren aus dem NitroStrip Projekt vorgestellt.

T 67: Neutrinophysik / theoretische Astroteilchenphysik

Zeit: Mittwoch 16:30–18:50 Raum: Z6 - SR 2.011

T 67.1 Mi 16:30 Z6 - SR 2.011

Radiate Neutrino masses, keV-scale DM and viable Leptogenesis via sub-TeV new physics — •Sven Baumholzer[1], Vedran Brdar[1], Pedro Schwaller[1], and Joachim Kopp[2] — [1]Johannes Gutenberg-Universität, Mainz — [2]MPI-K, Heidelberg

In this talk we will present a realization of the Scotogenic model which can explain the observed DM abundance and baryon asymmetry and also the masses of Neutrinos. All this can be achieved within the model without introducing new physics beyond the TeV scale.

We achieve this by adding 3 sterile neutrinos N_i and an additional Higgs doublet Σ to the SM and imposing a Z_2 symmetry under which all new particles are charged and whose masses are below the TeV-scale.

Our DM candidate is the lightest sterile neutrino N_1 which mass is $\mathcal{O}$(keV) while N_2 and N_3 have masses of $\mathcal{O}$(few GeV). Finally the scalar masses are considered to be at $\mathcal{O}$(TeV).

Due to the Z_2 symmetry neutrino masses are generated at one loop level therefore leading to higher possible Yukawa couplings compared to generic seesaw models. The production of DM is governed by Freeze In of N_1 and contributions coming from the decay ofN_2. Baryon asymmetry is explained via resonant Leptogenesis based on L-violating decays of Σ to N_i and leptons.

T 67.2 Mi 16:45 Z6 - SR 2.011

Gravitinos in Inflation Models — •Sebastian Prenzel — Universität Hamburg, Hamburg, Deutschland

In this talk I try to constrain the mass of the gravitino in two different cases of a NMSSM model embedded in supergravity and consistent with inflation.
I will introduce a Jordan frame Supergravity in which an NMSSM model arising from a superconformal ansatz is embedded. This model will then also be suitable for inflation.
The general assumptions for canonical superconformal supergravity models are presented and how the NMSSM can be constructed from this set of models.
The first case considers a NMSSM model with a hidden sector that determines the gravitino mass. By investigating vacuum and parameter conditions the mass can be constrained to $10MeV \lesssim m_{3/2} \lesssim 100GeV$.
The second case investigates an NMSSM model without a hidden sector with and without vacuum tuning. Without vacuum tuning it turns out that a hidden sector is necessary to generate soft breaking terms, thus SUSY is broken and the Higgs fields acquire VEV's. Here the gravitino mass can be constrained to $10^{-23}eV \lesssim m_{3/2} \lesssim 10GeV$.
Adding an extra term to the superpotential to tune the vacuum generates soft breaking-like terms and thus a hidden sector is not needed to break SUSY and the gravitino mass can be constrained to $m_{3/2} \gtrsim 1MeV$.

T 67.3 Mi 17:00 Z6 - SR 2.011

Nonequilibrium Dynamics of Inhomogeneous Quantum Fields — •Thomas Garratt — Julius-Maximilians-Universitaet Wuerzburg

The dynamics of inhomogeneous quantum fields out of equilibrium are especially relevant for the study of first-order phase transitions. It is our aim to calculate how critical bubble configurations of the new phase, that form in such a process, propagate and locally approach thermal equilibrium. The Electroweak phase transition in the early universe is of particular interest, since Baryogenesis can potentially explain the matter-antimatter asymmetry in the Universe for fitting dynamical properties of the phase transition and the bubble collisions result in gravitational waves that could be observed by the new generation of detectors. To calculate the dynamics of quantum bubbles we have developed a program that solves the non-equilibrium equations of motion, the so called *Kadanoff-Baym Equations*. As a starting point we investigate the dynamics of bubbles in (1+1)-dimensional toy models.

T 67.4 Mi 17:15 Z6 - SR 2.011

Multifield aspects of NMSSM-inspired Higgs inflation — •Michael Matlis, Alexander Westphal, Gudrid Moortgat-Pick, Jonathan Frazer, and Mafalda Dias — Deutsches Elektronen-Synchrotron DESY, Theory Group, D-22603 Hamburg, Germany

The NMSSM model is one of the simplest extensions to the standard model capable of describing inflation. The model has an extended Higgs sector which can lead to multifield inflation, however, most studies to date focus on the single field regime, which constitutes only a small fraction of the total parameter space. Very little is known about the multifield regime which can in principle give rise to much richer phenomenology. In this work we consider the full multifield dynamics, ultimately seeking constraints over the full parameter space.

T 67.5 Mi 17:30 Z6 - SR 2.011

Multi-messenger emission in GRB internal shock models — •Annika Rudolph, Anatoli Fedynitch, and Walter Winter — DESY

Because of their high luminosities, Gamma-Ray Bursts are considered possible sources of Ultra High Energy Cosmic Rays (UHECR) and high energy neutrinos. In the fireball internal shock scenario, the prompt high energy emission is generated in collisions between regions of the jet with different Lorentz factors. In this talk, I will discuss the production of multiple astrophysical messengers within the internal shock scenario while including different models on the collision process.

T 67.6 Mi 17:45 Z6 - SR 2.011

Axion minicluster power spectrum and mass function — •Andreas Pargner and Thomas Schwetz — Institut für Kernphysik, Karlsruher Institut für Technologie (KIT), 76021 Karlsruhe, Germany

We present a semi-analytical method to calculate the average axion energy density, as well as the power spectrum, from the re-alignment mechanism in a scenario where the Peccei-Quinn symmetry breaking happens after inflation. Furthermore, we develop a modified Press & Schechter approach, suitable to describe the collapse of non-linear density fluctuations during radiation domination. This allows us to make a prediction for the distribution of mass and size of axion miniclusters.

Gruppenbericht T 67.7 Mi 18:00 Z6 - SR 2.011

Recent results of the Double Chooz reactor neutrino experiment — •Denise Hellwig for the Double Chooz-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

Double Chooz is a reactor antineutrino disappearance experiment located in Chooz, France, to measure the neutrino mixing angle θ_{13}. By detecting the unique inverse beta decay (IBD) prompt-delayed signal antineutrinos can be precisely identified. The experiment consists of two liquid scintillator detectors of identical design; a far detector at a distance of about 1 km is operating since 2011; a near detector at a distance of about 400 m is operating since begin 2015. This double-detector setup with iso-flux configuration allows to fit the far detector data to the near detector data without relying on the reactor neutrino flux prediction where systematic uncertainties are suppressed to per mill level. Statistical uncertainties are reduced by not only using the delayed signal of neutron capture on Gadolinium but adding neutron captures on Hydrogen yielding a statistics increase of more than a factor of two.

Apart from a precise measurement of θ_{13}, the combination of the two detectors also offers sensitivity to sterile neutrino mixing parameters. Sterile neutrinos are neutrino mass states not taking part in weak interactions, but may mix with known neutrino states. This induces additional mixing angles and mass differences.

This contribution will present the latest θ_{13} results of the Double Chooz collaboration as well as the results of the sterile analysis.

T 67.8 Mi 18:20 Z6 - SR 2.011

Latest advances in the development of a poissonian based likelihood fit for the Double Chooz experiment — Denise Hellwig[1], Philipp Kampmann[2], Stefan Schoppmann[3], •Philipp Soldin[1], Achim Stahl[1], and Christopher Wiebusch[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]IKP Jülich — [3]MPIK Heidelberg

Double Chooz is a reactor neutrino disappearance experiment with the purpose of a precise measurement of the neutrino mixing angle θ_{13}. The experimental setup consists of two identical liquid scintillator detectors at average baselines of about 400m and 1km to two reactor

cores at the nuclear power plant in Chooz, France. The neutrinos are detected by measuring the signature of the inverse beta decay (IBD), which consists of a prompt positron signal and a delayed neutron capture signal. By performing a simultaneous poissonian based likelihood fit of both detector neutrino rates, energy spectral shapes and all relevant backgrounds, the neutrino mixing angle θ_{13} can be obtained. The method, design and latest advances of such a likelihood fit are presented in this talk. Furthermore, a crosscheck for the latest final fit results is shown.

T 67.9 Mi 18:35 Z6 - SR 2.011

Investigations of the Sensitivity of the Double Chooz Experiment to sterile Neutrinos in a 3+2 Scenario — Denise Hellwig, Philipp Soldin, •Yannic Sommer, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

The Double Chooz experiment is a reactor neutrino disappearance experiment for the precise measurement of the neutrino mixing angle θ_{13}. Two identical liquid scintillator detectors with baselines of 1050 m and 400 m are installed at the nuclear power plant in Chooz, France. These are measuring the flux of antineutrinos from two reactor cores utilizing the signature of the inverse beta decay (IBD). To explain the deviation from the measured data to the theoretically predicted neutrino flux, one possibility would be non weakly-interacting sterile neutrinos. A study of the sensitivity to a scenarion with two additional sterile neutrinos will be presented.

T 68: Neutrinophysik III

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.012

T 68.1 Mi 16:30 Z6 - SR 2.012

The calibration campaign of the Borexino experiment — •Michael Nieslony for the Borexino-Collaboration — Institute of Physics, JGU Mainz, Germany

The Borexino experiment is a liquid scintillator detector located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy which was originally aimed at detecting solar neutrinos. The experiment's exceptional radiopurity levels enabled the spectral measurement of almost the whole pp-fusion-cycle of the sun, including ^{7}Be-, *pp*-, and *pep*-neutrinos. Besides the solar program, a multitude of analyses ranging from the detection of geoneutrinos up to setting the most stringest limit on the lifetime of the electron were performed.

To ensure the ongoing high-accuracy analysis of the experiment, an extensive calibration campaign is planned for the near future. The basic features and some preliminary studies are presented in this talk.

T 68.2 Mi 16:45 Z6 - SR 2.012

Optimisation of selection cuts for updated geoneutrino analysis with Borexino — •Sindhujha Kumaran, Dong Han, and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich

The Borexino detector is a liquid scintillator detector located at the Laboratori Nazionali del Gran Sasso at a depth of 3800 meters water equivalent. Far distance from nuclear reactors and the high level of radiopurity of the liquid scintillator make Borexino ideal for geoneutrino analysis.

Geoneutrinos are electron flavoured antineutrinos produced from natural radioactive decays within the Earth, and can provide direct information from the inside of our planet. Detailed study of geoneutrinos will help us to set further constraints to the current Earth models. Borexino has observed geoneutrino signal with more than 5 sigma confidence level in 2015. Thanks to improved selection criteria of inverse beta decay events in the whole data set from 2007, we expect an important increase in the total statistics.

Due to a very low interaction rate of geoneutrinos, it is important to maximise the used exposure. This contribution will present the optimisation of the selection cuts crucial for the updated analysis.

T 68.3 Mi 17:00 Z6 - SR 2.012

Background study for an updated geoneutrino analysis with Borexino — •Dong Han, Sindhujha Kumaran, and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich

Geoneutrinos are electron antineutrinos produced from natural radioactive decays within the Earth, which can provide direct information from the inside of our planet. Detailed study of geoneutrinos will help us to set further constraints to the current Earth models.

Borexino detector is located in Laboratori Nazionali del Gran Sasso underground laboratory in Italy, at a depth of 3800 meters water equivalent. Far distance from nuclear reactors, as well as a high level of radiopurity of liquid scintillator, makes Borexino an excellent geoneutrino observatory. Borexino has observed geoneutrino signal with more than 5 sigma confidence level in 2015. Thanks to improved selection criteria of inverse beta decay events in the whole data set from 2007, we expect an important increase in the total statistics.

This talk will concentrate on the investigation of backgrounds, which needs to be reevaluated after the changes in the analysis approach.

T 68.4 Mi 17:15 Z6 - SR 2.012

Solar neutrino analysis with the Borexino detector — •Mariia Redchuk and Livia Ludhova for the Borexino-Collaboration — IKP-2 Forschungszentrum Jülich, Jüilch, Germany

Borexino is a liquid scintillator detector the primary goal of which is measuring the flux of neutrinos coming from the un. It is located in the Laboratori Nazionali del Gran Sasso (LNGS) in the mountains of Italy at 3800 m water-equivalent depth. In 2012 Borexino started Phase-II of data taking which is characterized by its higher sensitivity. This was made possible due to extensive purification campaigns in 2010 and 2011 after which the already unprecedentedly low radioactive background of the detector was improved even more.

In the recent analysis of Phase-II data, for the first time the energy range of the fit was extended in order to obtain information about the pp, 7Be, and pep solar neutrinos simultaneously. To determine the rates of the background and the solar species, multivariate fits have been performed on the Borexino energy spectra, the radial and pulse-shape distributions of the events. Monte Carlo as well as analytical approaches were used in the analysis.

The highlights of the Phase-II data analysis and updated results on the measurement of the solar neutrino fluxes will be summarized in this talk.

T 68.5 Mi 17:30 Z6 - SR 2.012

Rejection of the cosmogenic ^{11}C background in the Borexino detector for the observation of the neutrino flux from CNO chain in the sun — •Alessio Porcelli for the Borexino-Collaboration — Johannes Gutenberg Universität, Mainz, Deutschland

Borexino is a liquid scintillator detector sited underground in the Laboratori Nazionali del Gran Sasso. Its physics program is centred in the study of solar neutrinos. Recently, a simultaneous spectroscopy was performed for the neutrinos from the *pp*, *pep* and ^{7}Be fusion reactions, together with a new analysis of the νs from the ^{8}B chain. The next goal of the Borexino solar program is to improve the current lower limit of the neutrino flux from the CNO cycle, or possibly measure it for the first time. This result will greatly improve the understanding of the Solar Standard Model. The main limitation of this measurement is the ^{11}C cosmogenic background produced from ^{12}C nuclei by muon induced spallations with emission of neutrons: the physics of this process is not very well understood and ^{11}C has a long average decay time (half hour), therefore its direct identification and prediction is not possible. The Borexino analysis approach to deal with this background is called Three Fold Coincidence (TFC) and relies on time and space coincidence of muons and neutrons, vetoing volumes where those associated signatures occurred and might contain ^{11}C. In this work it is presented an overview of the TFC and studies performed to improve its efficiency, including a complementary method that take advantage of possible productions of multiple ^{11}C by the same muon.

T 68.6 Mi 17:45 Z6 - SR 2.012

Modulation of the cosmic muon flux measured at Borexino — •Dominik Jeschke for the Borexino-Collaboration — Technische Universität München

The Borexino Experiment is situated at the Laboratori Nazionali del

Gran Sasso and aims for the measurement of low energetic solar neutrinos. Even though the flux of cosmic muon is reduced by a factor 10^6 due to the 3800 mwe. of rock overburden at the experimental side, a residual cosmic muon flux of $(3.432 \pm 0.001) \cdot 10^{-4} \mathrm{m}^{-2}\mathrm{s}^{-1}$ with a mean energy of 270 GeV is still present. These muons are detected by a highly efficient muon veto at Borexino.
Most of the cosmic muons reaching the detector are produced in the decay of pions that originate from collisions of the primary cosmic radiation with atoms of the atmosphere. Since only pions and kaons that decay in flight without undergoing any interactions before produce muons with sufficient energy to reach the detector, a seasonal modulation of the cosmic muon flux is expected due to density changes in the atmosphere that alter the mean free path of the parent mesons.
In this talk, an analysis of the cosmic muon flux based on almost 10 years of data from the Borexino experiment is presented. Besides the seasonal modulation, other periods are searched for and their significance is checked with the help of a Lomb-Scargle periodogram. This work is funded by the DFG (GZ:OB 168/2-1).

T 68.7 Mi 18:00 Z6 - SR 2.012

A thermal calorimeter for the activity measurement of the SOX antineutrino source — •Konrad Altenmüller for the Borexino-Collaboration — Technische Universität München

A thermal calorimeter was developed by TUM and INFN to measure the activity of a ^{144}Ce-^{144}Pr antineutrino source for the SOX experiment, which investigates short baseline neutrino oscillations with the Borexino detector to search for eV-scale sterile neutrinos. The source activity is estimated from the decay heat that is measured through the temperature increase of a well-defined water flow in a heat exchanger that surrounds the source. Adjustable measurement conditions and an elaborate thermal insulation allow an operation with negligible heat losses. In a blind measurement with an electrical source mockup it was shown that the heat of a decaying source can be measured with $< 0.2\%$ uncertainty. This talk presents a complete overview on this apparatus and the final results of the characterization.

T 68.8 Mi 18:15 Z6 - SR 2.012

Backgrounds in the SOX experiment — •Birgit Neumair for the Borexino-Collaboration — James-Franck-Straße 1, 85748 Garching bei München

In the last years, several neutrino oscillation experiments reported results not compatible within the 3-neutrino model, which hint at the existence of light sterile neutrinos. To test this hypothesis, the SOX (Short distance neutrino Oscillations in BoreXino) experiment will search for oscillations from active to sterile neutrinos by placing a (100-150) kCi $\bar{\nu}_e$ - source underneath the liquid scintillator detector Borexino. Oscillations will be observed via a reduction of the detected interaction rate of the $\bar{\nu}_e$ and an oscillatory pattern as a function of the neutrino energy and travelled distance. In the talk the individual background components are discussed.

The work is supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 68.9 Mi 18:30 Z6 - SR 2.012

Gamma biasing in the Borexino/SOX framework — •Michael Gschwender — University of Tübingen

The **S**hort distance neutrino **O**scillations with Bore**X**ino (SOX) experiment aims to search for sterile neutrinos in the eV-scale. SOX is searching for the disappearance of antineutrinos from a radioactive source (^{144}Ce - ^{144}Pr).
In order to achieve a higher sensitivity, SOX aims to use the whole Borexino inner vessel scintillator, in contrast to previous analysis of solar neutrinos where a smaller fiducial volume was used. This introduces in turn more background contributions to the sensitive volume. A source of background originates from gammas coming from outside the buffer liquid of Borexino. In order to simulate these gammas in a reasonable timeframe within the Borexino simulation framework, a biasing approach has been implemented. By dividing the Borexino detector geometry into multiple slices and making use of techniques such as geometrical importance sampling, and weight roulett this can be done in a feastable way. This talk presents the implemented techniques used by this approach as well as some simulation results.
This work is funded by the Deutsche Forschungsgemeinschaft.

T 68.10 Mi 18:45 Z6 - SR 2.012

Vessel shape reconstruction for the SOX experiment — •Sebastian Rottenanger for the Borexino-Collaboration — Eberhard Karls Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen

The SOX (**S**hort distance neutrino **O**scillations with Bore**X**ino) experiment will measure the energy spectrum and spatial distribution of anti-neutrino capture events from an artificial source, looking for a signature of sterile neutrinos in the eV-range. This ^{144}Ce-^{144}Pr source will be placed below the Borexino liquid-scintillator detector.
The thin inner nylon vessel containing the scintillator, changes its shape over time. To have the best possible sensitivity within the enlarged target volume this shape has to be well known. This can be achieved using an event data sample of background events, allowing a reconstruction of the vessel shape on a regular basis.
A method to perform a fit of the vessel shape is already in use and a new improved and more stable method is currently under development. Several background contributions are fitted simultaneously to the energy spectrum and spatial event distribution. The basic concept and first results will be presented in this talk.
This work is funded by the Deutsche Forschungsgemeinschaft.

T 69: Experimentelle Methoden der Astroteilchenphysik III

Zeit: Mittwoch 16:30–19:00 Raum: Z6 - SR 2.013

T 69.1 Mi 16:30 Z6 - SR 2.013

IceAct, SiPM based Imaging Air Cherenkov Telescopes for IceCube — •Merlin Schaufel, Jan Auffenberg, Pascal Backes, Thomas Bretz, Giang Do, Erik Ganster, Jan Paul Koschinsky, Leif Rädel, Martin Rongen, Anna Sauret, Johannes Schumacher, Aatif Waza, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut, RWTH Aachen University

The development of cost effective and compact Silicon Photomultipliers (SiPM) based Imaging Air Cherenkov Telescopes enables new measurements using a hybrid configuration with ground based detectors. IceAct is a proposed surface array of such telescopes above IceCube. During January 2018, a new version of an IceAct telescope demonstrator featuring 61 SiPM pixels and improved optics was installed in the center of the IceTop surface detector at the geographic South Pole. Combining information from the telescope and IceCube, it is possible to test the performance in primary particle discrimination, energy calibration and veto capabilities.

We present the status of the project and the prospects of the upcoming data taking season during the antarctic winter.

T 69.2 Mi 16:45 Z6 - SR 2.013

In situ performance of the IceAct Imaging Air Cherenkov Telescope at the South Pole — •Erik Ganster, Jan Auffenberg, Pascal Backes, Thomas Bretz, Giang Do, Jan Paul Koschinsky, Leif Rädel, Martin Rongen, Anna Sauret, Merlin Schaufel, Johannes Schumacher, Aatif Waza, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut, RWTH Aachen University

The IceAct Imaging Air Cherenkov Telescopes are proposed surface detectors extending the IceCube Neutrino Observatory. By observing cosmic ray air showers in the atmosphere with a SiPM based camera, IceAct is capable to veto atmospheric muons and neutrinos, which are a background in cosmic neutrino searches. In December 2015 a 7-pixel demonstrator telescope has been installed at the South Pole and operated in coincidence with IceCube. We present the first analysis of coincident events with the IceCube in-ice detector and the IceTop surface detector and conclude on the performance of the telescope.

T 69.3 Mi 17:00 Z6 - SR 2.013

Prospects on improving the IceCube composition measurements of Cosmic Rays with IceAct — •Pascal Backes, Jan

Auffenberg, Thomas Bretz, Giang Do, Erik Ganster, Jan Paul Koschinsky, Leif Rädel, Martin Rongen, Anna Sauret, Merlin Schaufel, Johannes Schumacher, Aatif Waza, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

One main goal of IceCube is improved composition measurements of Cosmic Rays above the knee. IceAct is a planned surface detector consisting of compact Imaging Air Cherenkov Telescopes each equipped with a 61 pixel SiPM camera. Operating in coincidence with the surface detector IceTop and the IceCube in-ice detector, IceAct can provide additional information on the longitudinal profile of air showers. By simulating the response of IceAct to air showers, we study how well IceAct can measure this profile and separate different cosmic ray primaries.

T 69.4 Mi 17:15 Z6 - SR 2.013

HAWC's Eye - Implementing hybrid detection by combining a compact Imaging Air-Cherenkov Telescope with the HAWC Gamma-Ray Observatory — •Merlin Schaufel, Thomas Bretz, and Johannes Schumacher — III. Physikalisches Institut, RWTH Aachen University

Combining the techniques of Imaging Air-Cherenkov Telescopes (IACT) with ground based array detectors promise different advantages and new measurements using the complementary shower informations. We developed a compact Silicon Photomultiplier (SiPM) based telescope which was operated in coincidence with the HAWC Gamma-Ray Observatory during July 2017. Performance parameters including the effective area, zenith angle depended trigger response or the effective trigger threshold, usually only accessible by simulation, were directly measured using real air-shower data. Benefiting from the HAWC shower-core reconstruction, a direct measurement of the Cherenkov light density on ground was carried out for the high altitude of 4100 m.

We present the results of this study and discuss possible improvements for energy resolution and the gamma-hadron separation using a hybrid detector.

T 69.5 Mi 17:30 Z6 - SR 2.013

IceScint: A surface scintillation detector array as Enhancement of IceCube — •Thomas Huber for the IceCube-Gen2-Collaboration — Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT) and Deutsches Elektronen-Synchrotron, (DESY)

To increase the amount of detected high-energy neutrinos of cosmic origin IceCube-Gen2 is under development.

An Enhancement of the present surface array at IceCube (IceTop) by scintillation detectors is foreseen. A scintillator array can be used to increase the veto capabilities for cosmogenic neutrinos and enables an improvement in cosmic-ray reconstruction. This Enhancement and its research and development is in progress for a large-scale surface array of IceCube-Gen2.

2 Prototype stations with 7 scintillators showcasing technological advances for the next generation in cosmic ray detection have been developed for deployment at the South Pole in January 2018. For the readout of the scintillators, SiPMs *(Sillicon Photomultiplier)* are in use. These solid-state photosensors are similar in detection efficiency compared to classical photomultiplier tubes and have considerable advantages.

The detector design, the operation status and first measurements will be presented in this talk.

T 69.6 Mi 17:45 Z6 - SR 2.013

PEN as a Scintillator, Characterisation of Light Output Properties — •Thomas Kraetzschmar — MPI für Physik, München

Polyethylene Naphthalene (PEN) presently attracts the interest of various groups as a cheap, radio pure scintillating material with various potential fields of applications, spanning from low background experiments to high energy physics calorimeters and potential use in education. In this work, the light output of this scintillator was investigated. Several samples of PEN have been molded at different institutes, and characterized for their light output. The measurements conducted include photo spectral analysis and light yield measurements with SiPMs.The measurements and analysis are presented. Results for different molding parameters are presented.

T 69.7 Mi 18:00 Z6 - SR 2.013

Characterization of SiPMs for cosmic-ray air-shower detectors for the IceCube upgrade — •Marie Oehler[1], Andreas Haungs[1], Thomas Huber[1,2], Max Renschler[1], Harald Schieler[1], Bernd Hofmann[1], and Andreas Weindl[1] for the IceCube-Gen2-Collaboration — [1]KIT, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany

IceCube is a cubic-kilometer neutrino detector installed in the ice at the geographic South Pole. To increase the amount of detected extragalactic neutrinos the upgrade IceCube-Gen2 is under development. Among others, a large surface scintillation detector array is proposed.

First prototype stations consisting of seven detectors each, will be installed in January 2018 at the South Pole. These recently developed detectors use scintillators, wavelength shifting optical fibers and a photosensor. Silicon Photomultipliers (SiPMs) by Hamamatsu are used as sensors because they are mechanically robust and do not require high voltage compared to classical photomultipliers. Before mounting the SiPMs in the detectors, characterization measurements were made to ensure their suitability and performance for the prototype station. In addition, in order to improve these scintillation detectors, comparison studies between SiPMs of other companies were performed. In this talk the photo-sensor calibration setup, the results of the calibration measurements and the comparison studies will be shown.

T 69.8 Mi 18:15 Z6 - SR 2.013

A study of SiPMs as light detectors for the use in imaging atmospheric Cherenkov telescopes — •Alexander Hahn[1], David Fink[1], Daniel Mazin[2], Razmik Mirzoyan[1], and Masahiro Teshima[2] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]Institute for Cosmic Ray Research, the University of Tokyo, Tokyo, Japan

MAGIC is a stereoscopic system of two identical Imaging Atmospheric Cherenkov Telescopes (IACTs) with mirrors of 17 m diameter operated by the MAGIC collaboration on the Canary of Island La Palma. Each of the telescope cameras is equipped with 1039 pixels, based on photomultiplier tubes (PMTs). We developed several prototype detector modules using silicon photomultipliers (SiPMs) as light detectors. The three detector modules consist of assembled matrices based on $6 \times 6\text{mm}^2$ SiPMs from Excelitas, SensL and Hamamatsu correspondingly. Our aim is to develop a SiPM-based pixel with the same active area as the PMT-based one, and to investigate the possible use of SiPMs as new photo sensors for existing and future large size IACTs. An active summation of the individual SiPM outputs to a combined signal of the assembled matrix was achieved while preserving the fast pulse shape. Special design constraints e.g. the operation at ambient temperature and a high level of background light have been addressed and are compared among our different prototypes. In this talk, we will present the features of our design and compare the SiPM-based modules to the existing PMT ones.

T 69.9 Mi 18:30 Z6 - SR 2.013

Silicon Photomultipliers (SiPM) in a Liquid Xenon Time Projection Chamber (TPC) — •Christopher Hils[1], Matteo Alfonsi[1], Andrea Brogna[2], Daniel Wenz[1], and Uwe Oberlack[1,2] — [1]Johannes Gutenberg-Universität Mainz — [2]PRISMA Detektor Labor, Johannes Gutenberg-Universität Mainz

Liquid Xenon Time Projection Chambers (LXeTPC) are used in rare event searches for Dark Matter or neutrinoless double beta decay, or in applications as Compton telescope or camera, where the noble medium offers a combination of scintillation light and ionization that can be used to build large, uniform 3D position sensitive detectors. SiPMs are compact solid state light sensors with single photon count capabilities superior to the commonly used photomultiplier tubes (PMTs). Additionally they provide a high granularity, require comparatively low bias voltage, require less volume and induce less mass into the TPC due to their compact dimensions and, potentially, have a smaller cost per area. Most commercially available SiPMs are not sensitive to the scintillation light of xenon in the VUV regime at 178nm, so a special treatment is neccesary, in which the inactive entrance layer on top of the SiPM is thinned. We operate a test stand to observe the operational stability and to measure the sensitivity, crosstalk and afterpulse properties of three VUV-sensitive SiPM samples in liquid xenon. A 1" PMT is operated simultaneously for reference while scintillation light is provided by a ^{241}Am source immersed in liquid xenon.

T 69.10 Mi 18:45 Z6 - SR 2.013

Extending the Linear Dynamic Range of Silicon Photomultipliers — •Julian Kemp, Thomas Bretz, Thomas Hebbeker,

Lukas Middendorf, Christine Peters, and Johannes Schumacher — III. Physikalisches Institut A, RWTH Aachen

Silicon photomultipliers (SiPMs) are replacing conventional photomultiplier tubes in many applications. They have similar or higher photon detection efficiencies, are very robust and do not suffer from aging. SiPMs are cell structured devices consisting of some hundred up to some ten thousand avalanche photodiodes operated in Geiger mode (G-APDs). When detecting a single photon, a cell discharges and produces a well defined output pulse. While recharging, the cell's gain and photon detection efficiency are reduced. Thus, for long lasting bright light pulses, one cell can be hit multiple times, each hit producing a reduced response. The SiPM response to large light fluxes is therefore non-linear and also depends on the temporal distribution of the incident photons. As expected from semiconductor devices, SiPMs are manufactured with great precision. Thus, the variation in the response of different cells and also between different SiPMs of the same type is small. This allows for a precise simulation of the SiPM behavior also for bright incident photon pulses. Making use of this high precision, an algorithm has been developed to recover signals in the highly non-linear regime of the SiPM. It allows to significantly increase the usable dynamic range of SiPMs. The working principle of the algorithm will be presented as well as first measurements to prove its usability.

T 70: Hauptvorträge III

Zeit: Donnerstag 11:00–12:10 Raum: Z6 - HS 0.004

Hauptvortrag T 70.1 Do 11:00 Z6 - HS 0.004

The Pierre Auger Observatory: the quest for elucidating the nature and origin of UHECRs — •Markus Roth — KIT, Karlsruhe, Germany

Ultra-high energy cosmic rays are the most energetic particles directly measured, reaching orders of magnitude above those attained in the LHC. The Pierre Auger Observatory is the largest ultra-high energy cosmic ray observatory in the world. The huge amount of high quality data collected since 2004 up to now led to great improvements in our knowledge of ultra-high energy cosmic rays. The suppression of the cosmic-ray flux at highest energies was clearly established, and the extra-galactic origin of these particles was confirmed. On the other hand, measurements of the depth of shower maximum indicate a puzzling trend in the mass composition of cosmic rays at energy around the ankle up to the highest energy. The just started upgrade of the Observatory, dubbed AugerPrime, will improve the identification of the mass of primaries allowing us to disentangle models of origin and propagation of cosmic rays. We will present the latest results and future perspectives emphasizing the expected performance of AugerPrime.

Hauptvortrag T 70.2 Do 11:35 Z6 - HS 0.004

Top Quark Physics at the LHC: Probing the New Energy Frontier — •Carmen Diez Pardos — DESY Hamburg, Germany

The top quark is the heaviest known elementary particle and the only quark that decays before hadronising, and thus gives direct access to its properties. With its large mass, it plays a crucial role for testing the predictions of the Standard Model (SM) and in the measurement of the Higgs boson properties. Top-quark measurements also provide important input to QCD calculations. Moreover, various scenarios of physics beyond the SM expect the top quark to couple to new particles.

The large data samples collected at the CERN LHC allow performing very precise measurements of top-quark production and properties, challenging the accuracy of the state-of-the-art SM theoretical predictions, as well as measuring for the first time very rare SM processes. In this presentation, I will review a selection of the most recent top-quark physics measurements performed with the ATLAS and CMS experiments.

T 71: Eingeladene Vorträge III

Zeit: Donnerstag 14:00–16:00 Raum: Z6 - HS 0.001

Eingeladener Vortrag T 71.1 Do 14:00 Z6 - HS 0.001

Radio detection of cosmic rays – achievements and future potential — •Tim Huege — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe, Germany — Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium

When modern efforts for radio detection of cosmic rays started more than a decade ago, hopes were high but the true potential was unclear. Since then, we have achieved a detailed understanding of the radio-emission physics and have consequently succeeded in developing sophisticated detection schemes and analysis approaches. In particular, we have demonstrated that the important air-shower parameters arrival direction, particle energy and depth of shower maximum can be reconstructed reliably from radio measurements, with a precision that is competitive with that of other detection techniques. In this talk I will review the achievements of the radio detection technique and discuss the potential for future application in existing and new experiments.

Eingeladener Vortrag T 71.2 Do 14:24 Z6 - HS 0.001

Prospects and Techniques of Surface Detector Extensions for IceCube — •Jan Auffenberg for the IceCube-Gen2-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The discovery of astrophysical neutrinos up to PeV energies by the IceCube Observatory has triggered intense interest in identifying their origin. Therefore, to improve IceCube's neutrino detection- and overall capabilities, IceCube-Gen2 is planned. For neutrino astronomy, a large background-free sample of well-reconstructed astrophysical neutrinos is essential. The main background for this signal are muons and neutrinos which are produced in cosmic-ray air showers in the Earth's atmosphere. The coincident detection of these air showers by the surface detector IceTop has been proven to be a veto for atmospheric neutrinos and muons in the field of view of the Southern Hemisphere. This motivates a large extension of IceTop to more efficiently detect cosmic rays. In addition, the measurement of different signal channels of air showers is a powerful tool to improve gamma ray detection and cosmic ray composition studies with IceCube. The different channels can be: the high energy muon detection by IceCube deep in the ice, the particle detection on the surface, air Cherenkov light detection, or radio signals of air showers. A selection of technologies, like the usage of imaging air Cherenkov telescopes, IceAct, radio signal detection of air showers, or particle detection with scintillator paddles is discussed.

Eingeladener Vortrag T 71.3 Do 14:48 Z6 - HS 0.001

UHECR propagation: interactions and secondary messengers — •Denise Boncioli — DESY, Platanenallee 6, 15738 Zeuthen

Ultra high energy cosmic rays (UHECRs) are accelerated in astrophysical sources and travel through the extragalactic space before hitting the Earth atmosphere. They interact both with the environment in the source and with the intergalactic photon fields they encounter, causing different processes at various scales depending on the photon energy in the nucleus rest frame. The general implications of the situation of nuclear measurements for cosmic ray astrophysics will be discussed, from the point of view of the propagation and of the candidate sources of cosmic rays. The sensitivity of the UHECR observables and of the secondary messengers like neutrinos and photons to uncertainties in the extragalactic background light and photo-disintegration models will be also described. The possibility of using secondary messengers as a powerful tool to unveil the UHECR sources will be also pointed out.

Eingeladener Vortrag T 71.4 Do 15:12 Z6 - HS 0.001

SQUID readout for microcalorimeter based neutrino experiments — •Sebastian Kempf — Kirchhoff-Institute for Physics, Heidelberg University, Im Neuenheimer Feld 227, 69120 Heidelberg, Germany.

Neutrino physics has been always a strong driving force for the devel-

opment of low-temperature microcalorimeters. The latter are presently used in a variety of experiments such as direct neutrino mass investigations or searches for the neutrinoless double beta decay. A famous example is the Electron capture in Ho-163 experiment ECHo which aims to investigate the electron neutrino mass by means of a calorimetric measurement of the ^{163}Ho electron capture spectrum using large metallic magnetic calorimeter arrays. Most of these microcalorimeter based experiments rely on the existence of ultra-low noise signal transducers converting the detector output signal into a voltage pulse. Superconducting quantum interference devices (SQUIDs) are often the devices of choice since they are intrinsically compatible with the microcalorimeter operation temperature, show a near quantum-limited noise performance and offer a very high system bandwidth.

This talk will give a short introduction into metallic magnetic calorimeter based neutrino physics experiments such as ECHo. It will then concentrate on the development of single-channel SQUIDs for experiments using only a small number of readout channels as well as frequency-domain multiplexed SQUID systems for next-generation large-scale experiments requiring tens or hundreds of thousands of individual detectors.

Eingeladener Vortrag T 71.5 Do 15:36 Z6 - HS 0.001
Radio detection of cosmogenic neutrinos in the Antarctic Ice — •Anna Nelles — DESY, 15738 Zeuthen, Germany — University of California, Irvine, CA 92617, USA

Measuring neutrinos of energies of more than 10^{16} eV will be an important step towards finding the origin of ultra-high energy cosmic rays. The interaction of cosmic rays with the cosmic microwave background and matter surrounding the sources will create an inevitable but low neutrino flux that mostly depends on source evolution and composition. The most promising technique to detect these neutrinos is based on radio emission. Particle showers generated by neutrinos create a short nanosecond-scale radio pulse, which can be measured at large distances in radio transparent media such as ice. The attenuation length of usually more than 500 meters allows for the construction of large arrays at modest costs. In order to effectively detect neutrinos at the relevant energies, effective volumes two orders of magnitude larger than current detectors are needed. Also, analysis methods have to be developed, of which many can built on the success of radio detection of air showers. I will elaborate on recent results of pilot stage arrays in Antarctica and discuss the way forward.

T 72: Eingeladene Vorträge IV

Zeit: Donnerstag 14:00–16:00 Raum: Z6 - HS 0.002

Eingeladener Vortrag T 72.1 Do 14:00 Z6 - HS 0.002
Vom fehlenden Baustein zum Alleskönner - Die steile Karriere des Top-Quarks — •Andrea Knue — Albert-Ludwigs-Universität Freiburg

Auch 23 Jahre nach seiner Entdeckung hat das Top-Quark nichts von seiner ursprünglichen Faszination verloren. Mit einer Masse weit grösser als die Masse seiner Geschwisterteilchen und nahe der Skala der elektroschwachen Symmetriebrechung nimmt es eine Sonderstellung im Standardmodell der Teilchenphysik ein. Die hohen Produktionsraten am LHC erlauben es, bisher nicht zugängliche Prozesse zum ersten Mal genauer unter die Lupe zu nehmen. Darüberhinaus spielt das Top-Quark auch in vielen Suchen nach neuer Physik eine zentral Rolle. In diesem Vortrag werden die neuesten Präzisionsmessungen der Top-Quark Eigenschaften und Wechselwirkungen gezeigt und ein umfassender Über- und Ausblick über Suchen nach seltenen Standardmodell-Prozessen und neuer Physik gegeben.

Eingeladener Vortrag T 72.2 Do 14:24 Z6 - HS 0.002
Real-time Analysis with the LHCb Trigger, present and future — •Sascha Stahl — CERN

The LHCb detector and its trigger enable a wide range of physics measurements at the LHC in proton and heavy ion collisions in the forward region. The experiment will have a major upgrade in the next long shutdown to increase the instantaneous luminosity by a factor of five. The high production rate of beauty and charm hadrons in proton-proton collisions make it impossible to save the full information of all decays in the limited offline storage. To overcome this problem in Run 2 and for the Upgrade, LHCb has implemented a novel approach: it is the first ever High Energy Physics detector which is aligned, calibrated, and fully reconstructed in real-time. This means the information needed for data analysis is immediately available and less information needs to be stored, dramatically increasing the number of events which can be written to the offline storage. To further increase efficiency and flexibility in the Upgrade the trigger system will be fully implemented in software and the full detector is read out at the LHC crossing rate of 40 MHz. The performance of the real-time analysis approach in Run 2 is reviewed, and an outlook to the challenges and possible solutions for Run 3 is given.

Eingeladener Vortrag T 72.3 Do 14:48 Z6 - HS 0.002
Deep-Learning Ansätze in der Teilchenphysik — •Gregor Kasieczka — Universität Hamburg

Tiefe neuronale Netzwerke (deep neural networks) haben sich innerhalb kurzer Zeit als flexibles Werkzeug zur Lösung vieler Datenprobleme ausserhalb der Physik erwiesen. Bekannte Beispiele sind die Klassifikation von Bildern, Spracherkennung, oder die Entwicklung von Lösungsstrategien für das Brettspiel "Go". Gleichzeitig ist die Verwendung von komplexen Algorithmen und immer leistungsfähigeren Rechnersystemen aus der modernen Teilchenphysik nicht mehr wegzudenken. Die Unterscheidung zwischen hadronisch zerfallenden top-Quark Jets und Jets initiiert von leichten Quarks oder Gluonen ist ein typisches Klassifikationsproblem welches durch neuronale Netzwerke gelöst werden kann. Wir benutzen top-Quark Identifikation als Basis zur Diskussion unterschiedlicher Netzwerkarchitekturen. Über Klassifikationsaufgaben hinausgehend besprechen wir weitere Entwicklungen wie etwa adversielle Netzwerke und Techniken zum direkten Lernen aus experimentellen Daten.

Eingeladener Vortrag T 72.4 Do 15:12 Z6 - HS 0.002
Future Probes of the (Beyond the) Standard Model Higgs Boson — •Ramona Gröber — Institute of Particle Physics Phenomenology, Durham University, UK

After the Higgs boson discovery, one of the main focus of the LHC programme became the precise exploration of its properties. Some basic questions like "is the Higgs boson the only elementary spin-0 particle?" or "is the Higgs boson an elementary field at all?" remain to some extent still unaddressed. In this talk, I will discuss how different beyond-the Standard Model Higgs boson scenarios can be probed in future.

Eingeladener Vortrag T 72.5 Do 15:36 Z6 - HS 0.002
Status and final steps towards neutrino mass measurements with the KATRIN experiment — •Philipp Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The **KA**rlsruhe **TRI**tium **N**eutrino experiment (KATRIN) aims to determine the neutrino mass with a sensitivity of $0.2\,\mathrm{eV/c^2}$ by measuring the end-point region of the ^{3}H β-spectrum. The required high statistics and high resolution are achieved with a $\sim 100\,\mathrm{GBq}$ windowless gaseous tritium source and a MAC-E filter spectrometer with an energy width of 0.93 eV as well as with large acceptance.

The experiment is set up at the Karlsruhe Institute of Technology (KIT), where the full beam line has been tested with combined commissioning experiments since the end of 2016. During these measurements photo-electrons, D_2^+ ions as well as conversion electrons from ^{83m}Kr were used.

The beam line, the tritium circulation and safety infrastructure are currently undergoing final installation and commissioning tests, while the operation and analysis teams are preparing for first tritium operation June 2018. This will be followed by careful systematic studies and a gradual increase of source strength before starting the real neutrino mass measurements.

This talk gives an overview of the current status of the KATRIN experiment, the major commissioning achievements and the final steps towards first tritium operation and beyond.

The work of the author is supported by BMBF Verbundforschung under contract 05A17PM3.

T 73: Top-Quarks: Eigenschaften und Zerfälle III

Zeit: Donnerstag 16:30–18:35 Raum: Philo-HS1

Gruppenbericht T 73.1 Do 16:30 Philo-HS1

Die Messung des $t\bar{t}Z$- und $t\bar{t}W$-Wirkungsquerschnitts im 2-, 3- und 4-Leptonen-Endzustand mit dem ATLAS-Experiment — Katharina Bierwagen[1], Volker Büscher[1], Markus Cristinziani[2], Michal Dubovsky[3], Sebastian Herr[2], Clara Nellist[4], Nils-Arne Rosien[4], •Alexandra Schulte[1], Elizaveta Shabalina[4] und Arnulf Quadt[4] — [1]Institut für Physik, JGU Mainz — [2]Physikalisches Institut, Universität Bonn — [3]Comenius University, Slovakia — [4]Universität Göttingen

Die Messung des $t\bar{t}V$-Wirkungsquerschnitts erlaubt Informationen über die Top-V-Kopplung zu extrahieren. Neue Physik jenseits des Standardmodells kann die Produktionsrate von Top-Quark-Paaren mit assoziierten Vektor-Bosonen modifizieren. Erste Messungen wurden bereits bei 7 und 8 TeV durchgeführt.

In diesem Vortrag wird der aktuelle Stand der $t\bar{t}Z$- und $t\bar{t}W$-Wirkungsquerschnittsmessung mit dem Datensatz von 36 fb^{-1} vorgestellt. Mit dem erhöhten Wirkungsquerschnitt bei 13 TeV ist erstmals eine Messung mit Signifikanzen von deutlich über 5σ möglich. Bei der Messung werden Analysen in 2-,3- und 4-Leptonen-Endzuständen kombiniert. Die Ergebnisse der Wirkungsquerschnittsmessung werden zur Einschrängung von Beiträgen neuer Physik im Rahmen einer effektiven Feldtheorie interpretiert.

T 73.2 Do 16:50 Philo-HS1

Top quark mass measurement in $t\bar{t}$ all-jets events with CMS at $\sqrt{s} = 13\,\text{TeV}$ — Christoph Garbers, Nataliia Kovalchuk, •Johannes Lange, Peter Schleper, Hartmut Stadie, and Fred Stober — Institut für Experimentalphysik, Universität Hamburg

The top quark is the heaviest known elementary particle and its mass is an important parameter of the standard model (SM) of particle physics. In conjunction with the W and Higgs boson masses and other precision observables, it provides a self-consistency check of the SM and is responsible for the largest part of higher-order corrections to the Higgs boson mass.

A measurement of the top quark mass in the $t\bar{t}$ all-jets decay channel is presented. The pp collision data used for the analysis have been collected with the CMS experiment at the LHC in 2016 at $\sqrt{s} = 13\,\text{TeV}$. Events containing at least six jets are selected, requiring at least two jets to be tagged as originating from a b quark. To resolve the ambiguity in the jet assignments and improve the mass resolution a kinematic fit is employed. The background arising from QCD multijet production is estimated with a data driven method and validated using simulation. For the mass extraction the ideogram method is applied and the uncertainties are evaluated by performing pseudo experiments.

T 73.3 Do 17:05 Philo-HS1

Measurement of the jet mass distribution in boosted top quark decays — Johannes Haller, Roman Kogler, and •Dennis Schwarz — Institut für Experimentalphysik, Universität Hamburg

At the LHC, top quarks with high momenta play an important role in both precision measurements and searches for new physics. In these cases, the top quark decay products merge into a single hadronic jet and jet substructure techniques become important to resolve and identify the top quark. The presented analysis aims at a measurement of the jet mass distribution of highly boosted top quarks at $\sqrt{s} = 13$ TeV, which is not only a crucial jet substructure variable but also shows sensitivity to the top quark mass. The measured distribution is unfolded to particle level to be comparable to analytical calculations that are now available for the LHC. The differential $t\bar{t}$ production cross section and the top quark mass can be extracted. In studies of several jet clustering algorithms the XCone algorithm was found to give the best performance.

T 73.4 Do 17:20 Philo-HS1

Measurement of Top Tagging Efficiencies in CMS — •Torben Dreyer, Roman Kogler, and Johannes Haller — Institut für Experimentalphysik, Universität Hamburg

High Lorentz boosts pose a challenge to the reconstruction of hadronically decaying top quarks (t → bW → bqq') as the decay products of the top quark are collimated and a reconstruction in three separate jets is no longer possible. Instead, the decay products merge and are reconstructed in one large jet. Top tagging uses the substructure of large jets for top quark identification, which opens the high momentum phase space for standard model measurements of the top quark and increases the sensitivity in searches for heavy new particles.

This contribution presents measurements of top tagging efficiencies with the CMS detector at a center of mass energy of 13 TeV. The performance of established algorithms and new approaches is studied in simulation and data, and correction factors are derived for the use of these algorithms in physics analyses.

T 73.5 Do 17:35 Philo-HS1

Measurement of the $t\bar{t}Z$ cross section in the 4ℓ channel with the ATLAS experiment at 13 TeV — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], Carlo A. Gottardo[1], •Sebastian Heer[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

In the Standard Model the tZ coupling is predicted via the weak interaction and can be tested by measuring the cross section of the $t\bar{t}Z$ process. The decay channel with 4 leptons in the final state has the smallest branching ratio (0.5% of all $t\bar{t}Z$ decays) but is the region with the highest purity. In the Standard Model, the available processes that also have 4 leptons in the final state are few, with the ZZ, the tWZ and the $t\bar{t}H$ processes being the dominant backgrounds.

This talk will present the latest results, using the full 2015 and 2016 dataset of 36.1 fb^{-1} taken by the ATLAS detector at a centre-of-mass energy of 13 TeV, using proton–proton collisions. In total 48 events have been observed. Performing a profile likelihood fit in the 4ℓ-channel alone yields a signal strength compatible with the Standard Model prediction with an expected significance of 5.0σ and an observed significance of 5.3σ. The uncertainties in this analysis are driven by the available statistics, while the dominant systematic uncertainties are related to flavour tagging and signal modelling.

T 73.6 Do 17:50 Philo-HS1

Towards a differential measurement of the $t\bar{t}Z$ cross section with the CMS experiment — •Joscha Knolle and Andreas B. Meyer — DESY, Hamburg, Germany

The production of a top quark pair in association with a Z boson is a direct probe of the top quark–Z boson coupling and can now, as the LHC collects more and more data, be measured precisely.

The CMS collaboration has reported a measurement of the $t\bar{t}Z$ cross section at $\sqrt{s} = 13\,\text{TeV}$ with $35.9\,\text{fb}^{-1}$ of data recorded in 2016 that is in agreement with the Standard Model prediction. Extending this measurement with data (to be) recorded in 2017 and 2018, a first differential measurement will be possible. With differential cross sections, the weak dipole moments of the top quark–Z boson interaction can be probed, thus allowing to constrain contributions from New Physics.

In my talk, I will present first studies on the $t\bar{t}Z$ measurement in the three-lepton channel, where an opposite-sign same-flavour lepton pair comes from the Z boson decay and the third lepton from the semi-leptonically decaying top quark pair, using full 2017 data.

T 73.7 Do 18:05 Philo-HS1

Auswirkungen von höheren Ordnungen in $t\bar{t}$- und Wt-Ereignisgeneratoren auf eine direkte Top Quark Zerfallsbreitenmessung — Tomas Dado[1,2], •Marcel Niemeyer[1], Thomas Peiffer[1], Arnulf Quadt[1] und Royer Ticse Torres[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Institute of Physics, Comenius University Bratislava

Die meisten verfügbaren Monte-Carlo-Generatoren für die $t\bar{t}$-Produktion verfügen nur über Präzision führender Ordnung im Zerfall des Top-Quarks oder approximieren die $t\bar{t}$- und Wt-Interferenz- und $t\bar{t}$-Off-Shell-Effekte. Der kürzlich veröffentlichte $b\bar{b}4\ell$-Monte-Carlo-Generator ordnet exakte QCD-Matrixelemente nächstführender Ordnung des Prozesses $pp \to \ell^+\nu_\ell l^-\bar{\nu}_l b\bar{b}$ den Partonschauern zu. Dies ermöglicht eine exakte Beschreibung der Interferenz und der $t\bar{t}$-Off-Shell-Effekte.

Diese Präsentation wird einen Überblick über den neuen $b\bar{b}4\ell$-Monte-Carlo-Generator und die Untersuchungen zu diesem Generator im Kontext einer direkten Top-Quark-Zerfallsbreitenmessung geben. Der $b\bar{b}4\ell$-Generator wird mit verschiedenen beim ATLAS-Experiment verwendeten Generatoren verglichen, welche den Top-Quark-Zerfall entweder

nur in führender Ordnung wiedergeben bzw. Off-Shell- und Interferenzeffekte approximieren. Es werden ebenfalls die gemachten Schritte zum Tuning des $b\bar{b}4\ell$-Generators beschrieben.

T 73.8 Do 18:20 Philo-HS1

Constraining systematic effects of top quark mass measurements from data — Hartmut Stadie, Christoph Garbers, Fred Stober, Johannes Lange, Nataliia Kovalchuk, Peter Schleper, and •Colin Frunder — Universität Hamburg, Institut für Experimentalphysik

The mass of the top quark is an important parameter of the standard model of particle physics. It precise measurement is of particular importance for consistency tests of the standard model.

The presented study is based on the CMS measurement of the top quark mass in the $t\bar{t}$-semileptonic channel using 2016 data. The result for the top quark mass was $m_t = 172.25 \pm 0.08(\text{stat.} + \text{JSF}) \pm 0.62(\text{syst.})$ GeV. The precision of this measurement is limited by systematic uncertainties, especially from b-jet modelling. Here additional observables are studied in order to constrain these model uncertainties. The impact of an extended mass measurement including this observable is estimated.

T 74: Higgs: Erweiterte Modelle II / Suchen

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS2

T 74.1 Do 16:30 Philo-HS2

A search for pairs of Higgs bosons in the $b\bar{b}\tau^+\tau^-$ decay channel with the ATLAS detector — •Petar Bokan[1,2], Pedro Sales de Bruin[2], Jason Veatch[1], Arnaud Ferrari[2], and Stan Lai[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Department of Physics and Astronomy, Uppsala University

After the discovery of the Higgs boson, a full measurement of the Higgs potential is needed to further probe the mechanism of electroweak symmetry breaking. Since the Higgs potential is related to the fact that the Higgs boson couples to itself, such a measurement can be performed by searching for pairs of Higgs bosons. However, the Standard Model (SM) predicted cross-section is very small due to destructive interference between the Higgs self-coupling and the Higgs-fermion Yukawa coupling production modes. On the other hand, a search for pairs of Higgs bosons potentially offers insight into physics beyond the Standard Model (BSM), since several BSM hypotheses predict heavy resonances that could decay to a pair of Higgs bosons.

A search for non-resonant and resonant Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ channel is presented for 36.1 fb^{-1} of $\sqrt{s} = 13$ TeV data taken by the ATLAS experiment at the Large Hadron Collider (LHC). The analysis considers the semi-leptonic and fully hadronic di-tau final states. The $b\bar{b}\tau^+\tau^-$ final state is one of the most sensitive channels and, in particular, it is the most sensitive channel to search for non-resonant Higgs boson pair production. A study on the High-Luminosity Large Hadron Collider (HL-LHC) prospects of the SM Higgs pair production in the $b\bar{b}\tau^+\tau^-$ channel is also presented in addition.

T 74.2 Do 16:45 Philo-HS2

Monte Carlo studies on the estimation of $ZZ \to \ell\ell\nu\nu$ background using $Z\gamma \to \ell\ell\gamma$ events — •Mangesh Sonawane[1], Beate Heinemann[2], Pieter Everaerts[2], Sarah Heim[2], and Jorge Sabater Iglesias[2] — [1]IISER Pune, Indien — [2]DESY Hamburg, Deutschland

In the search for Dark Matter (DM) at the LHC, SM particles are produced in association with DM particles, which are invisible as they don*t interact with the detector. Thus, events with large imbalance in transverse momentum are of interest. One such signature is $\ell\ell + E_T^{miss}$.

The dominant background contributing to the search for DM in the $\ell\ell + E_T^{miss}$channel is $ZZ \to \ell\ell\nu\nu$. Currently, this background is determined using Monte Carlo simulation, with an uncertainty of about 10%. The goal of this study is to establish a data driven method to estimate this background, and reduce the uncertainty. Using $Z\gamma \to \ell\ell\gamma$, a process with low backgrounds and a high BR$\times\sigma$, it is possible to estimate the $ZZ \to \ell\ell\nu\nu$ contribution. In regions where $p_T(\gamma) \gg M_Z$, the two processes are kinematically similar. They have the same production mechanisms, but differ due to the photon and Z boson couplings to the quarks being different, as well as the difference in mass (photons are massless, while Z bosons are massive). Introducing a transfer factor R as the ratio $\sigma(ZZ)/\sigma(Z\gamma)$ which is determined from simulation, the contribution of $ZZ \to \ell\ell\nu\nu$ to the background can be estimated from $Z\gamma \to \ell\ell\gamma$ data. The uncertainty on the prediction of R due to theoretical aspects is estimated in this work.

T 74.3 Do 17:00 Philo-HS2

Search for H→WW in MSSM Scenarios with the Emphasis on Minimizing Systematic Uncertainties using a Multi-Variate Strategy — David Brunner, Jordy Degens, •Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

A promising model beyond the Standard Model is the Minimal Supersymmetric Standard Model (MSSM), which is commonly parameterized in the Higgs sector by $\tan\beta$ and m_A. As in every 2HDM, five different Higgs bosons are predicted. Especially the decay of the heavy scalar Higgs boson into two W bosons is very sensitive to low values of $\tan\beta$ and m_A. Standard Model background processes are a challenge in this region. These backgrounds are modelled using data driven methods, whose performances heavily rely on the purity of their associated control regions. In the last few years Deep Learning showed remarkable progress and success in high energy physics. We present a classification strategy with deep neural networks, which increases the purity in control regions for SM background processes. This strategy minimizes systematic uncertainties and thus improves the limits in an unexplored region of the MSSM parameter space in the search for H→WW.

T 74.4 Do 17:15 Philo-HS2

Search for Neutral MSSM Higgs Bosons in the H/A→ $\tau\tau$ channel at ATLAS — •Emily Thompson, William Davey, and Jochen Dingfelder — Physikalisches Institut Universität Bonn

The Minimal Supersymmetric Standard Model (MSSM) is an extension of the Standard Model (SM) that is able to address problems of the SM such as the hierarchy problem, gauge coupling unification and the existence of dark matter. Its Higgs Sector consists of two charged, $H^\pm$, and three neutral Higgs bosons, h, H, A. The couplings of H and A to down-type fermions are enhanced over a large region of parameter space, resulting in increased branching fractions to τ leptons and b-quarks. This has motivated a variety of searches of MSSM Higgs bosons decaying into $\tau\tau$ final states.

In this talk, a search for neutral MSSM Higgs Bosons decaying into a τ lepton pair is presented in the channel where one τ decays leptonically and the other τ decays hadronically. The selection is split into a b-tagged and a b-veto region to optimize the sensitivity for different production processes. Currently, the H→ $\tau\tau$ analysis is being developed for use with the full Run 2 dataset of proton-proton collision data collected with the ATLAS detector at a centre-of-mass energy of $\sqrt{s} = 13$ TeV. The recent progress of this development is presented, with a focus on signal region optimization.

T 74.5 Do 17:30 Philo-HS2

Identifizierung geboosteter $h \to b\bar{b}$-Zerfälle mit dem ATLAS-Detektor — •Stefan Maschek, Andreas Hönle, Felix Müller, Hubert Kroha und Sandra Kortner — Max-Planck-Institut für Physik

Mit seiner Masse von 125 GeV zerfällt das Higgsboson h vorwiegend in bottom-Antibottom-Quarkpaare, welche aufgrund von Hadronisierung und Fragmentierung im Detektor als Jet gemessen werden können. Stark geboostete Higgsbosonen, wie sie in Zerfällen hypothetisch neuer, massiver Teilchen auftreten können, haben die Eigenschaft, dass die Jets der beiden bottom-Quarks fast kollinear gerichtet sind und nicht voneinander getrennt werden können. Um eine solche geboostete Topologie dennoch identifizieren zu können, werden Jets mit großen Radien definiert, welche die Zerfallsprodukte beider b-Quarks umfassen. Diese großen Jets unterscheiden sich durch hohe invariante Massen von einfachen Quark- und Gluonjets. Darüber hinaus werden b-Quarktagging

und verschiedene Variablen, die die Jetsubstruktur charkterisieren, zur Diskriminierung der Signalereignisse gegenüber dem Untergrund verwendet. In diesem Vortrag werden die jüngsten Entwicklungen bei der $h \to b\bar{b}$-Identifizierung und deren Anwendung bei der Suche nach neuen, schweren Teilchen vorgestellt, die in ein Higgsboson und ein W-oder Z-Boson zerfallen.

T 74.6 Do 17:45 Philo-HS2

Search for a heavy charged Higgs boson in Run-2 — •Francesco Peri, Heiko Lacker, and Janet Dietrich — Humboldt University of Berlin

Charged Higgs bosons ($H^{\pm}$) are predicted by many Beyond-the-Standard Model (BSM) scenarios, like the MSSM (Minimal Supersymmetric Standard Model). The production mechanisms and decays of such particles strongly depend on their mass. This presentation focuses on heavy charged Higgs bosons, with a mass larger than the top-quark mass. In this case, the dominant production mode is in association with a top quark, while the decay is into a top-bottom pair. The latest developments from the ATLAS collaboration are hereby discussed, presenting the results obtained during Run-2 and including prospectives for the future.

T 74.7 Do 18:00 Philo-HS2

Search for new Physics in Boosted $hh \to bb\tau\tau$ Decays at ATLAS. — •David Kirchmeier, Arno Straessner, and Wolfgang Mader — IKTP, TU Dresden, Germany

The resonant and non-resonant production of two Higgs bosons play an important role, in the investigation of the Higgs self-coupling and in searches for physics beyond the Standard Model.

Due to the relatively high Higgs mass and its narrow width, decays into two Higgs bosons are ideal e.g. in searches for heavy Higgs bosons like they are predicted by supersymmetric theories or heavy Kaluza-Klein Gravitons. Furthermore the $hh \to bb\tau\tau$ decay channel is promising as the Higgs decay into bb has the highest branching ratio, while the decay into $\tau\tau$ final states has still a moderately high branching ratio and allows good separation against QCD background.

In particular the regime of very high mass resonances above 1 TeV is experimentally challenging. The high boost of the b- and τ-pair systems lead to signatures with close-by pairs of b-jets and tau decays in the ATLAS detector and requires dedicated experimental techniques to tag those topologies. This talk presents a search for new physics in the highly boosted $bb\tau\tau$ final state while also going into some of the latest developments in the identification of boosted hadronic τ pair decays in ATLAS.

T 74.8 Do 18:15 Philo-HS2

Suche nach Dunkler Materie im Mono-Higgs-Kanal mit dem ATLAS-Detektor bei einer Schwerpunktenergie von 13 TeV — •Rainer Röhrig, Sandra Kortner, Hubert Kroha und Patrick Rieck — Max-Planck-Institut für Physik, München

Dunkle Materie dominiert die Materie im Universum und ist einer der wichtigsten Hinweise auf Physik jenseits des Standardmodells. Die Teilchennatur der Dunklen Materie ist bisher unbekannt, jedoch wird vermutet, dass sie aus sogenannten WIMPs bestehen könnte. Solche Teilchen könnten am LHC erzeugt und im ATLAS-Detektor in Ereignissen mit hohen fehlenden Transversalimpuls beobachtet werden. Die Paarproduktion von Teilchen der Dunklen Materie zusammen mit dem entdeckten Higgs-Boson, der sogennante Mono-Higgs-Kanal, liefert eine neue Signatur für Dunkle Materie. Am vielversprechendsten ist dabei die Suche im Endzustand mit Higgs-Bosonzerfällen in $b\bar{b}$-Paare. Die Higgs-Bosonen werden hier mit hohen Impulsen erzeugt, was zu einer starken Kollimation der beiden b-Quarks im Endzustand führt, die daher als ein gemeinsamer Hadron-Jet mit großem Radiusparameter rekonstruiert werden. Die Rekonstruktion der Jets aus Teilchenspuren bei variablem Radiusparameter wurde untersucht. Diese Substruktur der Jets liefert zusätzliche Kriterien zur Unterdrückung des Untergrunds und reduziert die durch die b-Jetidentifizierung bedingten systematischen Unsicherheiten. Für die Suche nach Mono-Higgs-Ereignissen wurde die Sensitivität für verschiedene Signalmodelle untersucht und die Daten der Jahre 2015-2017 analysiert.

T 74.9 Do 18:30 Philo-HS2

Search for a light CP-odd Higgs boson decaying into a pair of taus — •Paul Moder, Dirk Duschinger, Wolfgang Mader, and Arno Straessner — IKTP Dresden, Deutschland

In 2012 the Standard Model was confirmed with the discovery of the Higgs boson and since then its predictions have often been proven to be correct when compared to experiments. However there are still some phenomena it can not explain, for example the anomalous magnetic moment of the muon, which shows significant deviations in the experiment. These deviations could be explained in the context of a 2 Higgs Doublet Model (2HDM). This model predicts a second Higgs doublet which leads to four additional Higgs bosons, one of them CP-odd. This model contains several free parameters. Of particular interest are the mass of the CP-odd Higgs boson and the couplings to charged leptons and up type quarks.

In this talk, an analysis for the search for a light CP-odd Higgs boson is presented. In the analysis the Higgs boson is produced via gluon fusion because of its strong coupling to top quarks. The mass range for the CP-odd Higgs boson lies between 60GeV and 120GeV with decays into a pair of tau leptons, where both tau leptons decay leptonically, one into an electron, one into a muon.

T 74.10 Do 18:45 Philo-HS2

Search for heavy Vh resonances with the ATLAS detector in the final state with boosted $h \to b\bar{b}$ decays — •Andreas Hönle, Sandra Kortner, Hubert Kroha, Stefan Maschek, and Felix Müller — Max-Planck-Institut für Physik, München, Deutschland

Many extensions of the Standard Model (SM) predict the existence of heavy resonances that decay into boson pairs. A process with promising search prospects is the decay of a heavy particle into a SM vector boson V ($\equiv W, Z$) and the SM Higgs boson h with a subsequent leptonic V decay and a Higgs boson decay into a pair of b quarks.

The searches now move towards higher masses, since the lighter heavy resonance candidates have been widely excluded with present data. Therefore, the topologies with boosted decay products become increasingly important. The b quark from such boosted Higgs boson decays are often nearly collinear, such that the two corresponding b jets oftentimes merge into a single large-radius jet.

In this talk, the optimized techniques for the reconstruction of boosted $h \to b\bar{b}$ decays are introduced, and their use in the search for heavy Vh resonances will be explained.

T 75: Suche nach Supersymmetrie III

Zeit: Donnerstag 16:30–18:45 Raum: Philo-HS3

T 75.1 Do 16:30 Philo-HS3

Study of a search for stau pair production with the ATLAS experiment at the LHC — •Patrick Selle, Hubert Kroha, Johannes Junggeburth, and Zinonas Zinonos — Max Planck Institut für Physik, München

Supersymmetry provides solutions to many open problems of the Standard Model. Since none of the predicted supersymmetric partners of the Standard Model particles has been observed so far, supersymmetry must be broken. The masses of the supersymmetric particles are expected in the mass range around 1 TeV which is accessible at the Large Hadron Collider (LHC). In this talk, the search for stau lepton pair production with the ATLAS detector at the LHC at a centre-of-mass energy of $\sqrt{s} = 13$ TeV is discussed. The results are interpreted in the framework of a simplified model. The model parameters and the expected signal sensitivity are discussed.

T 75.2 Do 16:45 Philo-HS3

Studies to increase the sensitivity of the search for top squarks in final states with one electron or muon at the ATLAS experiment — •David Handl, Jovan Mitrevski, and Jeannine Wagner-Kuhr — LMU München

Many theories favour a relatively light top squark ($\tilde{t}_1$), which is the supersymmetric partner of the top quark, with a mass that should be within the reach of the LHC.

The presented studies focus on events with multiple jets, missing transverse momentum and exactly one isolated electron or muon in

the final state. A particular simplified model is considered where the mass difference between the top squark and the neutralino ($\tilde{\chi}_1^0$) is smaller than the top quark ($\Delta m \equiv m_{\tilde{t}_1} - m_{\tilde{\chi}_1^0} < m_t$), leading to a three-body decay. Such decay scenarios are very challenging because the kinematics are very similar to the production of top quark pairs.

Machine learning (ML) techniques, such as boosted decision trees and neural networks could provide a very helpful tool to isolate the signal from the standard model background. In this talk applications of multivariate algorithms to the current search are presented. The corresponding sensitivity reach is determined and compared to the current standard cut-based approach. Analyses conducted in extreme phase space regions generally face the issue of low statistics, which is a crucial aspect for the evaluation of systematic effects. To overcome this issue a ML-based reweighting procedure is applied on the high-statistic Monte-Carlo sample, which is used for the default prediction, to imitate systematic effects and the results are validated and discussed.

T 75.3 Do 17:00 Philo-HS3

Suche nach Supersymmetrie bei CMS in Endzuständen mit Photonen und Leptonen — Christian Autermann, Lutz Feld, Maximilian Knut Kiesel, Johannes Schulz und •Sebastian Wuchterl — I. Physikalisches Institut B, RWTH Aachen University

Supersymmetrie ist eines der vielversprechendsten Modelle zur Ergänzung des Standardmodells der Teilchenphysik. In Szenarien, in denen die Symmetriebrechung durch Eichbosonen vermittelt wird (GMSB), werden Endzustände mit Photonen (γ) und Gravitinos ($\tilde{G}$), hier das leichteste supersymmetrische Teilchen, vorhergesagt, die sich aufgrund der Undetektierbarkeit der Gravitinos in fehlendem transversalem Impuls im Detektor (p_T^{miss}) niederschlagen. Auch andere Bosonen können im Zerfall des zweitleichtesten Teilchens, dem Neutralino (χ_1^0), entstehen, $\chi_1^0 \to \tilde{G} + \gamma/Z$.

Es wird der aktuelle Status einer Suche präsentiert, die Daten untersucht, die 2016 in Proton-Proton Kollisionen bei einer Schwerpunktsenergie von 13 TeV vom CMS-Detektor aufgezeichnet wurden und einer integrierten Luminosität von 36 fb^{-1} entsprechen. In der Analyse werden Endzustände mit einem Photon und zwei Leptonen gleicher Familie und unterschiedlicher elektrischer Ladung selektiert. Das Ziel dieser Analyse ist die möglichst präzise Suche nach wino-artigen Neutralinos. Die Sensitivität in dem bisher nicht untersuchten $\gamma + l^+l^-$ Endzustand wird mit bereits veröffentlichten Ergebnissen in anderen Kanälen verglichen.

T 75.4 Do 17:15 Philo-HS3

Suche nach Supersymmetrie mit Charm-Jets — Katharina Bierwagen, Volker Büscher, •Jan Schäffer und Rosa Simoniello — Johannes Gutenberg-Universität Mainz

Das Standardmodell liefert eine gute Beschreibung der beobachteten Phänomene, jedoch können einige offene Fragen nicht beantwortet werden. Ein möglicher Lösungsansatz ist die Supersymmetrie (SUSY), welche zu jedem bekannten Standardmodell-Teilchen einen supersymmetrischen Partner voraussagt. Das Stop-Quark - der SUSY-Partner des Top-Quarks - ist besonders interessant, da das Top-Quark eine starke Yukawa-Kopplung besitzt und sein Partner somit große Schleifenkorrekturen auf die Masse des Higgs-Bosons liefert. Ein wichtiger und gleichzeitig anspruchsvoller Kanal ist der Zerfall des Stop-Quarks in ein Charm-Quark und das leichteste Neutralino, welcher dominant für kleine Massendifferenzen zwischen dem Stop-Quark und dem leichtesten Neutralino ist. Ein weiterer in dieser Analyse betrachtete Kanal ist der Zerfall des skalaren Charm-Quarks in den gleichen Endzustand. Der Vortrag beschreibt die Optimierung der Signal- und Kontrollregionen für die Suche nach Supersymmetrie in diesen Zerfallskanälen, unter Ausnutzung von Abstrahlungen im Anfangszustand und der Rekonstruktion von Jets aus Charm-Quarks. Es werden die aktuellen Ergebnisse der Analyse mit dem gesamten Datensatz aus 2015 und 2016 bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV präsentiert.

T 75.5 Do 17:30 Philo-HS3

Suche nach Supersymmetrie mit versetzten Leptonpaaren beim ATLAS-Experiment am LHC — •Dominik Krauss, Zinonas Zinonos und Hubert Kroha — Max-Planck-Institut für Physik, München

Die meisten Suchen nach Supersymmetrie am LHC konzentrieren sich auf den Fall, dass das leichteste supersymmetrische Teilchen stabil und die anderen supersymmetrischen Teilchen kurzlebig sind. Bisher sind diese Suchen jedoch erfolglos geblieben und daher wird es immer wichtiger auch supersymmetrische Modelle zu betrachten, in denen diese Annahmen nicht erfüllt sind. Einige dieser Modelle sagen langlebige supersymmetrische Teilchen voraus, die in geladene Leptonen zerfallen. Liegt deren Lebensdauer im Bereich von Pikosekunden bis Nanosekunden, können deren Zerfälle als sekundäre Vertices im Innerdetektor rekonstruiert werden. Da das Standardmodell solche Zerfälle nicht vorhersagt, gibt es nur einen geringen Untergrund, der es ermöglicht, selbst schwache Signale in den Daten auszumachen. In diesem Vortrag wird eine Suche nach solchen versetzten Vertices mit geladenen Leptonen am ATLAS-Experiment vorgestellt.

T 75.6 Do 17:45 Philo-HS3

Optimising the Sensitivity of the ATLAS Experiment for the Direct Pair-Production of Scalar Tau Leptons at the LHC in Run-2 — Ferdinand Krieter, •Clara Leitgeb, and Alexander Mann — Ludwig-Maximilians-Universität, München

Supersymmetry is a promising extension of the Standard Model of particle physics. An important goal of the physics program of the ATLAS detector at the LHC is the search for direct pair-production of scalar tau leptons (staus) and their subsequent decay into a tau lepton and the lightest neutralino. Because of the very low expected cross section, a search for this process in the first run of the LHC could hardly reach any sensitivity. But the higher center-of-mass energy in run-2 results in a higher cross section for this process. Together with the enhanced integrated luminositiy in run-2, this causes an increase of the production rate of stau pairs. Furthermore, the identification efficiency of tau leptons has been improved in run-2. However, there is also an increase of the cross sections of some Standard Model background processes. In addition, the trigger selection becomes more difficult due to the higher instantaneous luminosity and pile-up.

In this talk, the search for direct stau production with ATLAS at a center-of-mass energy of 13 TeV will be presented. The main focus is on the design of an optimal signal region, for which a cut-and-count approach is used as well as boosted decision trees. In order to improve the statistical uncertainty on the contribution of events containing one W -boson and jets, a reweighting technique called tau promotion is applied.

T 75.7 Do 18:00 Philo-HS3

Search for chargino and neutralino pair production decaying via a W and Higgs boson into final states with two same-sign leptons with the ATLAS detector — •Daniela Köck and Jeanette Lorenz — Ludwig-Maximilians-Universität München

Supersymmetry (SUSY) is an extension of the Standard Model (SM), which can solve the SM hierarchy problem if SUSY particles are present at the TeV scale. If R-parity is conserved, SUSY particles are produced in pairs, and the lightest supersymmetric particle (LSP) is stable. The pair production of charginos and neutralinos might be the dominant production mode of supersymmetric particles in $\sqrt{s} = 13$ TeV p-p-collisions at the LHC, if squarks and gluinos are beyond the reach of the LHC.

A search for pair production of charginos and neutralinos with 36.1 fb^{-1} of proton-proton collisions recorded by the ATLAS detector is presented, where the charginos and neutralinos decay into W and Higgs bosons and LSPs. These decays may lead to different final states depending on the decays of the W and Higgs bosons. Among those, the final state with two same-sign leptons (electrons and muons) provides a distinguished signature with low SM background. This talk will present an analysis in this channel, in particular highlighting the sensitivity optimisation and expected results.

T 75.8 Do 18:15 Philo-HS3

Suche nach Supersymmetry in Endzuständen mit Photonen und pTmiss bei CMS — •Johannes Schulz, Lutz Feld und Christian Autermann — I. Physikalisches Institut B, RWTH Aachen University

Supersymmetrische Modelle, in denen die Brechung durch Eichbosonen vermittelt wird (GMSB), sagen je nach Mischung der Gauginos Endzustände mit Photonen und Gravitinos vorher. Die nicht detektierbaren Gravitinos führen zu einem Ungleichgewicht des Impulses in der transversalen Ebene des Detektors (pTmiss). Elektroschwache Produktion von Eichbosonen erzeugt Endzustände mit geringer hadronischer Aktivität.

Die Analyse untersucht Daten, die 2016 in Proton-Proton Kollisionen bei einer Schwerpunktsenergie von 13 TeV vom CMS Detektor aufgezeichnet wurden und die Triggeranforderung eines hochenergetischen Photons erfüllt haben. Der Datensatz korrespondiert zu einer

integrierten Luminosität von 36 fb^{-1}. Die Analyse nutzt Daten zur Bestimmung der dominanten Standardmodell-Untergründe durch Monte-Carlo-Normalisierung oder vollständig datengetriebener Abschätzung. Prozesse geringfügigeren Beitrags werden durch direkte Simulation abgeschätzt. Ereignisse mit großem pTmiss und großen transversalen Massen, rekonstruiert aus dem transversalen Impuls des höchstenergetischen Photons und p_T^{miss}, werden selektiert. Die Ergebnisse werden in GMSB und vereinfachten Modellen interpretiert und Ausschlussgrenzen berechnet.

T 75.9 Do 18:30 Philo-HS3

Suche nach Supersymmetrie in 1-Lepton Ereignissen mit mindestens 2-9 Jets am ATLAS Experiment — •Nikolai Hartmann und Jeanette Lorenz — Ludwig-Maximilians-Universität München

Der Zerfall der Superpartner der Gluonen (Gluinos) und Quarks (Squarks) ist in vielen Modellen durch einen Endzustand mit Jets, fehlender Transversalenergie und Leptonen gekennzeichnet. Dieser Vortrag präsentiert die Resultate der ATLAS Analyse im 1-Lepton Kanal mit Daten aus 2015 und 2016, die einer integrierten Luminosität von mit 36,1 fb^{-1} entsprechen. Verschiedene Signalregionen mit mindestens 2-6 Jets werden in vereinfachten Modellen mit einstufigem Zerfall von Gluinos und Squarks mit einem W Boson interpretiert, basierend auf einer simultanen Anpassung der jeweiligen Verteilung der effektiven Masse. Zusätzlich deckt eine Signalregion mit mindestens 9 Jets Szenarien mit längeren Zerfallsketten ab. Der Untergrund im 9 Jet Regime wird mit einer datengestützten Technik abgeschätzt. Die 9 Jet Signalregion wird in zweistufigen Gluino Zerfällen mit einem W und Z Boson, sowie Modellen des phänomenologischen minimalen supersymmetrischen Standardmodells (pMSSM) interpretiert. Es konnte kein signifikanter Überschuss jenseits des erwarteten Untergrunds beobachtet werden. Für die einstufigen Modelle werden Gluino Massen mit bis zu 2,1 TeV und Squark Massen bis zu 1,25 TeV auf einem Konfidenzniveau von 95% ausgeschlossen. Für die zweistufigen Modelle und die pMSSM Szenarien ergeben sich Auschlussgrenzen für Gluino Massen bis zu 1,75 TeV und 1,7 TeV.

T 76: Suche nach Physik jenseits des Standardmodels IV

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS4

T 76.1 Do 16:30 Philo-HS4

Search for new physics in events with one lepton and high missing transverse energy with the ATLAS detector — •Eike Becher and Stefan Tapprogge — Johannes Gutenberg Universität Mainz

Many models of physics beyond the Standard Model (SM) predict the existence of new spin 1 gauge bosons that could be discovered by experiments at the Large Hadron Collider (LHC). In the leptonic decay channel the massive charged W' boson decays into a lepton and a neutrino.
The analysis requires a single high-p_T isolated lepton ($l = e, \mu$) and substantial missing transverse energy E_T^{miss} originating from the undetected neutrino. The signal discriminant is the transverse mass

$$m_T = \sqrt{2 p_T E_T^{miss} (1 - \cos\varphi_{l\nu})} \quad (1)$$

where $\varphi_{l\nu}$ ist the angle between the lepton and E_T^{miss} in the transverse plane.
The existence of a W' boson could lead to an excess of data in the high transverse mass region. From 2015 to 2017 the LHC provided proton collisions at a center of mass energy of 13 TeV. Data corresponding to an integrated luminosity of about 70 fb^{-1} has been recorded by the ATLAS experiment. The analysis strategy and an understanding of the data used in the search for narrow resonance like structure in $l + E_T^{miss}$ final state will be presented.

T 76.2 Do 16:45 Philo-HS4

Analysis of high mass lepton flavour violating processes with CMS — •Aaron Hornschild, Thomas Hebbeker, Sören Erdweg, Arnd Meyer, and Swagata Mukherjee — III. Physikalisches Institut A, RWTH Aachen University

Lepton flavour violating processes are common in several models of physics beyond the standard model. Some models predict objects at the TeV scale that can decay into two charged standard model leptons of different flavour, like electron + muon or muon + tau. For example supersymmetry with R-parity violation can permit resonant sneutrino production which could decay into such two different leptons. This scenario results in an excess of events at high invariant masses, thus leading to a striking signature with low standard model background.

In this talk the analysis of such a lepton flavour violating process is presented, based on the 2016 CMS dataset corresponding to an integrated luminosity of 36 fb^{-1} at a pp center of mass energy of 13 TeV.

T 76.3 Do 17:00 Philo-HS4

Unfolding of control regions in the search for lepto-quarks using the 2015 and 2016 datasets from ATLAS — •Alexander Sydorenko — Institut für Physik, Uni Mainz

Many Exotics and SUSY analyses use control regions in interesting regions of phase space to perform their searches. The information obtained from these control regions could have applications beyond the original search. For example, unfolded distributions of certain observables in these regions could be used for re-interpretations or tuning of Monte Carlo generators. This note is intended as a demonstration of the unfolding of search control regions. The unfolding is based on a search for leptoquarks performed using data collected by the ATLAS experiment during LHC pp collisions at 13 TeV in 2015 and 2016. A simple bin-by-bin unfolding is performed on a number of variables in eejj, $\mu\mu$jj and eμjj control regions of the search.

T 76.4 Do 17:15 Philo-HS4

Search for singly produced lepto-quarks decaying into a quark and a charged lepton of the first or second generation with ATLAS — •Holger Herr and Stefan Tapprogge — Universität Mainz

Recent anomalies observed in flavour physics challenge the very successful standard model. The introduction of new particles which carry lepton and baryon number - the so called lepto-quarks (LQ) - could explain these in a convenient way.

The ATLAS experiment collects data of proton-proton collisions at a center of mass energy of 13 TeV since 2015. The single production channel allows to extend the mass reach probed compared to the search for pair produced lepto-quarks. This comes at the cost of introducing an additional dependency on the quark-lepton-LQ coupling. The quark emitting the LQ transitions into a charged lepton. This leads to a final state containing a charged lepton and anti-lepton as well as a quark. So far only charged leptons of the first and second generation are considered.

In this talk signal kinematics, expected backgrounds, the selection strategy as well as first sensitivity estimates will be presented.

T 76.5 Do 17:30 Philo-HS4

Search for pair-produced first and second generation scalar leptoquarks in *pp* collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector at the LHC — Stefan Tapprogge and •Anton Wolf — Institut für Physik, Johannes Gutenberg-Universität Mainz

Leptoquarks (LQs) are predicted in many extensions of the Standard Model (SM) and may provide an explanation for many observed similarities between the quark and lepton sectors of the SM. LQs are commonly assumed to couple to quarks and leptons of the same generation.

The talk will summarize results of a search for pair-produced first and second generation LQs. Channels where both LQs decay to a charged lepton and a quark are considered. The probed final states consist of exactly two same flavour opposite sign leptons (electrons or muons) and at least two jets. The dataset used was recorded in 2015 and 2016 by the ATLAS experiment. It corresponds to 36.1 fb^{-1} of *pp* collision data at a center-of-mass energy of 13 TeV.

T 76.6 Do 17:45 Philo-HS4

Searches for pair production of leptoquarks in top quark final states at the CMS experiment. — Johannes Haller, Roman Kogler, •Arne Christoph Reimers, and Marc Stöver — Institut

für Experimentalphysik, Universität Hamburg

In this talk we present searches for pair produced scalar leptoquarks in pp-collisions of $\sqrt{s} = 13\,\text{TeV}$. The data have been collected by the CMS experiment in 2016. In these analyses, the production of scalar leptoquarks decaying into a top quark and a muon or a tau lepton is studied.

The searches are carried out in final states with either two isolated muons or at least one hadronically decaying tau lepton and one additional electron or muon. Both channels are divided into sub-categories in order to maximize the sensitivity to a wide range of leptoquark masses. The dominating standard model backgrounds ($t\bar{t}$ and Drell-Yan or W+jets, respectively) are estimated by selecting control regions and extrapolating the data using additional shape and normalization information from simulation. A combination of both analyses is performed to achieve the best overall sensitivity.

T 76.7 Do 18:00 Philo-HS4

Suche nach skalaren Leptoquarks der dritten Generation am ATLAS Experiment — Daniela Börner, Frank Ellinghaus, Jan Küchler und •Jens Roggel — Bergische Universität Wuppertal

Leptoquarks werden in vielen Erweiterungen des Standardmodells vorhergesagt und wären in der Lage Ähnlichkeiten zwischen Quark- und Leptonsektor zu erklären.

Dieser Vortrag beschreibt die Suche nach skalaren Leptoquarks aus Paarproduktion mit einer Ladung von +2/3, die in ein Top-Quark und ein Tau-Neutrino zerfallen. Aufgrund der Ähnlichkeit des Endzustandes zu einer Suche nach supersymmetrischen Top-Squarks mit einem Lepton, Jets und fehlender transversaler Energie im Endzustand kann letztere im Sinne einer Suche nach Leptoquarks uminterpretiert werden. Limits auf den Wirkungsquerschnitt für die Leptoquark Produktion werden basierend auf den vom ATLAS Detektor in den Jahren 2015 und 2016 gesammelten Daten berechnet. Es wird angenommen, dass Leptoquarks nur in ein Quark und ein Lepton derselben Generation zerfallen und somit zusätzlich nur ein Zerfall in ein Bottom-Quark und ein Tau-Lepton möglich ist. Daher werden auch Limits als Funktion des Verzweigungsverhältnisses in die beiden Zerfallskanäle präsentiert.

T 76.8 Do 18:15 Philo-HS4

Reinterpretation of the ATLAS search for stop quarks decaying through tau sleptons as a search for 3rd generation leptoquarks — Alexander Mann and •Alexander Mario Lory — Ludwig-Maximilians-Universität München

Leptoquarks appear in many extensions of the Standard Model and can potentially help us understand the similarities between quark and lepton generations. A recent study, motivated by supersymmetry, analysed events with final states with tau leptons, b-quarks and missing transverse momentum in the dataset recorded with the ATLAS detector in 2015 and 2016. No deviation from the Standard Model was observed. The results of a reinterpretation of this analysis in terms of third generation leptoquarks of up- and down-type is presented. Leptoquark signal models are analysed and compared to the supersymmetric benchmark models. The reinterpretation has good exclusion power for intermediate values of the model paramater β, which determines the branching ratio of a leptoquark decaying to a charged lepton and a quark. For $\beta = 0.5$, the up-type and down-type models are excluded for leptoquark masses up to 780 and 800 GeV, respectively.

T 76.9 Do 18:30 Philo-HS4

Flavorful Leptoquarks at Hadron Colliders — •Dennis Loose — TU Dortmund

Driven by the $b \to s$ anomalies, we study bottom-up leptoquark scenarios and explore the flavor structure of the associated couplings in the context of flavor symmetries that can explain masses and mixings of the standard model fermions. We work out collider signatures focusing on single leptoquark production, which is sensitive to the couplings and their structure. The flavor patterns that are in accordance with the data put an emphasis on the processes $pp \to b\mu\mu$ and $pp \to t\mu\nu$ and allow for leptoquark masses as low as a few TeV.

T 76.10 Do 18:45 Philo-HS4

Diskriminierung von Quark- und Gluonjets mit dem ATLAS-Detektor — •Johannes Balz, Katharina Bierwagen, Volker Büscher, Andreas Reiss, Jan Schäffer und Christian Schmitt — Institut für Physik, Johannes Gutenberg-Universität Mainz

Eines der gegenwärtig wichtigsten Ziele für das ATLAS Experiment ist neben der präzisen Vermessung des Standardmodells (SM) die Suche nach Physik jenseits des SM (BSM).

In nahezu jeder BSM-Suche spielen Jets eine wichtige Rolle, da diese aus der Hadronisierung von Quarks und Gluonen entstehen. In vielen BSM-Modellen sind die Untergrundprozesse durch Jets aus Gluonen dominiert, während in den Signalprozessen Quarkjets dominieren. Daher is eine Unterscheidung von Jets aus Quarks und Gluonen (Quark-Gluon-Tagging) ein wichtiges Hilfsmittel zur weiteren Diskriminierung von Signal- und Untergrundereignissen.

In diesem Vortrag wird ein Verfahren/Methode vorgestellt, in dem mithilfe eines BDT einige diskriminierende Messgrößen aus Spurdetektor und Kalorimeter kombiniert werden, die sensitiv auf die Substruktur der Jets sind. Die Performanz des Taggers wurde mithilfe von Dijet-Monte-Carlo- und Daten-Ereignissen bei einer Schwerpunktsenergie von $\sqrt{s}$=13 TeV studiert.

T 77: Suche nach dunkler Materie IV

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS5

Gruppenbericht T 77.1 Do 16:30 Philo-HS5

Latest Dark Matter Results of XENON1T — •Constanze Hasterok — Max-Planck-Institut für Kernphysik

Weakly interacting massive particles (WIMPs) are a very popular explanation for the nature of dark matter. The XENON1T experiment aims for the direct detection of WIMP-nucleon interactions using a dual phase time projection chamber (TPC) with a liquid xenon target of 3.5 tons. With the data taken during the first science run of 34.2 live days the experiment could impose the most stringent upper limit on spin-independent WIMP-nucleon cross-sections with $7.7 \cdot 10^{(-47)}\,\text{cm}^2$ at a mass of 35 GeV. This unprecedented sensitivity is further exploited in the second science run for which about 7 times more data has been acquired during the course of last year. After an overview on the XENON1T experiment the talk will present the latest WIMP search results and the prospects of the detector upgrade XENONnT.

Gruppenbericht T 77.2 Do 16:50 Philo-HS5

The MAgnetized Disk and Mirror Axion dark matter eXperiment (MADMAX) — •Stefan Knirck for the MADMAX-Collaboration — Max-Planck-Institute for Physics, Munich, Germany

In contrast to WIMPs, light Dark Matter candidates have increasingly come under the focus of scientific interest. In particular the QCD axion is very well motivated, since it was originally introduced to solve another fundamental problem: CP-conservation in strong interactions. Galactic axions and axion-like particles in a strong magnetic field can be converted to photons at boundaries between materials of different dielectric constants. Combining many such surfaces, one can enhance this conversion significantly using constructive interference and resonances. The proposed MADMAX setup containing approximately 80 high dielectric disks in a 10 T magnetic field would probe the well-motivated mass range of 40–400 μeV, a range which is at present inaccessible by existing cavity searches. We explain the foundations of this approach and give an overview over the R&D challanges the newly founded collaboration is facing, concluding with sensitivity estimates for the planned setup.

Gruppenbericht T 77.3 Do 17:10 Philo-HS5

Testing the dark matter hypothesis for the Fermi GeV-excess versus alternative explanations (molecular clouds, millisecond pulsars) — •Leo Bosse, Wim de Boer, Iris Gebauer, Alexander Neumann, and Peter L. Biermann — Dept. of Phys., KIT, Karlsruhe, Germany

The so-called "GeV-excess" of the diffuse Galactic gamma-ray emission, is studied with a spectral template fit based on energy spectra for each relevant process of gamma-ray emission, which allows to determine simultaneously the standard background processes and possible

new signals in each sky direction. The excess can be explained by the contribution of a new source with a spectrum peaking at 2 GeV. Three sources have been proposed in the literature: a dark matter annihilation signal (DM), a signal from milli-second pulsars (MSP) and a signal from molecular clouds (MC). All three sources have spectra peaking at 2 GeV, but slightly different spectral shapes and will be compared with the data. All hypotheses provide acceptable fits, if one considers a limited field-of-view around the Galactic center. However, if one considers the whole gamma-ray sky and includes gamma-ray spectra up to 500 GeV we find that the MC hypothesis is strongly preferred over the other hypotheses for several reasons: i) The MC hypothesis provides significantly better fits; ii) The morphology of the "GeV-excess" follows the morphology of the CO-maps, a tracer of MCs; iii) The massive central molecular zone shows the excess in its rectangular field-of-view which contradicts the spherical morphology expected for the other hypotheses.

T 77.4 Do 17:30 Philo-HS5

Search for Light Dark Matter with the MESA Accelerator — •Luca Doria — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Mainz (Germany)

At the Institute for Nuclear Physics of the Johannes Gutenberg University in Mainz, the construction of the new MESA facility has started. At its core there is a new superconducting energy-recovery linac which will provide intense electron beams for precision experiments in subnuclear physics. An important part of the MESA physics program consists in the search for a "dark sector" which is a candidate explanation for the long-standing dark matter puzzle. This talk will highlight the MESA dark sector program and in particular it will focus on the unique opportunity to install a beam-dump experiment for detecting dark matter particles in the MeV mass range. The experiment is in its design phase and the current status and future prospects will be presented.

T 77.5 Do 17:45 Philo-HS5

First results and status of the DEAP-3600 dark matter experiment — •Tina Pollmann[1] and Deap Collaboration[2] — [1]Technische Universität München — [2]SNOLAB, Sudbury, Kanada

DEAP-3600 is a single-phase liquid-argon Dark Matter direct detection experiment located 2 km underground at SNOLAB, in Sudbury, Canada. With a 1 tonne fiducial mass, the target sensitivity to spin-independent scattering of 100 GeV weakly interacting massive particles (WIMPs) is 10^{-46} cm^2. The detector was designed and built to reach a background level of less than 0.6 events in 3 tonne-years exposure. This included designing all parts of the detector to prevent or veto backgrounds, radio-purity screening for all detector materials, working with suppliers to source radio-pure materials, and using construction techniques that limit contaminations with radio-isotopes. The largest remaining background - beta decays from Ar-39 - is mitigated offline through pulse shape analysis. DEAP-3600 has been taking physics data since late 2016. This paper presents first results and the status of the experiment.

T 77.6 Do 18:00 Philo-HS5

Towards the next generation of Dark Matter searches: the h(bb) + E_T^{miss} signature in the 2HDM + pseudoscalar simplified model — •Lars Henkelmann and Oleg Brandt — Kirchhoff Institut für Physik, Heidelberg

A wide range of cosmological and astrophysical observations indicate the existence of Dark Matter. Yet, its particle properties are unknown. Constraining the particle properties of Dark Matter using collider experiments requires accurate and realistic model predictions. Such predictions cannot be obtained with Effective Field Theories because the mediators can be resolved at LHC energies for a large class of underlying theories.

The Two-Higgs-Doublet-Model with an additional pseudoscalar represents a simplified and ultraviolet-complete model for dark matter which provides a wide spectrum of experimental signatures with detectable cross-sections at the LHC. The sensitivity of the ATLAS experiment using the signature with a 125 GeV Higgs boson decaying to two b quarks and missing transverse momentum from dark matter particles is discussed in the context of this model. The exclusion potential is discussed using simplified detector-level limits. In addition, exact exclusion limits are provided based on the full analysis using 36.1 fb^{-1} of data.

T 77.7 Do 18:15 Philo-HS5

Improvement of Dark Matter searches with the ATLAS detector using dijet production to constrain systematic uncertainties — •Sebastian Mario Weber — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

The composition and origin of Dark Matter (DM) remains one of the most important questions of modern physics and could be an avenue to phenomena beyond the Standard Model. A typical signature for direct DM production at hadron colliders is large missing transverse energy (E_T) in association with one or more energetic jets.

An irreducible background to this signature is the decay of the Z boson to neutrinos ($Z \to \nu\nu + jets$). For searches, a very precise control of this background in the signal region is necessary. This is typically achieved using a control region enriched with $Z \to l^+l^- + jets$ production. The main limitation of this approach is the small cross section of $Z \to l^+l^- + jets$ at large missing (E_T), resulting in statistical fluctuations that dominate the total uncertainty.

This talk proposes an improvement of DM searches with a new CR based on dijet production in the context of a cross section ratio measurement. The main advantage of this CR are small statistical uncertainties due to a higher cross section up to large missing E_T. The focus of this talk is the constraining power of the new CR with respect to experimental jet systematics, as well as theoretical scale variations and uncertainties of the parton density functions.

T 77.8 Do 18:30 Philo-HS5

Hunting the Dark Higgs at CMS — •Samuel Baxter[1,2], Alexander Grohsjean[1], Christian Schwanenberger[1], and Oliver Buchmüller[2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Imperial College London, London, England

The dark Higgs model is an extension of the Standard Model (SM) that describes the phenomenology of dark matter while respecting the SM gauge symmetries.
Besides adding a fermionic dark matter candidate to the SM, it introduces a new vector boson (Z') along with a new scalar, the dark Higgs particle.
This new approach provides several advantages over other so-called simplified models of dark matter which will be discussed in this talk.
Moreover, a first search using 36fb^{-1} of proton-proton data recorded in 2016 by the CMS experiment, which is part of the LHC at CERN, will be presented.

T 77.9 Do 18:45 Philo-HS5

Neutrino-Dunkle Materie Interaktionen — •Tobias Pick, Gudrid Moortgat-Pick und Daniel Dercks — II. Institut für Theoretische Physik, Universität Hamburg

In dieser Bachelorarbeit wird die Interaktion von Neutrinos mit Dunkler Materie untersucht. Bei den hier angenommenen DM Kandidaten handelt es sich um Neutralinos, die supersymmetrischen Partner der elektrisch und farbneutralen Eich- und Higgsbosonen. Dabei werden verschiedene vom LHC erlaubte Parameter-Bereiche gescannt und die zugehörigen Wirkungsquerschnitte berechnet. Insbesondere wird untersucht, in wie fern die Wirkungsquerschnitte dieser Prozesse von der Temperatur abhängen.

T 78: Kosmische Strahlung IV

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS6

T 78.1 Do 16:30 Philo-HS6

Correlation analysis between arrival directions of ultra-high energy cosmic rays and positions of starburst galaxies — •Marcus Wirtz, Tersa Bister, Martin Erdmann, and Martin Urban — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

A strong correlation between the arrival directions of ultra-high energy cosmic rays above 39 EeV and the positions and fluxes of nearby

starburst galaxies has been discovered recently. By performing a likelihood analysis with symmetric search radius around the galaxy positions, an isotropic arrival hypothesis can be excluded at the 4.0σ confidence level. We extend this model by introducing an individual charge-sensitive cosmic ray weight in the likelihood, and therefore account for our current understanding of cosmic ray deflection in the galactic magnetic field.

T 78.2 Do 16:45 Philo-HS6

The Cosmic-Ray Shadow of the Moon and Sun: Seven Years of Data from the IceCube Neutrino Observatory and Particle Propagation within the Solar Magnetic Field — •Frederik Tenholt, Julia Tjus, and Fabian Bos for the IceCube-Collaboration — Ruhr-Universität Bochum

The shadowing effect of the Moon and Sun in high-energy cosmic rays has been measured with high statistical significance by several experiments. Unlike particles from the direction of the Moon, charged particles passing the Sun are deflected due to the solar magnetic field. Because of this deflection, a change in the shape and depth of the cosmic-ray Sun shadow measured at Earth is expected.

While the Moon shadow is used to estimate the angular resolution and to verify the stability of the IceCube detector, we use the Sun shadow in order to investigate a possible correlation between solar shadowing and solar activity, which is, in turn, a measure for the strength of the near magnetic field of the Sun. Ultimately, we aim to simulate both the Moon and Sun shadow in order to verify the data results and to quantitatively investigate particle deflection due to the solar magnetic field.

In this talk, we present results from seven years of data from the IceCube Neutrino Observatory and first conclusions about the temporal variation of the cosmic-ray shadow of the Sun.

T 78.3 Do 17:00 Philo-HS6

Untersuchung der Abschattung kosmischer Strahlung durch die Sonne mithilfe von Teilchenpropagation im sonnennahen Magnetfeld — •Niklas Döpper[1], Mike Kroll[1], Julia Becker Tjus[1], Horst Fichtner[1], Frederik Tenholt[1] und Paolo Desiati[2] — [1]Ruhr-Universität Bochum — [2]Wisconsin IceCube Particle Astrophysics Center, Madison, USA

Kosmische Strahlung ist eine hochenergetische Teilchenstrahlung, deren Quellen in der Milchstraße sowie in anderen Galaxien liegen, und die zum größten Teil aus Protonen besteht. Da elektrisch geladene Teilchen wie Protonen von dem Magnetfeld der Sonne abgelenkt werden, lassen sich über ihre Ablenkung Rückschlüsse auf die Stärke und Struktur des Sonnenmagnetfeldes ziehen. In diesem Vortrag geht es um die Simulation der Trajektorien von Protonen im sonnennahen Magnetfeld. Von Interesse ist dabei die Form des sogenannten Sonnenschattens, der durch die Abschirmung der kosmischen Strahlung durch die Sonne auf der Erde entsteht und von Experimenten wie Tibet, HAWC und IceCube im GeV - PeV Bereich gemessen werden kann. Die Ergebnisse der Simulation werden bezüglich zweier Verfahren zur Lösung der Bewegungsgleichungen verglichen: Dem klassischen Runge-Kutta-Verfahren sowie dem sogenannten Boris-Push, einem von J.P. Boris entwickelten Verfahren. Perspektivisch ermöglicht ein Vergleich des simulierten Sonnenschattens mit experimentellen Daten eine Untersuchung verschiedener Modelle zur Beschreibung des sonnennahen Magnetfeldes.

T 78.4 Do 17:15 Philo-HS6

Investigation of cosmic ray deflections in cosmic magnetic fields for the source hypothesis of starburst galaxies — •Paula Bigalke, Teresa Bister, Martin Erdmann, Martin Urban, and Marcus Wirtz — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

Magnetic field deflections of cosmic rays provide rigidity dependent patterns which can be exploited in anisotropy studies on small and intermediate scales. The galactic magnetic field leads to coherent displacements in the arrival directions and small scale turbulent components in extragalactic and galactic regions induce a symmetric scatter around the source directions.

Recently, an indication for anisotropy in the arrival directions of UHECRs correlating with the flux patterns of the Starburst Galaxy source catalogue was found. In order to further study this Starburst Galaxy scenario we investigate several observables sensitive to patterns originating from deflections in cosmic magnetic fields.

T 78.5 Do 17:30 Philo-HS6

Cosmic ray production in superwinds generated by starbursts — •Ana Laura Müller[1,2,4], Gustavo Esteban Romero[1,3], and Markus Roth[2] — [1]Instituto Argentino de Radioastronomía (CCT-La Plata, CONICET; CICPBA), Villa Elisa, Argentina — [2]Institut für Kernphysik (Karlsruher Institut für Technologie), Karlsruhe, Deutschland — [3]Facultad de Ciencias Astronómicas y Geofísicas (Universidad Nacional de La Plata), La Plata, Argentina — [4]Instituto de Tecnologías en Detección y Astropartículas (CNEA, CONICET, UNSAM), Buenos Aires, Argentina

Starburst galaxies have an exceptionally high rate of star formation. Stellar winds of massive stars and supernova explosions produce a high-temperature cavity in the nuclear region of these objects. This very hot gas expands adiabatically and escapes from the galaxy creating a superwind which sweeps matter from the galactic disk. The collision of the superwind with the halo and swept-up material generates shock waves and turbulent conditions where cosmic rays might be accelerated up to high energies. We present our results for the acceleration rate, particle distributions, and non-thermal emission resulting from this astrophysical scenario in the case of nearby galaxy NGC 253. We conclude that NGC 253 and galaxies with similar starbursts can only accelerate heavy nuclei up to $\sim 10^{18}$ eV unless some very special conditions occur. Further research is necessary to assess quantitatively this latter possibility.

T 78.6 Do 17:45 Philo-HS6

Tidally disrupted stars as a possible origin of both cosmic rays and neutrinos at the highest energies — •Daniel Biehl[1], Denise Boncioli[1], Cecilia Lunardini[2], and Walter Winter[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Platanenallee 6, D-15738 Zeuthen, Germany — [2]Department of Physics, Arizona State University, 450 E. Tyler Mall, Tempe, AZ 85287-1504 USA

Tidal Disruption Events (TDEs) are processes where stars are torn apart by the strong gravitational force near to a massive or supermassive black hole. If a jet is launched in such a process, particle acceleration may take place in internal shocks. We demonstrate that jetted TDEs can simultaneously describe the observed neutrino and cosmic ray fluxes at the highest energies if stars with heavier compositions, such as carbon-oxygen white dwarfs, are tidally disrupted and these events are sufficiently abundant. We simulate the photo-hadronic interactions both in the TDE jet and in the propagation through the extragalactic space and we show that the simultaneous description of Ultra-High Energy Cosmic Ray (UHECR) and PeV neutrino data implies that a nuclear cascade in the jet develops by photo-hadronic interactions.

T 78.7 Do 18:00 Philo-HS6

Influence of the source evolution on the energy spectrum, chemical composition and anisotropy of ultra-high-energy cosmic rays* — •David Wittkowski and Karl-Heinz Kampert — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

In the context of ultra-high-energy cosmic rays (UHECR, cosmic charged particles with energies $E > 1$ EeV), most of the main questions are still unanswered. This includes the important question about the sources of UHECR. A reason for this lack of knowledge is that on the way from their sources to Earth UHECR interact with the photon background and are deflected in cosmic magnetic fields, which obscures the origin of UHECR measued at Earth. To examine these questions, we carried out realistic simulations of the UHECR' propagation to Earth, taking into account all relevant effects on the propagation, and compared the results with experimental data measured at Earth. In this talk, we present a novel astrophysical scenario that – in contrast to previous approaches – correctly reproduces the measured energy spectrum, chemical composition and anisotropy of UHECR. Furthermore, we address how these observables depend on the cosmological evolution of the UHECR' sources and discuss conclusions that can be drawn about the sources.

**Gefördert durch die BMBF Verbundforschung Astroteilchenphysik (Vorhaben 05A17PX1)*

T 78.8 Do 18:15 Philo-HS6

Die Leistung der ultrahochenergetischen kosmischen Strahlung von Radiogalaxien im Vergleich — •Karolin Hymon, Julia Tjus und Björn Eichmann — Ruhr Astroparticle and Plasmaphysics Center, Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany

Der Ursprung der ultrahochenergetischen kosmischen Strahlung (UHECR) ist noch immer eines der großen Rätsel der Astrophysik. Eine der meistdiskutierten möglichen Quellen dieser höchst-energetischen Teilchen (mit E > 5EeV) sind Aktive Galaktische Kerne (AGN). AGN bilden ein- bzw. zweiseitige Plasma-Jets,die Strahlung im Radiowellenbis Gammabereich emittieren. Dazu muss kosmische Strahlung in diesen Objekten beschleunigt werden, vermutlich sogar bis zu Energien von einigen EeV. Die Jetleistung kann über die Radioleuchtkraft oder die Masse des zentralen super-massiven schwarzen Lochs abgeschätzt werden.

In dem Vortrag sollen die verschiedenen Korrelationen, welche sich hieraus für die Jetleistung ergeben, verglichen und diskutiert werden. Darüber hinaus wird der Anteil der kosmischen Strahlung an der gesamten Leistung des Jets abgeschätzt und die maximale Energie der individuellen radiolauten AGN bestimmt. Solche physikalischen Charakterisierungen der möglichen Quelle der UHECR stellen eine notwendige Grundvoraussetzung für weitere Analysen dar.

T 78.9 Do 18:30 Philo-HS6

Cosmic rays from the Galactic termination shock — •Lukas Merten[1,2], Chad Bustard[3], Ellen Zweibel[3,4], and Julia Becker Tjus[1,2] — [1]Ruhr-Universität Bochum, Theoretische Physik IV, Bochum, Germany — [2]Ruhr Astroparticle and Plasmaphysics Center — [3]Physics Department, University of Wisconsin-Madison, Madison, WI 53706 — [4]Department of Astronomy, University of Wisconsin-Madison, Madison, WI 53706

Although several theories for the origin of cosmic rays in the region between the spectral "knee" and "ankle" exist, this problem is still unsolved. A variety of observations suggest that the transition from Galactic to extragalactic sources occurs in this energy range.

In this work we examine if a Galactic wind outflow which eventually forms a termination shock far outside the Galactic plane can contribute as a possible source to the observed flux in the region of interest. In previous work by Bustard et al. was shown that particles can be accelerated up to energies above the "knee" up to $R_{\max} = 10^{16}$ V. The remaining questions is if the accelerated cosmic rays can propagate back into the Galaxy.

To answer this crucial question, we simulated the propagation of the cosmic rays using the CRPropa framework. The setup included all relevant processes, like three-dimensional anisotropic spatial diffusion, advection and corresponding adiabatic cooling. We find that, assuming realistic parameters for the shock evolution, a possible Galactic termination shock can contribute significantly to the energy budget in the knee region and above.

T 78.10 Do 18:45 Philo-HS6

An empirical modification of the force field approach to describe the modulation of galactic cosmic rays close to Earth in a broad range of rigidities — Jan Gieseler, •Bernd Heber, and Konstantin Herbst — IEAP, University of Kiel, Germany

On their way through the heliosphere, Galactic Cosmic Rays (GCRs) are modulated by various effects before they can be detected at Earth. This process can be described by the Parker equation, which calculates the phase space distribution of GCRs depending on the main modulation processes: convection, drifts, diffusion and adiabatic energy changes. A first order approximation of this equation is the force field approach, reducing it to a one-parameter dependency, the solar modulation potential ϕ. Utilizing this approach, it is possible to reconstruct ϕ from ground based and spacecraft measurements. However, it has been shown previously that ϕ depends not only on the Local Interstellar Spectra (LIS) but also on the energy range of interest. We have investigated this energy dependence further, using published proton intensity spectra obtained by PAMELA as well as heavier nuclei measurements from IMP-8 and ACE/CRIS. Our results show severe limitations at lower energies including a strong dependence on the solar magnetic epoch. Based on these findings, we will outline a new tool to describe GCR proton spectra in the energy range from a few hundred MeV to tens of GeV over the last solar cycles.

T 79: Gammaastronomie III

Zeit: Donnerstag 16:30–18:35 Raum: Philo-HS7

Gruppenbericht T 79.1 Do 16:30 Philo-HS7

Recent Highlights of the MAGIC Telescopes — •Martin Will for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München

MAGIC is a system of two 17m Imaging Air Cherenkov Telescopes, located at the Observatorio Roque de los Muchachos on the Canary Island of La Palma. MAGIC measures gamma rays in the very high energy regime between around 50 GeV and 50 TeV. In this presentation, highlights from Galactic and extragalactic observations and transient follow up programs are presented, as well as the performance and recent technical upgrades of the telescopes.

T 79.2 Do 16:50 Philo-HS7

FACT - Probing the Periodicity of Active Galactic Nuclei — •Thomas Bretz for the FACT-Collaboration — RWTH Aachen, Germany

Periodic signals from Active Galactic Nuclei could arise from Keplerian motion in binary black hole systems, accretion flow instabilities, jet motion or other reasons. With the HEGRA telescope system, a hint for a periodic modulation of 23-days was seen for Mrk 501 at TeV energies in coincidence with a hint for modulation in X-rays. Recently, a quasi-periodic modulation of PG1553+113 of about 2 years was observed with Fermi at GeV energies supported by consistent data points from MAGIC at TeV energies. Since most models for periodic modulations of TeV emission predict time scales in the order of weeks, only unbiased and continuous long-term monitoring can lead to conclusive results. With its dedicated observation strategy for monitoring the brightest blazars, the First G-APD Cherenkov Telescope (FACT) is ideally suited for such a study. This talk presents the result of a periodicity analysis on five years of data taken on Mrk 501 and Mrk 421 analysed with a Lomb-Scargle algorithm.

T 79.3 Do 17:05 Philo-HS7

Variability study of the Crab Pulsar above few tens of GeV with MAGIC — •Giovanni Ceribella for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München, Deutschland

The Crab Nebula shows flaring activity in the energy range around 100 MeV, but the origin of such large flux variations is still unknown. The flares could originate in the nebula itself or around the pulsar, the central engine of the source. The pulsar is known to be stable at the hundreds of MeV energy domain, but its temporal behaviour at few tens of GeV has never been probed. Due to the very low energy-threshold provided by the new Sum-Trigger-II, MAGIC is an ideal instument to perform a study of the stability of the pulsar, on timescales as short as days. If detected, this variability at VHE will constitute a remarkable new result, which could shed light on the mechanisms of the pulsar emission and pulsar/nebula interactions. We will present the first proof-of-concept results of the project, the plans for the next future, as well as the status of the MAGIC Sum-Trigger-II system.

The MAGIC Telescopes are two Imaging Atmospheric Cherenkov telescopes located on the Canary island of La Palma, at 2200 m a.s.l.. The Sum-Trigger-II is a new system designed to detect the lowest energy air showers, extending the sensitivity of MAGIC down to 30 GeV and even below.

T 79.4 Do 17:20 Philo-HS7

Studying TeV Blazars with HAWC and FACT — •Michael Blank[1], Daniela Dorner[1], Jose Andres Garcia[2], Magdalena Gonzalez[2], and Robert Lauer[3] for the FACT-Collaboration — [1]Universität Würzburg, Germany — [2]UNAM, Mexico — [3]UNM, USA

Blazars are highly variable objects on time scales from minutes to years. To study typical variability time scales from few hours to one day, continuous monitoring is crucial. To cover up to 12 hours of observations, data from the TeV monitoring instruments HAWC and FACT are combined. While the imaging air Cherenkov telescope FACT features a better sensitivity, HAWC provides a more continuous time coverage, as it is independent of weather and sun using the water Cherenkov technique.

Being the two brightest blazars in TeV energies, Mrk 421 and Mrk

501 are ideal targets for a combined variability study. Taking into account three years of data, we investigate the flux and spectral variability. The light curves of the two instruments have been compared and agree very well. Outliers found in the nightly flux correlation of the two instruments can be attributed to intra-night variability. Apparent flux changes within 12 hours can also be explained by changes of the spectral shape given the different energy ranges. Therefore, we study the spectral behaviour especially for flaring episodes. To determine time periods with constant flux, bayesian blocks are used. For a time range with constant flux, we determine the spectra for both instruments.

The presentation will show the results of the analysis of the combined data sample from HAWC and FACT.

T 79.5 Do 17:35 Philo-HS7

The First Catalog of Fermi-LAT sources below 100 MeV — •Giacomo Principe, Dmitry Malyshev, and Stefan Funk — ECAP, Erlangen Nurenberg University, Germany

Previous analyses of point sources in the gamma-ray range were done only below 30 MeV (COMPTEL) or above 100 MeV (Fermi-Large Area Telescope). Below 30 MeV, the imaging Compton telescope (COMPTEL) detected 26 steady sources in the energy range from 0.75 to 30 MeV. At high energy, the LAT detects more than three thousand sources between 100 MeV and 300 GeV (3FGL). Since the Fermi-LAT detects gamma rays down to 20 MeV, we create a list of sources detected in the energy range between 30 MeV and 100 MeV, using PGWave, a background independent tool that makes use of a wavelet-based method. This closes a gap of point source analysis between the COMPTEL catalog and the previous Fermi-LAT catalogs. We present the Fermi-LAT low energy catalog (1FLE) of sources detected in the 30 MeV - 100 MeV range, based on 8 years and 9 months of Fermi-LAT data.

T 79.6 Do 17:50 Philo-HS7

Pair cascades in active galactic nuclei — •Christoph Wendel and Karl Mannheim — Fakultät für Physik und Astronomie, Universität Würzburg, Germany

External radiation fields due to recombination radiation from photoionized gas clouds or thermal emission from accretion flows lead to energy losses of relativistic particles in active galactic nuclei. Near the central black hole, particle acceleration by impulsive injection from flares or magnetospheric vacuum gaps or photons from photo-pion decay can induce pair cascades driven by inverse-Compton energy losses of primary or secondary electrons and positrons. Here, we discuss the kinetic equations and their numerical solution describing the emerging radiation from such pair cascades in the context of recent high-energy observations.

T 79.7 Do 18:05 Philo-HS7

Spectral and Temporal Behaviour of Mrk 501 in Gamma Rays — •Daniela Dorner[1], Michael Blank[1], Nachiketa Chakraborty[2], and Carlo Romoli[3] for the FACT-Collaboration — [1]Universität Würzburg, Germany — [2]MPIK Heidelberg, Germany — [3]DIAS, Dublin, Ireland

The blazar Mrk 501 is a well-known BL-Lac type object emitting some of the highest energy photons emanating from an extragalactic source. It is highly variable down to timescales of a few minutes at TeV energies. This makes it an excellent laboratory for studying particle acceleration and radiative emission processes in jets through the spectral and temporal properties of the observed emission.

Since 2012, the First G-APD Cherenkov Telescope (FACT) is continuously monitoring Mrk 501 providing a total of more than 2000 hours of physics data. In June 2014, FACT recorded enhanced activity with an exceptional outburst at TeV energies on June 23rd. Several alerts were sent to the community. Based on this, also H.E.S.S. has observed the high state of Mrk 501 comparable to its historical maximum of 1997. At GeV energies, the Fermi satellite is monitoring the sky.

Here, we present the complex temporal and spectral behaviour of Mrk 501 in gamma-ray energies. We compute the gamma-ray power spectral density as well as the energy spectrum for the highest TeV flux state observed by H.E.S.S. and FACT in June 2014. We compare the behaviour of the strong activity in June with the long-term behaviour in the whole 2014 season. Furthermore, we study the spectral index in correlation with the different fluxes states.

T 79.8 Do 18:20 Philo-HS7

Search for TeV Radio Galaxies Using High-Resolution Radio Images — •Kevin Schmidt, Lena Linhoff, and Simone Mender — TU Dortmund, Lehrstuhl für Experimentelle Physik Vb, Otto-Hahn-Straße 4a, 44227 Dortmund

Active galactic nuclei (AGN) belong to the most powerful sources in the universe. They dominate the gamma-ray sky and are regularly observed by imaging cherenkov telescopes. In the past years a new class of very-high-energy emitters was found, the TeV radio galaxies. These sources show big differences to existing models, therefore they are interesting objects for studies.

With the help of morphological radio analysis promising sources can be extracted from a sample of candidates. This can be achieved by obtaining important characteristics from high-resolution images made by radio interferometers. Finding more TeV radio galaxies is necessary to learn about the properties of this type of AGN and its emission processes. In this talk first results of the ongoing analysis of high-resolution radio images of some TeV radio galaxy candidates will be presented.

T 80: Neutrinophysik VIII

Zeit: Donnerstag 16:30–18:35 Raum: Z6 - HS 0.001

Gruppenbericht T 80.1 Do 16:30 Z6 - HS 0.001

KM3NeT/ORCA: status and perspective — •Jannik Hofestädt for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

ORCA is the low-energy part of KM3NeT, the next-generation underwater Cherenkov neutrino detector under construction in the Mediterranean Sea. ORCA's primary goal is to resolve the long-standing question of the neutrino mass hierarchy by measuring matter-induced modulations on the oscillation probabilities of few-GeV atmospheric neutrinos. ORCA features a dense configuration of optical modules, optimised for the study of interactions of neutrinos with energies down to a few GeV. The same technology, albeit in a sparser configuration, is also used for high-energy (TeV-PeV) neutrino astronomy with the ARCA neutrino telescope, the other part of KM3NeT. The first ORCA detection unit was successfully deployed on 22.9.2017 and is providing high-quality data since then.

In this talk, the status of the ORCA detector construction and the performance of the first detector modules in the deep sea will be reported. The expected sensitivity of ORCA to the neutrino mass hierarchy and oscillation parameters are discussed.

T 80.2 Do 16:50 Z6 - HS 0.001

Tau-neutrino appearance with KM3NeT/ORCA — •Steffen Hallmann for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

The deep-sea neutrino detector KM3NeT/ORCA – currently under construction in the Mediterranean Sea – is optimised to study oscillations of atmospheric neutrinos in the few GeV energy range. Within its instrumented volume of more than 7 Mm^3 of sea water, an unprecedented statistics of >3k neutrinos per year are detected which have oscillated from a purely ν_μ and ν_e initial flux into the ν_τ-channel along their passage through Earth. As the major contribution comes from $\nu_\mu \longrightarrow \nu_\tau$ conversion, the ν_τ flux can be determined as a statistical excess of shower-like event topologies.

The contribution will present the sensitivity of KM3NeT/ORCA to ν_τ-appearance. Recent improvements in the detector geometry, trigger and reconstruction algorithms with respect to the performance presented in the Letter of Intent for KM3NeT 2.0 are taken into account. KM3NeT/ORCA will confirm the exclusion of non-appearance within the first months of operation. In the longer run, a precise measurement of the ν_τ normalisation will allow to put stringent experimental constraints on the commonly presumed unitarity of the PMNS matrix describing 3-flavour neutrino mixing.

T 80.3 Do 17:05 Z6 - HS 0.001

Results from Measuring the Neutrino Mass Ordering with IceCube DeepCore — •Martin Leuermann, Martin Rongen,

Marius Wallraff, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, Otto-Blumenthal-Str., 52074 Aachen

The measurement of the Neutrino Mass Ordering (NMO), i.e. the ordering of the neutrino mass eigenstates, is one of the outstanding questions in Neutrino Physics which is in the focus of many experiments. One experimental strategy is to measure matter effects in the oscillation pattern of atmospheric neutrinos, while propagating through Earth, as proposed for PINGU as part of the IceCube-Gen2 Neutrino Observatory. With three years of data from the currently running IceCube Deepcore detector, we have explored this type of measurement, resembling the methods as proposed for PINGU. However, due to the higher energy threshold, the sensitivity is lower. In this talk, we present the results of this first measurement.

T 80.4 Do 17:20 Z6 - HS 0.001

Combining JUNO and PINGU to determine the neutrino mass hierarchy — •Jan Weldert, Thomas Ehrhardt, Sebastian Lorenz, Michael Wurm, and Sebastian Böser — Johannes Gutenberg-Universität Mainz

The neutrino mass hierarchy (NMH) - i.e., the order of the mass eigenstates ν_1, ν_2, ν_3 - is one of the fundamental open questions in neutrino physics. Both the Jiangmen Underground Neutrino Observatory (JUNO) and the Precision IceCube Next Generation Upgrade (PINGU) will carefully examine the oscillation behavior of neutrinos to determine the NMH. For this purpose, JUNO will measure the energy dependent flux of MeV reactor neutrinos, whereas PINGU specializes in the measurement of the energy and direction dependent flux of GeV atmospheric neutrinos. More precisely, JUNO searches for the NMH via tiny wiggles in the energy spectrum due to the reactor neutrino survival probability in vacuum. PINGU, on the other hand, looks for NMH-dependent oscillation signatures from terrestrial matter effects. The combination of these approaches and the excellent energy resolution of JUNO together with the high statistic of PINGU are expected to yield sensitivity beyond the purely statistical combination because of the different impacts of the mass difference $\Delta m^2_{31} = m^2_3 - m^2_1$ in the two experiments. This talk covers the current status of a combined analysis of JUNO and PINGU.

T 80.5 Do 17:35 Z6 - HS 0.001

Determining the neutrino mass with the Megaton Ice Cherenkov Array (MICA) — •Elisa Lohfink, Maike Jung, Thomas Ehrhardt, Lutz Köpke, and Sebastian Böser — Johannes Gutenberg-Universität Mainz, Mainz, Germany

The Megaton Ice Cherenkov Array (MICA) is an envisioned low-energy extension of the IceCube neutrino telescope. It aims at the detection of extragalactic supernovae at distances of up to 10 Mpc through a large effective volume and a sensor spacing optimized for MeV neutrinos. This results in a supernova detection rate at the order of one per year, as compared to the rate of galactic supernovae of one per century to which existing detectors are sensitive. In addition to the rich information on supernova- and astrophysics that could be obtained with such a detector we show the possibility to determine the neutrino mass using mass-dependent delays in the neutrino time-of-flight. For supernova neutrinos, this causes an energy- and distance-dependent shift of the arrival time spectrum. With the SN detection range of MICA of up to 10 Mpc, this effect will be significantly enhanced compared to galactic supernovae. Using only data from MICA, the biggest uncertainty stems from the exact explosion time and onset of the neutrino flux. External information on the explosion time, e.g. from future gravitational wave detectors, would therefore further improve the obtained mass limits especially for distant supernovae.

T 80.6 Do 17:50 Z6 - HS 0.001

Investigating the atmospheric neutrino to antineutrino ratio with IceCube DeepCore — •Lasse Halve, Marvin Beck, Martin Leuermann, Saskia Philippen, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

The IceCube Neutrino Observatory, located at the geographic South Pole, measures neutrinos and antineutrinos produced in cosmic-ray showers in the atmosphere. Neutrinos and antineutrinos cannot be distinguished on an event-to-event basis within IceCube. However, they show different distributions in the inelasticity parameter y for deep inelastic scattering. Based on a new reconstruction of y with machine-learning methods in the muon-neutrino channel, we present a first analysis dedicated to measure the energy-dependent $\nu/\bar{\nu}$ ratio above 100 GeV.

T 80.7 Do 18:05 Z6 - HS 0.001

Model Independent Measurement of the Atmospheric Muon Neutrino Energy Spectrum with 3 Years of IceCube Data — •Mathis Börner, Mirco Huennefeld, Tobias Hoinka, Thorben Menna, and Maximillian Meier for the IceCube-Collaboration — U Dortmund, Lehrstuhl für Experimentelle Physik 5b, Otto-Hahn-Straße 4a, 44227 Dortmund

The main array of the IceCube neutrino observatory is the largest running neutrino detector in the world and covers neutrino energies starting at a few hundred GeV and ending in the PeV region. This allowed to prove the existence of astrophysical neutrinos and now with increasing data to probe the detailed spectral shape of the different flux components. In this contribution a model independent unfolding of the muon neutrino spectrum between 125 GeV and 2.5 PeV is presented. This covers the transition between an atmospheric to an astrophysical dominated spectrum.

The analysis consists of a selection to obtain a sample of muon neutrino events and a subsequent unfolding. The event selection utilizes modern machine learning techniques to achieve maximal efficiency while preserving a signal purity over 99%. For the first time in IceCube, data from multiple years are used in a dedicated unfolding analysis. In conjunction with the efficient event selection this analysis provides the most precise model independent measurement of the muon neutrino flux in this energy region.

T 80.8 Do 18:20 Z6 - HS 0.001

Myonspurrekonstruktion bei SNO+ — •Johann Dittmer, Mikko Meyer und Kai Zuber — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

SNO+ ist ein Flüssigszintillator-Experiment, bestehend aus einer Acrylsphäre mit 12 m Durchmesser. Aufgebaut ist das Experiment in 2 km Tiefe in einer Mine bei Sudbury, Ontario, Kanada. Das Hauptziel ist die Suche nach dem neutrinolosen Doppel-Betazerfall ($0\nu\beta\beta$) bei ^{130}Te; es können aber auch solare, Geo-, Reaktor- und Supernova-Neutrinos vermessen werden. Nach einer anfänglichen Wasser-Phase wird der Detektor mit Flüssigszintillator sowie 0,3-0,5 % natürlichen Tellur gefüllt.

Der Vortrag behandelt die Spurrekonstruktion von kosmischen Myonen, die den Detektor erreichen und dort Untergrundprozesse induzieren. Mit Hilfe der Spurrekonstruktion können solche Prozesse selektiert werden.

T 81: Pixel-Detektoren III

Zeit: Donnerstag 16:30–18:45 Raum: Z6 - HS 0.002

T 81.1 Do 16:30 Z6 - HS 0.002

Characterization of main production modules of the Pixel Vertex Detector for Belle II — •Philipp Leitl[1], Felix Müller[1], Christian Koffmane[2], Philipp Wieduwilt[3], and Harrison Schreeck[3] — [1]Max Planck Institute for Physics, Munich, Germany — [2]Semiconductor Laboratory of the Max-Planck-Society, Munich, Germany — [3]Georg-August-University, Göttingen, Germany

For the upgrade of the Belle detector at the electron positron collider SuperKEKB in Tsukuba, Japan, the vertexing system is completed by a new pixel detector. This Pixel Vertex Detector (PXD) is based on the Depleted P-channel Field-Effect Transistor (DEPFET) technology.

The PXD consists in total of 40 monolithic silicon modules which are cylindrically arranged around the interaction point in two layers. After a development and optimization period of several years the main production of the final detector modules run in 2017. The assembled modules were tested and characterized before they were joined to so called ladders and mechanically mounted to the support structure.

The testing procedure as well as an overview of the results is pre-

sented.

T 81.2 Do 16:45 Z6 - HS 0.002

Testing of Belle II Pixel Detector Production Modules and Integration into the Belle II Detector — Jochen Dingfelder, Leonard Germic, Tomasz Hemperek, Hans Krüger, Barbara Leibrock, Florian Lütticke, Carlos Marinas, •Botho Paschen, and Norbert Wermes — Universität Bonn

In the fall of 2017 the phase 2 BEAST detector was installed in the central volume of the Belle II detector at the SuperKEKB e^+e^- collider in Japan. Part of BEAST are four final configuration modules of the Belle II PiXel Detector (PXD). The common commissioning of the outer Belle II subdetectors and the collider will start in the spring of 2018 and last for about half a year. The BEAST detector will demonstrate the performance of the silicon pixel and strip detector systems in Belle II and help gathering live information about particle beam and background structures of SuperKEKB. This talk will outline the integration procedures of the PXD into Belle II and highlight some of the results from the testing of the PXD production modules.

T 81.3 Do 17:00 Z6 - HS 0.002

Energiekalibrierung der DEPFET-Matrix auf Demonstrationsmodulen für den Belle II-Pixelvertexdetektor — Jochen Dingfelder, Leonard Germic, Tomasz Hemperek, Hans Krüger, •Barbara Leibrock, Florian Lütticke, Carlos Marinas, Botho Paschen und Norbert Wermes — Universität Bonn

Bis zum Jahr 2017 wurde der KEKB-Beschleuniger in Japan zu SuperKEKB aufgerüstet. SuperKEKB wird asymmetrische e+e-Kollisionen bei etwa 40-mal höherer Luminosität liefern. Um die höhere Ereignisrate ausnutzen zu können, wird derzeit ein Upgrade des Belle-Detektors zu Belle II durchgeführt. Als ein wichtiger Teil des Upgrades wird ein neuer zweilagiger, auf DEPFET-Technologie basierender Pixeldetektor als innerster Subdetektor hinzugefügt. Die Pixelmatrix besteht aus p-FETs mit einem zusätzlichen internen Gate in einem vollständig verarmten Siliziumbulk. Die deponierten Ladungen driften ins interne Gate und modulieren durch dessen kapazitive Kopplung zum p-Kanal den Transistorstrom. Die Transistorströme der Pixel werden mit Hilfe des Drain Current Digitizer Chips in digitale Signale umgewandelt. Diese werden im Data Handling Processor Chip weiterverarbeitet, in dem eine erste Datenreduktion vorgenommen wird. Um die zuverlässige Zusammenarbeit der Komponenten zu gewährleisten, werden sie zunächst mit Demonstrationsmodulen getestet, die ein funktional vollständiges Matrix- und Komponentensystem enthalten. In diesem Vortrag wird eine Energiekalibrierung mit finalen Demonstrationsmodulen, sowie die Abweichung der Verstärkungsfaktoren einzelner Matrixpixel und deren Auswirkungen auf die Energieauflösung vorgestellt.

T 81.4 Do 17:15 Z6 - HS 0.002

Teststrahlstudien an großen DEPFET Pixelsensoren für den Belle II Vertexdetektor — Jochen Dingfelder[1], •Florian Lütticke[1], Carlos Marinas[1], Botho Paschen[1], Benjamin Schwenker[2] und Norbert Wermes[1] — [1]Universität Bonn, Physikalisches Institut, Nussallee 12 — [2]Universität Göttingen, Fakultät für Physik, Friedrich-Hund-Platz 1

Der Super-KEKB Beschleuniger am KEK Forschungszentrum in Tsukuba, Japan wurde bis zum Jahr 2017 aufgerüstet, um zukünftig eine instantane Luminosität von 8×10^{35} cm^{-2}s^{-1} zu liefern, 40 mal mehr als der Vorgänger KEKB. Um die dadurch erzeugte höhere Datenrate ausnutzen zu können, wird der Belle Detektor zu Belle II aufgerüstet. Dabei werden die innersten beiden Lagen des neuen Vertexdetektors aus DEPFET Pixelsensoren bestehen, die näher an den Interaktionspunkt verschoben, um eine höhere Vertexauflösung zu erreichen. Ein DEPFET Pixel besteht aus einem MOSFET, dessen Source-Drain-Strom durch gesammelte Ladung moduliert wird und dadurch als erste Verstärkungsstufe dient. Dieser Strom wird im Drain-Current-Digitizer (DCDB) in digitale Werte gewandelt, die kontinuierlich ausgelesen werden und in dem Data-Handling-Processor (DHP) verarbeitet und über eine Hochgeschwindigkeitsverbindung an die Back-End-Elektronik gesendet werden.

In diesem Vortrag werden Effizienz- und Auflösungsstudien an großen Prototyp Modulen vorgestellt, die in einer Teststrahlkampagne gemessen wurden. Diese Resultate werden genutzt um die erwartete Performance Parameter von finalen Belle II Modulen abzuschätzen.

T 81.5 Do 17:30 Z6 - HS 0.002

Precision Measurements of Induced Radioactivity and Absolute Luminosity Determination with TPX Detectors in LHC Proton-Proton Collisions at 13 TeV — •Andre Sopczak[1], Babar Ali[1], Jakub Begera[1], Benedik Bergmann[1], Thomas Billoud[2], Petr Burian[1], Davide Caforio[1], Erik Heijne[1], Josef Janecek[1], Claude Leroy[2], Petr Manek[1], Yesid Mora[1], Stanislav Pospisil[1], Michal Suk[1], and Zdenek Svoboda[1] — [1]IEAP CTU in Prague — [2]Group of Particle Physics, University of Montreal

A network of Timepix (TPX) devices installed in the ATLAS cavern measures the LHC luminosity as a stand-alone system. The data were recorded from 13 TeV proton-proton collisions in 2016. Using two TPX devices, the number of hits created by particles passing the pixel matrices was counted. Absolute luminosity is determined with the van der Meer scan technique by separating the LHC proton beams and measuring the widths of the beams in low-intensity LHC proton-proton collisions. The exact determination of the activation background contributes to the overall precision of the TPX luminosity measurements. The activation background varies in time due to induced radioactivity at the different positions of the TPX devices in the ATLAS cavern. The activation at a given time depends on the history of the LHC operation. A detailed study of induced radioactivity has been performed to reduce the uncertainty on both the relative and absolute luminosity measurements.

T 81.6 Do 17:45 Z6 - HS 0.002

Determination of Luminosity with Thermal Neutron Counting using TPX Detectors in the ATLAS Cavern in LHC Proton-Proton Collisions at 13 TeV — •Andre Sopczak[1], Babar Ali[1], Jakub Begera[1], Benedikt Bergmann[1], Thomas Billoud[2], Bartolomej Biskup[1], Petr Burian[1], Davide Caforio[1], Erik Heijne[1], Josef Janecek[1], Claude Leroy[2], Petr Manek[1], Yesid Mora[1], Stanislav Pospisil[1], Thomas Seidler[1], Michal Suk[1], and Zdenek Svoboda[1] — [1]IEAP CTU in Prague — [2]Group of Particle Physics, University of Montreal

A network of Timepix (TPX) devices installed in the ATLAS cavern has the unique capability of measuring the luminosity with thermal neutron counting in LHC proton-proton collisions at 13 TeV. Compared to the hit-counting method, the method of thermal neutron counting has the advantage that it is not affected by induced radioactivity. The results of the luminosity determination are presented for several independently-operated TPX detectors. The long-term time-stability measurements of the luminosity are presented for individual devices and between different devices. The high-statistics data-sets allow a detailed comparison between neutron counting and hit-counting luminosity determinations.

T 81.7 Do 18:00 Z6 - HS 0.002

Monolithic pixel sensor development in a novel 180nm CMOS process for the ATLAS inner tracker upgrade — •Konstantinos Moustakas[1], Tianyang Wang[1], Tomasz Hemperek[1], Ivan Berdalovic[2], Thanushan Kugathasan[2], Cesar Augusto Marin Tobon[2], Walter Snoeys[2], and Norbert Wermes[1] — [1]Physikalisches Institut, Bonn University, Nussallee 12, Bonn, Germany — [2]CERN, Geneva, Switzerland

The high luminosity LHC upgrade sets unprecedented constraints in terms of radiation tolerance and particle hit rate. To comply with these challenging requirements, a new full scale depleted monolithic active pixel sensor chip with pixel pitch equal to 36x40μm^2, called TJ-Monopix, has been developed for the outer layers of the ATLAS inner tracking detector. While inheriting the advantages of monolithic implementations, it combines high analog performance with high radiation tolerance. The key to its realization is a novel modification of the TowerJazz 180nm CMOS process, that enables full depletion of the sensitive volume, yielding charge collection efficiency above 95% even after a dose of $10^{15} n_{eq}/cm^2$ (NIEL). Below 3fF sensor capacitance is made possible by employing a small size collection electrode. A compact, low power analog front end, optimized for fast timing and linearity is used. The simulated time walk is less than 25ns and the equivalent noise charge is lower than $15e^-$, while the analog power consumption is only 70mW/cm^2. Hit timing and analog ToT information is read out by a synchronous column-drain architecture. First measurement results are expected during the first quarter of 2018.

T 81.8 Do 18:15 Z6 - HS 0.002

LF-MONOPIX01: A fully monolithic depleted active pixel sensor in a 150nm CMOS process for the ATLAS HL-LHC upgrade — •Ivan Caicedo, Toko Hirono, Tomasz Hemperek, Piotr Rymaszewski, Tianyang Wang, Hans Krüger, Fabian Hüg-

GING, NORBERT WERMES, and JOCHEN DINGFELDER — Physikalisches Institut, Universität Bonn. Bonn, Germany.

The high-luminosity upgrade of the ATLAS experiment at the LHC requires improvements in terms of radiation hardness and production costs of its inner tracker: Instantaneous luminosity is expected to reach values around $7.5x10^{34}cm^{-2}s^{-1}$ and the area of the modules will be increased ~ 10 times. Moreover, NIEL and TID radiation damage levels of $10^{15}n_{eq}/cm^2$ and 80Mrad are expected in the outermost layer.

Monolithic CMOS active pixel sensors in depleted substrates (DMAPS) are part of the R&D program of ATLAS for its inner tracker upgrade. Manufacturing these sensors in a well-known HV/HR CMOS commercial process permits a high volume production at an affordable cost and enables fast charge collection by drift, which in turn improves the charge collection efficiency after irradiation.

This talk will focus on results of characterization studies of the LF-MONOPIX01 chip, a large fill-factor DMAPS prototype in a 150nm CMOS process with a column-drain read-out architecture. After an introduction to the sensor, we will present noise measurements, threshold distributions and gains for a set of different pixel architectures. Furthermore, we will discuss the leakage current, detection efficiency and charge collection before and after irradiation.

T 81.9 Do 18:30 Z6 - HS 0.002

Charakterisierung von monolitischen Pixelsensoren mittels X-Ray Fluoreszenz — •SASCHA DUNGS[1,2], KEVIN KRÖNINGER[1], SUSANNE KÜHN[2], HEINZ PERNEGGER[2], CHRISTIAN RIEGEL[2,3] und ENRICO JUNIOR SCHIOPPA[2] — [1]TU Dortmund, Lehrstuhl für Experimentelle Physik IV — [2]CERN — [3]Bergische Universität Wuppertal

Im Rahmen des Phase-2 Upgrades des ATLAS Detektors wird der bisherige Spurdetektor durch einen Siliziumspurdetektor, den sogenannten Inner Tracker (ITk) ersetzt. Eine Möglichkeit die Eigenschaften der dafür neu entwickelten Pixelsensoren zu untersuchen sind Fluoreszenzmessungen. Dabei wird eine X-Ray Quelle auf ein Targetmaterial gerichtet, was zu einer Emission von monochromatischer Strahlung führt. Durch die Verwendung von verschiedenen Targetmaterialien kann ein breites Energiespektrum abgedeckt werden. In diesem Votrag wird zunächst das am CERN installierte X-ray Floureszenzsetup vorgestellt. Desweiteren wird die Inbetriebnahme für Messungen mit bestrahlten Sensoren präsentiert. Anschließend werden Ergbenisse von Messungen mit undbestrahlten und bestrahlten depleted monolithic active pixel sensor (DMAPS) aus Silizium gezeigt.

T 82: Higgs IV

Zeit: Donnerstag 16:30–19:05 Raum: Z6 - HS 0.004

T 82.1 Do 16:30 Z6 - HS 0.004

Messung des Produktionswirkungsquerschnittes für Higgs-Bosonen in der Vektorbosonfusion im Zerfallskanal $H \to WW^{(\star)}$ mit dem ATLAS-Detektor — •MARC GEISEN, VOLKER BÜSCHER, FRANK FIEDLER, ADAM KALUZA, SOPHIO PATARAIA und CHRISTIAN SCHMITT — Johannes Gutenberg-Universität Mainz

Zu den wichtigsten Aufgaben des Physikprogramms am LHC gehört die präzise Vermessung aller Kopplungen des Higgs-Bosons an andere Teilchen. Zur Vermessung der Kopplung zwischen Higgs-Boson und schweren Vektorbosonen eignet sich hierbei die Untersuchung von Ereignissen, in denen das Higgs-Boson durch Fusion zweier Vektorbosonen erzeugt wird und in W-Bosonen zerfällt. Wenn leptonische W-Zerfälle betrachtet werden, zeichnet sich der Prozess durch ein gutes Verhältnis von Signal- zu Untergrundereignissen aus. Dies liegt einerseits an den beiden geladenen Leptonen aus den W-Zerfällen, andererseits an den zwei auftretenden Teilchenjets, die bei der Vektorbosonfusion entstehen.
In diesem Vortrag wird zum einen die ATLAS-Analyse zur Messung des Wirkungsquerschnitts auf Grundlage der Datennahme in 2015 und 2016 bei einer Schwerpunktsenergie von 13 TeV vorgestellt. Zum anderen wird der Stand der Analyse von Daten aus 2017 thematisiert, bei der es aufgrund der höheren instantanen Luminosität zu einer höheren Anzahl zusätzlicher Proton-Proton-Wechselwirkungen (Pileup) kommt. Diese Änderung der Untergrundbedingungen wirkt sich mitunter auf die Lepton- und Jetrekonstruktion aus, so dass Anpassungen der Analyse nötig sein können.

T 82.2 Do 16:45 Z6 - HS 0.004

Measurement of the $H \to WW^* \to \ell\nu\ell'\nu'$ process at $\sqrt{s} =$ 13 TeV with the ATLAS detector — •RALF GUGEL and KARSTEN KÖNEKE — Albert-Ludwigs-Universität Freiburg

The $H \to WW^* \to \ell\nu\ell'\nu'$ decay channel allowed for the most precise measurement of the Higgs-boson signal strength in analyses of data collected during the first data-taking period of the LHC. The production modes with the highest cross section, and the best experimental sensitivity in this decay channel are gluon fusion and vector-boson fusion. In this talk an overview will be given summarizing the latest results from the ATLAS Collaboration based on data collected at a center-of-mass energy of 13 TeV. Special emphasis will be placed on the final signal extraction techniques.

T 82.3 Do 17:00 Z6 - HS 0.004

Search for non-resonant Higgs boson pair production in the $b\bar{b}b\bar{b}$ final state with the CMS Experiment — MARTIN ERDMANN, •BENJAMIN FISCHER, DENNIS NOLL, and MARCEL RIEGER — III. Physikalisches Institut A, RWTH Aachen University

The non-resonant Higgs boson pair production provides direct access to the triple Higgs self coupling λ_{hhh} and the underlying Higgs potential. The four-b-quark final state ($b\bar{b}b\bar{b}$) is the largest decay channel with a branching ratio of 1/3.

The background primarily consists of QCD-processes which are challenging to model using Monte Carlo samples. As a solution Hemisphere Mixing is employed, a new data-driven event modeling method. The signal extraction uses a discriminator produced by modern Deep Learning techniques, which is optimized taking into account the method-inherent systematics.

T 82.4 Do 17:15 Z6 - HS 0.004

Messung des Wirkungsquerschnitts der assoziierten Produktion von Higgs-Bosonen mit einem W-Boson im Zerfallskanal $H \to WW \to \ell\nu\ell\nu$ mit dem ATLAS-Detektor — •NATALIE WIESEOTTE, VOLKER BÜSCHER, FRANK FIEDLER und CHRISTIAN SCHMITT — Johannes Gutenberg-Universität Mainz

Nach der Entdeckung des Higgs-Bosons am LHC-Beschleuniger konnten Masse und Spin als wesentliche Eigenschaften bereits bestimmt werden. Der nächste Schritt sind der Nachweis in allen Produktions- und Zerfallskanälen und die Präzisionsmessung der Kopplungen. Eine Messung von Kopplungen des Higgs-Bosons hat das Potential, Erweiterungen des Standardmodells zu testen.
Für die vorläufige Messung mit 5.8 fb^{-1} und einer Schwerpunktsenergie von 13 TeV am ATLAS-Experiment im Kanal WH→WWW→lvlvlv ergibt sich für die auf Schnitten basierte Analyse nur eine geringe Signifikanz. Die aktuelle Analyse verwendet multivariate Methoden, mit denen der Untergrund ohne signifikanten Signalverlust deutlich stärker unterdrückt und somit die Sensitivität erhöht werden kann. Weiterhin wird eine Selektion hinzugefügt, die sich auf Beiträge neuer Physik jenseits des Standardmodells bei hohem Transversalimpuls des Higgs-Bosons konzentriert. Der Vortrag stellt den aktuellen Stand der Analyse mit dem bis Ende 2016 bei 13 TeV aufgezeichneten Datensatz bei einer integrierten Luminosität von 36.1 fb^{-1} vor.

Gruppenbericht T 82.5 Do 17:30 Z6 - HS 0.004

$t\bar{t}H$ production in final states with hadronically decaying tau leptons — •DAVID HOHN, ANDREA SCIANDRA, MARKUS CRISTINZIANI, and NORBERT WERMES — Physikalisches Institut, Universität Bonn

Evidence for the production of the Standard Model (SM) Higgs boson in association with a top-quark pair was found by ATLAS with 36.1 fb^{-1} of 13 TeV pp collision data collected at the LHC in the years 2015–2016. This was achieved by analysing Higgs boson decays to $b\bar{b}$ and $\gamma\gamma$, as well as leptonic final states which proceed via $H \to WW$, $H \to \tau\tau$ and $H \to ZZ$. The latter Higgs decays are not distinguishable with the present sensitivity and are analysed jointly. The measured cross section of the $t\bar{t}H$ process is also a direct probing of the coupling between the Higgs boson and top-quark and is compatible with the SM prediction.

This talk will present the results of the analysis of final states that include hadronically decaying tau leptons. They are an important contribution to the precision of the total cross section measurement and sensitive to the Higgs–tau coupling.

T 82.6 Do 17:50 Z6 - HS 0.004

Studies for the measurement of Higgs boson production with an additional heavy flavor quark in the final state and $H \rightarrow \gamma\gamma$ at the ATLAS experiment — •Isabel Nitsche, Diane Cinca, Johannes Erdmann, and Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

The production of a Higgs boson with an additional heavy flavor quark in the final state ($H+HF$), with the main contribution coming from gluon-gluon fusion, is a dominant background in measurements of Higgs boson properties at the ATLAS experiment. An important example is the production of a top-antitop-quark pair in association with a Higgs boson with both top quarks decaying hadronically. As $H+HF$ has not been measured so far and other measurements of processes with additional HF quarks in the final state observed differences between theory predictions and data, a conservative uncertainty of 100% has previously been assigned to it. Hence, the measurement of $H+HF$ would provide a valuable input to these measurements.

A multivariate discriminant, which is designed to identify jets resulting from the decay of a B-hadron, is used to distinguish between events with additional light jets, c-jets and b-jets. In addition, the use of a neural network to discriminate the signal from the large contribution of non-resonant background is studied. A strategy for the measurement of $H+HF$ production using data corresponding to an integrated luminosity of 80 fb^{-1} is presented.

T 82.7 Do 18:05 Z6 - HS 0.004

Search for non-resonant di-Higgs production in the decay channel $bb\ell\nu\ell\nu$ with the CMS experiment. — Martin Erdmann, Benjamin Fischer, •Dennis Noll, and Marcel Rieger — III. Physikalisches Institut A, RWTH Aachen University

An investigation of the non-resonant di-Higgs production can directly determine the trilinear Higgs coupling which is directly related to the Higgs potential. A search for a Higgs Boson decaying into a pair of Higgs Bosons, with one decaying into b quarks and the other one decaying into W bosons with subsequent decays into leptons is presented.

The investigated channel with two leptons in the final state has a low branching ratio in di-Higgs events but as a main feature avoids QCD contribution. A data driven modelling of the Drell-Yan process using an MVA technique accounts for low statistics in the Monte-Carlo background regime. Additionally, a deep neural network discriminant utilizing information related to object kinematics is used to increase the signal sensitivity.

T 82.8 Do 18:20 Z6 - HS 0.004

Search for the production of the Higgs boson in association with a pair of top quarks in the four leptons final state at 13 TeV in ATLAS — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], Carlo A. Gottardo[1], Sebastian Heer[1], David Hohn[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and •Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

The top Yukawa coupling is predicted to be large by the Standard Model and can be directly accessed by measuring $t\bar{t}H$ production at LHC. Depending on the decay of the Higgs boson and the top-quark pair, several final states are possible. The four-lepton channel is statistically limited by the small branching fraction, but it has a high purity and is not strongly affected by non-prompt backgrounds, events that contain leptons which are not originating from the primary interaction vertex.

The analysis selects events with exactly four reconstructed leptons and multiple jets. The most dominant background is the production of $t\bar{t}Z$, whose four leptons have a kinematics very similar to that of leptons in signal events, and diboson, whose cross section is much larger. I will present the ATLAS analysis performed with 36 fb^{-1}, which has been recently realeased.

T 82.9 Do 18:35 Z6 - HS 0.004

Validierung des statistischen Modells zur Suche nach der Top-Quark-Antiquark-Paar Produktion in Assoziation mit dem Higgs-Boson am CMS-Experiment — Karim El Morabit, Ulrich Husemann, •Philip Keicher, Matthias Schröder und Michael Wassmer — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Die assoziierte Produktion des Higgs-Bosons bei der Top-Quark-Antiquark-Paar Produktion ermöglicht eine modellunabhängige Messung der Top-Higgs-Yukawa-Kopplung. Diese ist von großer Bedeutung für die theoretische Beschreibung des Standardmodells und daher von besonderem physikalischen Interesse. Im Rahmen der Suche nach diesem Prozess werden mit multivariaten Analysemethoden Diskriminatoren gebaut, die in ein statistisches Modell eingespeist werden.

Die Präsentation zeigt Studien zur Validierung eines solchen Modells, das zur Suche des Zerfalls des Higgs-Bosons in ein Bottom-Quark-Antiquark-Paar im semileptonischen Zerfallskanal des Top-Quark-Antiquark-Systems verwendet wird. Dabei werden insbesondere das Modell selbst sowie verschiedene Teststrategien, die Toy-Monte-Carlo-Experimente zu Hilfe nehmen, vorgestellt.

T 82.10 Do 18:50 Z6 - HS 0.004

Suche nach Produktion von Top-Quark-Antiquark-Paaren in Assoziation mit Higgs-Bosonen bei CMS. — Karim El-Morabit, Ulrich Husemann, Philip Keicher, Matthias Schröder und •Michael Wassmer — Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie

Es wird eine Suche nach Top-Quark-Antiquark-Paar-Produktion in Assoziation mit einem Higgs-Boson vorgestellt. Dieser Prozess ermöglicht eine modellunabhängige Messung der Top-Higgs-Yukawa-Kopplung, welche von großer Bedeutung für die theoretische Beschreibung des Standardmodells ist. Präsentiert wird eine multivariate Analyse im semileptonischen Zerfallskanal des Top-Quark-Antiquark-Systems und dem Zerfall des Higgs-Bosons in ein Bottom-Quark-Antiquark-Paar mit Daten des CMS-Experiments. Dabei werden die Analysestrategie, die wichtigsten Hintergrundprozesse und Systematiken, eine multivariate Klassifikation mit z.B. Boosted Decision Trees zur Trennung von Signal und Untergrund sowie aktuelle Ergebnisse vorgestellt.

T 83: Elektroschwache Wechselwirkung II

Zeit: Donnerstag 16:30–18:30 Raum: Z6 - SR 1.005

T 83.1 Do 16:30 Z6 - SR 1.005

The measurement of W-charge asymmetry at 13 TeV with the CMS detector — •Vladyslav Danilov[1], Mariarosaria D'Alfonso[2], Elisabetta Gallo[1], Volodymyr Myronenko[1], and Katarzyna Wichmann[1] — [1]DESY, Hamburg, Germany — [2]MIT, Cambridge, Massachusetts, USA

In pp collisions at the LHC, rates of $u\bar{d}$ annihilation dominate over $d\bar{u}$. Consequently, W^+-boson production prevails over W^-, which results in an effect called W-charge asymmetry, A.
The analysis is based on the data sample corresponding to an integrated luminosity of 2.3 fb^{-1} recorded by the CMS detector over the year 2015. The events with W bosons decaying via the muon channel are selected. The signal extraction and background determination are performed using template fits to missing E_T distributions. The differential cross sections are used to calculate the W asymmetry in bins of rapidity, $A(\eta)$.
The presented measurement is sensitive to u/d ratio and the sea quark content in the proton and is used in global QCD analysis to determine parton density function.

T 83.2 Do 16:45 Z6 - SR 1.005

Separating WW and ZZ events in their hadronic decays at the International Linear Collider — •Jakob Beyer[1,2], Michael Kobel[2], and Jenny List[1] — [1]DESY Hamburg — [2]Technische Universität Dresden

Electroweak precision measurements at an e^+e^- collider are the next step in testing the Standard Model - and complementary to the LHC. Such measurements can be provided at the future International Linear collider (ILC). Its polarized electron and positron beams, the precise

event reconstruction using state-of-the-art detectors as well as the excellent theoretical calculability present an ideal environment for this enterprise.

The baseline design of the ILC provides a center-of-mass energy of 250 GeV but extensions up to 1 TeV are possible. With such an extension additional important physics measurements, e.g. of the quartic gauge coupling, could be performed. At the ILC, these studies can include the dominant hadronic decay modes of the W and Z due to the low QCD background. Even VBS-like signatures like $e^+e^- \to \nu\nu WW/\nu\nu ZZ$ are then accessible in their hadronic final states, allowing for a significant increase in signal events. For such measurements the separability of the W and Z decays to two jets is important and constitutes a benchmark for the detectors.

A study of this separation power at International Large Detector is performed in the case of diboson $(WW/ZZ)+\nu\nu$ events at the $\sqrt{s} = 1$ TeV ILC.

T 83.3 Do 17:00 Z6 - SR 1.005

Search for lepton flavour violation in Z boson decays — •David Brunner, Jordy Degens, Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and Dominik Wolfschläger — Physics Institute III B, RWTH Aachen University

In interactions of charged leptons only processes conserving the lepton flavour are observed. Since there is no known symmetry requiring this, a model independent search for Z bosons decays violating lepton flavour conservation is done in final states with electrons, muons and tau-leptons.

For this purpose a cut based analysis strategy is choosen. Bayesian statistics are used to calculate exclusion limits on the braching ratios of Z decays violating lepton flavour conversation. This analysis is done with the CMS data of 2016 with a center of mass energy of $\sqrt{s} = 13$TeV and an integrated luminosity of $\mathcal{L} = 35.9\text{fb}^{-1}$.

T 83.4 Do 17:15 Z6 - SR 1.005

Measurement of the Scattering of Electroweak Gauge Bosons in the WZjj Final State with the ATLAS Detector at the LHC — •Carsten Bittrich, Tim Herrmann, Michael Kobel, Franziska Iltzsche, Joany Manjarres, and Stefanie Todt — IKTP, TU Dresden

The scattering of massive gauge bosons, measurable at the LHC in the final states with decay products of two massive gauge bosons and two additional jets, is an essential process for the studies of the mechanism of electroweak symmetry breaking (EWSB) and provides a mean to study the gauge structure of the Standard Model via the quartic gauge couplings. The channel of $WZ/\gamma \to WZ$ scattering provides a good compromise between reconstructability of the boson kinematics and expected number of events. This process is studied in the final state with three charged leptons, missing energy and two jets at a center of mass energy of 13 TeV using the 2015 and 2016 dataset of the ATLAS detector in Run 2 of the LHC. Machine learning techniques are used to extract signal-like events allowing for the first measurement of this process.

T 83.5 Do 17:30 Z6 - SR 1.005

Search for Anomalous Triple Gauge Couplings in the Semileptonic WW and WZ Decays Using the CMS Experiment — •Muhammad Ansar Iqbal, Matthias Mozer, Thomas Müller, and Ivan Shvetsov — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

One of the best ways to search for physics beyond the Standard Model (SM) is in the framework of the Effective Field Theory. The Large Hadron Collider (LHC) at CERN with 13 TeV center of mass energy in Run II has opened new doors for such novel searches. We work with the Compact Muon Solenoid (CMS) experiment of the LHC on an analysis which focuses on anomalous triple gauge couplings (aTGC) in the electroweak sector. The analysis deals with the WW/WZ final states in the semileptonic decay channel, where the hadronically decaying vector boson is reconstructed in the boosted regime.

In this talk we present the on-going analysis with the steps involved in order to model our backgrounds and extraction of signal. We discuss the statistical techniques important for the analysis and show various results and plots we have for 36 fb^{-1} of 2016 data. We also present the limits on aTGC parameters already obtained with a previous iteration of the analysis.

T 83.6 Do 17:45 Z6 - SR 1.005

Study of different unfolding methods of kinematic distributions of the WZ → WZ Scattering with Simulations of the ATLAS Detector at the LHC — •Tim Herrmann, Carsten Bittrich, Franziska Iltzsche, Michael Kobel, Joany Manjarres, and Stefanie Todt — TU Dresden, Germany

In this talk different unfolding methods will be compared in order to determine which is the best suited for the P-value resp. CLs calculation in statistical tests. The different unfolding methods are compared on the example of the Vector Boson Scattering in the channel WZ → WZ for fully leptonic final states. The WZ → WZ scattering from the Standard Model is sensitive to the presence of new physics. New physics can manifest as modified cross section and kinematics distributions. For this study two sensitive kinematic distributions are used, the transverse mass of the WZ system and the transverse momentum of the Z boson.

The study show that for comparisons between data and theory predictions detector effects need to be considered, to do so two alternatives are possible either the theory has to be folded or the data unfolded. In this study, no significant advantage of using the unfolding approach instead of the folding approach have been found for computer based statistical tests using P-values resp. CLs.

T 83.7 Do 18:00 Z6 - SR 1.005

Polarization and Electroweak Precision Measurements at the ILC for $\sqrt{s} = 250$ GeV — •Robert Karl[1,2] and Jenny List[1] — [1]DESY Hamburg — [2]University of Hamburg

The International Linear Collider (ILC) is a planned electron-positron collider with a first stage at a center-of-mass energy of 250 GeV. Thereby, the electron beam will be polarized to 80% and the positron beam to 30%. This allows very precise measurements of Standard Model (SM) parameters, properties of the Higgs boson and unique searches for physics beyond the SM. In particular, the ILC will provide very precise measurements of electroweak observables, aiming for up to 2 order of magnitude better precision than previously achieved. This will provide a deep insight into the chiral structure of the SM and open an additional portal to physics beyond the SM.
In this contribution, a new study at 250 GeV will be presented using a combined analysis of W- and Z-pair production, as well as single-W production and s-channel Z/γ exchange including multiple decay channels. This analysis will provide a coherent extraction of the total cross section and the left-right asymmetry for each channel, anomalous Triple Gauge Couplings and the luminosity-weighted average polarization, which is used as the absolute scale calibration of the polarization for all physics analyses. Furthermore, systematic uncertainties (e.g. of the detector selection efficiency) including their correlations are considered in this analysis and their impact on the measurement precision of the electroweak observables will be presented.

T 83.8 Do 18:15 Z6 - SR 1.005

Measurement of the W^+W^- cross section in pp collisions at $\sqrt{s} = 13$ TeV at the ATLAS Detector — •Baishali Dutta — DESY Zeuthen, Zeuthen, Germany

W boson pair production plays an important role to understand the Standard Model electroweak sector. Due to the involvement of the triple gauge boson couplings, this process is sensitive to the occurrence of new physics beyond the Standard Model.

With the data collected by the ATLAS experiment in 2015 comprising an integrated luminosity of 3.16 fb^{-1}, the fiducial and total W^+W^- cross sections have been measured at a centre-of-mass energy of $\sqrt{s} = 13$ TeV. Signal events are selected where the two W bosons produce an electron, a muon and two associated neutrinos in the final state. This talk presents the results of this cross-section measurement and shows prospects of more precise and differential measurements with the combined 2015 and 2016 ATLAS data.

T 84: Theorie: BSM II

Zeit: Donnerstag 16:30–18:50 Raum: Z6 - SR 1.010

T 84.1 Do 16:30 Z6 - SR 1.010

Automatic calculations of effective Lagrangians in the path integral approach — Michael Kraemer, Alexander Voigt, and •Benjamin Summ — RWTH Aachen University, Aachen, Germany

Effective field theory (EFT) has become a major tool for studying extensions of the Standard Model. Unfortunately, the EFT approach requires the calculation of the effective action and higher dimensional operators, which in general is a model dependent task. Recently, a method based on the path integral formalism was introduced, which at one-loop reduces this calculation to transformations of the original Lagrangian and insertion into a master formula. We present this method and extend it to include the treatment of epsilon scalars, which become important when switching from a supersymmetric theory to an EFT without supersymmetry. We further discuss the possibility of automatizing the calculation of the effective action based on this method.

T 84.2 Do 16:45 Z6 - SR 1.010

Constraining BSM Scalar Sectors through Vacuum Stability — Georg Weiglein, Wolfgang G. Hollik, and •Jonas Wittbrodt — DESY, Notkestraße 85, 22607 Hamburg

Since the LHC has not provided us with any hints towards new physics, it is ever more interesting to constrain BSM theories from purely theoretical considerations. Requiring that the electroweak vacuum in any BSM model is at least metastable can lead to stringent constraints on the parameter space of the model. Many popular extensions of the SM, such as supersymmetry, feature greatly extended scalar sectors. In the resulting high dimensional scalar potential, vacuum decay can happen in many different field directions. Constraints from vacuum decay thus rely on finding all minima of multidimensional scalar potentials which is a nontrivial task even at tree-level. We present results on the vacuum stability in supersymmetric models from a new code aiming to provide an efficient and reliable check of vacuum stability for use in BSM parameter scans.

T 84.3 Do 17:00 Z6 - SR 1.010

Phenomenology of a unified model containing leptoquarks — •Thomas Faber — Julius-Maximilians-Universität Würzburg

For various ratios of different B-meson branching fractions (R_K, R_{K^*}, R_D and R_{D^*}) deviations between measurements and theoretical predictions have been observed. It is already known that leptoquarks can explain these deviations in simple extensions of the SM, e.g. simply putting a leptoquark field to the SM lagrangian. A natural question is if these leptoquarks can emerge from consistent unified models. We investigate a model based on the group $SU(4) \times SU(2)_L \times U(1)_R$ in the regions of parameter space, where the above mentioned deviations can be explained. In addition we take into account bounds from direct leptoquark searches at the LHC as well as other flavor observables e.g. $\mu \to 3e$. Moreover we investigate the observability of the leptoquarks as well as other new particles at the LHC.

T 84.4 Do 17:15 Z6 - SR 1.010

Consistent Simplified Descriptions of Dark Matter — •Valentin Tenorth[1,2], Florian Goertz[1], Tommi Alanne[1], Martin Bauer[2], and Martin Klassen[2] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Deutschland — [2]Institut für Theoretische Physik, Universität Heidelberg Philosophenweg 16, 69120 Heidelberg, Germany

The overwhelming evidence for the existence of particle dark matter is a clear hint towards physics beyond the Standard Model and searching for it is a major topic of particle physics in these days. In collider searches simplified models (and effective theories) are widely used as they are a powerful tool to calculate mono-X signatures in a general and mostly model independent way. In addition these approaches allow comparisons with results from direct and indirect detection experiments.

However, for the high energies reached by the LHC those models feature inherent limitations and might miss relevant features of more complex mediated dark sectors. In this talk I will present attempts to extend the used frameworks to be able to consistently describe more phenomena and cover a wide range of theories with more complex dark (or scalar) sectors.

T 84.5 Do 17:30 Z6 - SR 1.010

Beschränkungen an EDMs für flavourdiagonale CP-Verletzung — •Dimitrios Skodras — TU Dortmund, Deutschland

Die Entdeckung des Higgs Bosons hat ein neues Fenster geöffnet für die Suche nach neuer Physik im Bereich der elektroschwachen Symmetriebrechung. Beispielsweise können erhebliche CP-verletzende Beiträge zur Top-Yukawakopplung wesentlich für elektroschwache Baryogenese sein.

Niederenergetische Präzisionsobservablen wie das elektrische Dipolmoment (EDM) setzen strikte Grenzen an diese Kopplung. Um jedoch mögliche Aufhebungen untereinander miteinzubeziehen, müssen die Beiträge aller Yukawakopplungen berechnet werden. Nach einer kurzen Einführung zu EDMs als Untersuchsobjekt neuer Physik, werden die Berechnungen der verschiedenen Beiträge erklärt und erste Ergebnisse präsentiert.

T 84.6 Do 17:45 Z6 - SR 1.010

Solving the Strong CP Problem in a Grand-Unified Nelson-Barr Model — •Jakob Schwichtenberg[1], Paul Tremper[1], and Robert Ziegler[2] — [1]Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Theoretical Physics Department, CERN, Geneva, Switzerland

We investigate if the Nelson-Barr mechanism can be realized, in a phenomenologically viable way, in an E_6 GUT. We find the answer in the affirmative and argue that the combination of the Nelson-Barr mechanism and E_6 unification leads to predictions that can be tested in the near future. In this sense, we do not provide any novel solution for the strong CP problem, but rather use the experimental fact $\bar{\theta} < 10^{-10}$ as a guide for GUT model building. While neither the Nelson-Barr mechanism, nor Grand Unification lead to definite predictions, we argue that a combination of these ideas does.

T 84.7 Do 18:00 Z6 - SR 1.010

Electroweak Phase Transition in the N2HDM — •Jonas Müller, Margarete Mühlleitner, and Philipp Basler — Karlsruher Institut für Technologie, ITP, Karlsruhe, Deutschland

While in the Standard Model (SM) it is not possible to generate the observed matter-antimatter asymmetry of the universe through baryogenesis, extended Higgs sectors are more promising in this respect. We investigate the prospects for a strong first order electroweak phase transition (PT) in the Next-to-Two-Higgs Doublet Model (N2HDM) where the CP-conserving Two-Higgs-Doublet Model is extended by an additional real singlet. We consider the N2HDM type I and II where one of the three neutral CP-even Higgs bosons can be the SM-like Higgs boson. By taking into account all relevant theoretical and experimental constraints, we investigate the implications of the requirement of a strong PT for LHC phenomenology. We find preferred mass configurations for the non SM-like Higgs bosons and show the implications on the signal rates of the SM-like Higgs boson. We furthermore highlight the interplay between the strong PT and the size of the trilinear Higgs self-couplings.

Gruppenbericht T 84.8 Do 18:15 Z6 - SR 1.010

Hunting Higgs Inflation in the NMSSM — •Wolfgang G. Hollik[1], Stefan Liebler[2], Gudrid Moortgat-Pick[1,3], Sebastian Passehr[4], and Georg Weiglein[1] — [1]DESY, Hamburg, Germany — [2]ITP KIT, Karlsruhe, Germany — [3]UHH, Hamburg, Germany — [4]LPTHE, Paris, France

Most cosmological models of inflation are far away from providing a smoking gun at low energies. A model of Higgs inflation in the Next-to Minimal Supersymmetric Standard Model, however, changes the NMSSM phenomenology drastically and may be well distinguished from the pure NMSSM or MSSM at a future linear collider.

We point out certain differences of the inflationary model to the ordinary NMSSM and discuss the Higgs and Neutralino/Chargino sector in particular to identify the smoking gun of inflation at electroweak energies.

T 84.9 Do 18:35 Z6 - SR 1.010

Observational consequences of the braneworld scenario with two parallel 3-branes of the DGP type — •Max Warkentin — Ludwig-Maximilians-Universität Fakultät für Physik Theoretische Physik Lehrstuhl Prof. Dvali Theresienstr. 37 80333 München

In theories with large extra dimensions it is possible to lower the fundamental Planck scale and hence resolve the hierarchy problem. As a consequence, in those theories, graviton production rates and other experimental signatures differ from those where large extra dimensions are absent. Although so far no experimental evidence has been found for the reality of the investigated models, the prediction of a fundamental Planck scale, which is in our observational reach, remains tempting. In order to further sharpen the predictive power of those models, we study a particular braneworld scenario with two parallel 3-branes, embedded in a 4+1 dimensional spacetime. The setup is of the type of the Dvali-Gabadadze-Porrati (DGP) model, in which a kinetic term for gravity is induced on the branes by the matter fields localized on them. We investigate the gravitational exchange between the matter fields localized on their respective branes. In particular, the distance between the branes influences which modes of the lower dimensional mode decomposition of the 5-dimensional graviton are being exchanged predominantly. Since in this configuration our universe is one of those branes with the standard model particles localized on it, we can deduce experimental signatures for the existence of the parallel brane. This investigation strengthens the possibility to observe the existence of large extra dimensions.

T 85: Experimentelle Methoden III

Zeit: Donnerstag 16:30–19:05 Raum: Z6 - SR 1.013

Gruppenbericht T 85.1 Do 16:30 Z6 - SR 1.013

Track reconstruction for the Mu3e experiment — •Alexandr Kozlinskiy for the Mu3e-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The *Mu3e* experiment is designed to search for the lepton flavour violating decay $\mu^+ \to e^+e^-e^+$. The aim of the experiment is to reach a branching ratio sensitivity of 10^{-16}. At first phase the experiment will be performed at an existing beam line providing 10^8 muons per second at the Paul-Scherrer Institute (Switzerland) which will allow to reach sensitivity of 10^{-15}. The muons with a momentum of about 28 MeV/c are stopped and decay at rest on a target. The decay products (positrons and electrons) with energies below 53 MeV are measured by a tracking detector consisting of two double layers of 50 μm thin silicon pixel sensors. The high granularity of pixel detector with a pixel size of 80×80 μm allows for a precise track reconstruction in the high occupancy environment of the *Mu3e* experiment reaching 100 tracks per reconstruction frame of 50 ns in the final phase of experiment. To deal with such high occupancy and combinatorics the *Mu3e* track reconstruction uses a novel fit algorithm that in the simplest case takes into account only the multiple scattering, which allows fast online tracking on a GPU based filter farm. The implementation of the 3-dimensional multiple scattering fit based on hit triplets is described. The extension of the fit that takes into account energy losses and pixel size is used for offline track reconstruction. The algorithm and performance of the offline track reconstruction based on a full Geant4 simulation of the *Mu3e* detector are presented.

T 85.2 Do 16:50 Z6 - SR 1.013

Topological b-hadron decay reconstruction and application for heavy-flavour jet tagging in ATLAS — •Geoffrey Gilles — Bergische Universität Wuppertal, Wuppertal, Germany

The identification of jets originating from the hadronisation of heavy-flavour quarks represents a key ingredient in the physics program of the ATLAS experiment. Exploiting the topological structure of weak b- and c-hadron decays, the multi-vertex finder algorithm - JetFitter - tries to reconstruct the full b-hadron decay chain inside b-jets and provides a complementary approach to conventional secondary vertex finder algorithms. Based on the hypothesis that the primary and displaced b- and c-hadron decay vertices lie on a common line approximating the b-hadron flight direction, an extension of the Kalman Filter formalism for vertex reconstruction implemented in JetFitter allows to solve this pattern recognition problem. Detailed information on the reconstructed decay cascades is then used to identify and discriminate heavy-flavour jets. This presentation will discuss about the principle of this algorithm and its performance in the context of a recent optimization campaign performed in view of the 2017 LHC data-taking by the ATLAS detector.

T 85.3 Do 17:05 Z6 - SR 1.013

Studien zur Identifikation von Strangejets mit dem ATLAS-Detektor — •Sonja Zeissner, Johannes Erdmann und Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Die Identifikation von Jets aus Bottomquarks ist seit Jahren ein essentieller Bestandteil vieler Datenanalysen an Hochenergie-Kollidern. Neue Methoden erlauben heute zusätzlich die Identifikation von Jets aus Charmquarks und hadronisch zerfallenden Topquarks sowie die Unterscheidung von Quark- und Gluonenjets. Die Unterscheidung von leichten Jets aus Up-, Down- und Strangequarks ist hingegen herausfordernd. In diesem Vortrag werden Studien zur Identifikation von Strangejets vorgestellt, insbesondere unter dem Gesichtspunkt der Diskriminierung zwischen Strange- und Up-/Downjets.

T 85.4 Do 17:20 Z6 - SR 1.013

Measurement of the ATLAS muon reconstruction efficiency on 2016 data using $Z \to \mu\mu$ events — Johannes Junggeburth[1], •Nicolas Köhler[1], Hubert Kroha[1], and Max Goblirsch-Kolb[2] — [1]Max-Planck-Institut für Physik — [2]Brandeis University

The precise knowledge of the muon reconstruction efficiency is an important ingredient for all data analyses at the LHC with muons in the final state. A tag&probe method has been used in $Z \to \mu\mu$ events to determine the muon reconstruction efficiency from data. By applying the same procedure to Monte Carlo $Z \to \mu\mu$ events, an efficiency scale-factor used to correct the the Monte Carlo data is evaluated. Because of the large data set collected in Run-2 at 13 TeV center-of-mass energy, systematic uncertainties in the scale-factor measurement have become a significant source of uncertainty for the ATLAS data analyses. In this talk, the muon reconstruction efficiencies determined for the years of 2015-2017 are discussed as well as a new method for reducing the systematic uncertainties on the measurement by about one order of magnitude.

T 85.5 Do 17:35 Z6 - SR 1.013

Development of a new Soft Muon Tagger for ATLAS Run 2 — Julien Caudron[1], Markus Cristinziani[1], Mazuza Ghneimat[1], Carlo A. Gottardo[1], Sebastian Heer[1], Vadim Kostyukhin[1], Ö. Oğul Öncel[1,2], Arshia Ruina[1], and •Andrea Sciandra[1] — [1]Physikalisches Institut, Universität Bonn — [2]Institut für Kernphysik, Universität zu Köln

The identification of b-quark initiated jets (b-tagging) plays a fundamental role at LHC, as it helps in the identification of heavy particles that decay to bottom quarks, as for instance the top quark, the Higgs boson or heavy exotic particles. The Soft Muon Tagger (SMT) allows to identify jets from b-quarks taking advantage of the presence of a muon originating from b-hadron semileptonic decays. I will describe the development of a new b-tagging algorithm in ATLAS that takes advantage of the jet-muon angular distance. Despite the low BR($b \to \mu X$), the discriminating power of the muon and vertex variables is remarkable to reject light jets.

A performance enhancement has been obtained for all light rejection woking points through the implementation of the SMT output in the ATLAS baseline b-tagging algorithm MV2. A good modelling of input and output variables will be shown, comparing simulation to Run 2 data.

T 85.6 Do 17:50 Z6 - SR 1.013

Identification of Hadronic Tau Lepton Decays with Deep Neural Networks at the ATLAS Experiment — •Christopher Deutsch, Jochen Dingfelder, and William Davey — Physikalisches Institut, Bonn, Deutschland

The tau lepton is the heaviest lepton in the Standard Model and an important probe of physics at high energy scales, such as Higgs physics and physics beyond the Standard Model. Hadronic decays make up approximately two-thirds of the total tau lepton branching ratio.

Jets originating from quarks or gluons can mimic hadronic tau decays. They are more abundant than tau leptons due to the large multijet production cross section at the LHC. Therefore, dedicated algo-

rithms to discriminate hadronically decaying tau leptons from jets are required.

In this talk, the latest developments on a novel tau identification algorithm based on deep learning for data collected with the ATLAS detector during Run 2 of the LHC are presented. The new algorithm combines information on reconstructed objects and high-level identification variables in a neural network to build a powerful discriminant. A recurrent neural network architecture is used, allowing to process input sequences of variable length such as charged particle tracks and clusters of energy in the calorimeter. The network is expected to improve the jet rejection by a factor of two compared to the tau identification algorithm currently in use at the ATLAS experiment.

T 85.7 Do 18:05 Z6 - SR 1.013

Determining systematic uncertainties of boosted tau pair reconstruction and identification efficiencies in ATLAS — •Fabian Petsch, Christian Wiel, David Kirchmeier, Arno Straessner, and Wolfgang Mader — IKTP, Dresden, Deutschland

Tau reconstruction and identification plays an important role in the search for new physics in the ATLAS experiment at the LHC. Pairs of tau leptons with a boosted topology are produced in some channels and are possible final states in BSM scenarios, such as a graviton decaying into two Higgs particles. Since the two taus may be characterized by a low spatial separation, standard tau identification is not possible in this regime. Therefore a special approach for reconstruction and identification of boosted tau pair topologies has been developed. This talk focusses on semi-leptonic di-taus as final states. The calculation of systematic uncertainties for the reconstrucion and identification efficiencies using various simulated detector modifications is presented.

T 85.8 Do 18:20 Z6 - SR 1.013

Identification of hadronically decaying tau leptons in CMS and determination of their energy corrections — David HlushchenkoBrunner, Jordy Degens, Peter Fackeldey, •Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, Dominik Wolfschläger, and Günter Flügge — III. Physikalisches Institut B, RWTH Aachen University

To calculate the mass of a system including tau in the final state, any bias in the energy measurement or reconstruction of the tau lepton decay products must be determined and corrected for. In this talk, the identification method of tau leptons decaying into hadrons in the CMS experiment will be explained and the performance of the latest 2018 multivariate discriminators will be presented. The energy scales are determined to treat the charged and neutral components of the tau separately and are compared to the energy scale obtained without this separation. The application in the context of $H \to \tau\tau$ analysis is discussed.

T 85.9 Do 18:35 Z6 - SR 1.013

Reconstruction and Identification of Semi-Leptonic Di-Tau Decays in Boosted Topologies at ATLAS — Arno Straessner, Wolfgang Mader, David Kirchmeier, and •Christian Wiel — IKTP, Dresden, Deutschland

The reconstruction of boosted di-tau decays is important in the search for heavy resonances (e.g. Randall-Sundrum gravitons) decaying into a pair of Higgs bosons. Existing reconstruction and identification algorithms for pairs of tau leptons cease to work in the regime of very low spatial separation. Earlier studies showed successfully how to restore a high reconstruction efficiency if both tau leptons decay hadronically. In this talk algorithms for the case where one tau decays hadronically and the other one decays into lighter leptons are presented. The new identification algorithms show promising results by achieving high background rejections and signal efficiencies.

T 85.10 Do 18:50 Z6 - SR 1.013

Track classification in hadronic tau decays with recurent neural networks — •Max Märker, Dirk Duschinger, Richard Hartmann, Wolfgang Mader, and Arno Straessner — IKTP TU Dresden

Tau leptons often play an important role in searches for new physics, not only because the Higgs decay probability into tau leptons is magnitudes larger than that for decays into muons or electrons, but also physics beyond the Standard Model can introduce enhanced couplings to tau leptons. However, their short lifetime makes it hard to detect tau leptons directly. In fact, tau decays in the ATLAS detector at the LHC often take place before any detector component. The majority of these decays are those into hadrons and additional neutrinos, where the hadronic constituents are most often 1 or 3 charged pions plus additional neutral pions. The classification of tracks of hadronic tau decays plays a crucial role in ATLAS tau reconstruction in terms of rejection against QCD jets and electrons.

In previous ATLAS analyses Boosted Decision Trees (BDT) where used successfully to separate tracks from hadronic tau decays and tracks from pile-up, conversions and underlying event. With recent developments in the field of artificial neural networks, new approaches are investigated utilizing the higher flexibility of neural networks to further improve the reconstruction of the charge multiplicity of hadronic tau decays. The focus is set on architectures using recurrent neural networks in order to learn the the special kinematic properties of tau decays.

T 86: Kalorimeter

Zeit: Donnerstag 16:30–19:05 Raum: Z6 - SR 2.002

Gruppenbericht T 86.1 Do 16:30 Z6 - SR 2.002

Overview of production and tests for the CALICE AHCAL technological prototype — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik

The CALICE collaboration is studying several calorimeter concepts, each one optimized for a usage of particle flow algorithm, for a future linear collider detector. One of these concepts, the analog hadronic calorimeter (AHCAL), is using a sandwich design with tungsten or steel absorber plates. Due to a particle flow algorithm optimized design, small detection units are needed. This results in a large number of channels (around 8.000.000) which is realized by a system composed of small scintillator tiles each read out by a silicon photomultiplier (SiPM). Construction and calibration within a suitable time window are challenging and have to be optimized. Also the design of the components has to be adjusted for mass assembly.
In 2017 the production and testing of a large technological prototype with 160 electronics boards and around 23.000 channels was started. This presentation will show an overview of the technological prototype and its production. Also various test results related to performance and quality checks will be presented.

T 86.2 Do 16:50 Z6 - SR 2.002

AHCAL scintillator tile production — •Stephan Martens, Erika Garutti, and David Lomidze for the CALICE-D-Collaboration — Institute of Experimental Physics, Hamburg University

The CALICE collaboration develops a prototype particle flow calorimeter with excellent spatial and time resolution to investigate hadronic shower development with $3\times3\times0.3$ cm^3 granularity. The single channel of the AHCAL (analog hadronic calorimeter) prototype is a plastic scintillator tile wrapped in reflector foil and coupled to a silicon photomultiplier. The complete prototype requires about 24000 single channels, arranged in 40 sampling layers of about 0.5 m^2 in size.

A Light Yield (LY) of about 16-18 photoelectrons per minimum ionizing particle, with a spread lower than 10% can be reached if the production of the single channels is automatized and accurately controlled.

We present the automatized production of AHCAL tiles and their characterization in terms of LY.

T 86.3 Do 17:05 Z6 - SR 2.002

Hadronic energy reconstruction in the CALICE combined calorimeter — •Yasmine Israeli for the CALICE-D-Collaboration — Max Planck Institute for Physics, Munich, Germany

The CALICE collaboration develops highly granular calorimeters for present and future collider experiments. A system consisting of a Si-W electromagnetic calorimeter, a scintillator steel hadronic calorimeter and a tail catcher was tested with hadronic test-beams at CERN and Fermilab.

This contribution will discuss the calibration and the energy reconstruction for the combined configuration, which has to account for the differing geometry and different readout technology in the subsystems. The study includes the test beam data and Geant4 simulations with different hadronic physics models. The data were reconstructed with the standard reconstruction and with the software compensation method, which uses the information of the local energy of each detector cell.

The energy resolutions obtained with the combined system are comparable to the ones achieved for showers starting only in the hadronic calorimeter, demonstrating the success of the inter-calibration of the different subsystems. In addition,the software compensation-based algorithm improves the hadronic energy resolution by up to 30% compared to the standard reconstruction.

T 86.4 Do 17:20 Z6 - SR 2.002

Time Measurements with the CALICE Analog Hadronic Calorimeter — •Christian Graf für die CALICE-D-Kollaboration — Max-Planck-Institut für Physik, München, Deutschland

One of the main requirements of particle detectors at future linear e^+e^--colliders as ILC or CLIC is a jet energy resolution of 3-4%. To achieve this goal, the detector design heavily relies on the Particle Flow paradigm. Highly granular calorimeters with a fine spacial resolution play a key role in this approach.

The CALICE collaboration is developing concepts for such highly granular calorimeters. One of them, the analog hadronic calorimeter (AHCAL), is a sampling calorimeter using 3x3 cm^2 scintillator tiles as active material, read out by silicon photomultipliers (SiPMs) and steel or tungsten plates as absorbers. In order to investigate the performance of the used technologies and to prove the feasibility of constructing this type of calorimeters, a series of test-beam campaigns was carried out with a "technological prototype". The technological prototype is constructed with front-end chips integrated in the active layers and the design is scalable to a full detector.

This talk will focus on the time analysis of data taken in test-beam campaigns in 2015 and 2017 at SPS at CERN. Special emphasize will be put on the time structure of hadronic showers with a prototype in a large tungsten stack. Additionally, the influence of a 1.5T magnetic field on the detector performance will be investigated.

T 86.5 Do 17:35 Z6 - SR 2.002

The CMS High Granularity Calorimeter for the HL-LHC: Online Trigger and Particle Identification — •Luca Mastrolorenzo — RWTH III. Physikalisches Institut A, Aachen, Germany

The HL-LHC will pose significant challenges for radiation tolerance and event pileup on detectors, especially for forward calorimetry, hallmarking the issue for future colliders. As part of the Phase-II upgrade, the CMS collaboration envisages the complete replacement of the endcap calorimeters with the HGCAL detector. Based on silicon technology, HGCAL features unprecedented transverse and longitudinal segmentation. This will improve the event reconstruction, allowing to maximally exploit the particle-flow (PF) calorimetry. The intrinsic high-precision timing capabilities of the silicon sensors will add an extra dimension to the event reconstruction, especially in terms of pileup rejection. In parallel, the hardware (L1) trigger system will be subject to a deep upgrade to increase the sustainable rate up to O(750 kHz). A main challenge is represented by the design of the HGCAL L1 trigger architecture: it must be capable to exploit the high granularity to enhance the pileup rejection and particle identification, whilst still achieving good energy resolution and pioneering PF-based techniques at L1.

T 86.6 Do 17:50 Z6 - SR 2.002

Beam-tests of prototype modules for the CMS High Granularity Calorimeter with electrons and hadrons at CERN — •Thorben Quast — CERN, Geneva, Switzerland — Physics Institute IIIa, RWTH Aachen University, Germany

As part of its HL-LHC upgrade program, CMS is developing a High Granularity Calorimeter (HGCAL) to replace the existing endcap calorimeters. The HGCAL will be realised as a sampling calorimeter, including 28 layers of silicon pad and 24 layers of silicon+scintillator detectors interspersed with metal absorber plates. Starting from 2016, prototype modules, based on 6-inch hexagonal silicon pad sensors with pad areas of 1.0 cm2, have been constructed. In 2017, beam tests of different sampling configurations made from these modules have been conducted at CERN's SPS using beams of charged hadrons and electrons with momenta from 20 to 350 GeV/c. The setup was complemented with CALICE's AHCAL prototype, a scintillator based sampling calorimeter, mimicking the proposed design of the HGCAL's back part. Most importantly, the new Skiroc2-CMS readout ASIC has been used which will allow for the study of its timing capabilities in practice. This talk summarises the test beam efforts in 2017. In particular, the setups and the encountered challenges are discussed. Secondly, preliminary results, including gain characterisation, calibration with minimum ionising particles and energy reconstruction performance of electron and hadron induced showers are shown. Finally, a first impression on the timing capabilities is given.

T 86.7 Do 18:05 Z6 - SR 2.002

Muon Pion Separation for the $K^+ \to \pi^+\nu\bar{\nu}$ Measurement with the NA62 Experiment — •Riccardo Aliberti — Johannes Gutenberg University - Mainz

The ambitious goal of the NA62 experiment is to achieve a direct measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ branching ratio with an accuracy around 10%. This decay has a theoretical BR of $(8.4 \pm 1.0) \times 10^{-11}$ with a single track detectable: the π^+.
The main decay channels of charged kaons have rates several orders of magnitude larger than those for the signal. For this reason the presence of a very efficient veto system to reject background events is mandatory.
The discrimination between muons and pions is one of the central issues for the measurement of the $K^+ \to \pi^+\nu\bar{\nu}$ decay. In this context the measurement of the energy deposit inside the hadron calorimeter is one of the most important inputs to the pion-muon separation. This talk presents the procedure of the absolute calibration of the NA62 hadron calorimeter with particular focus on the usage of stopped high-energetic muons to calibrate the electromagnetic response of the detector.

T 86.8 Do 18:20 Z6 - SR 2.002

MicroMegas for measuring the direction of electromagnetic showers — •Stefan Kormannshaus — Johannes Gutenberg-Universitaet Mainz

The SHiP experiment, which is planned at the CERN SPS, aims to measure new, weakly interacting non-Standard Model particles. To reconstruct decays of neutral particles like axions into photons, not only the energy of the photons, but also their direction needs to be measured. The electromagnetic calorimeter is therefore planned to be equipped with layers of high-resolution MicroMegas detectors within the production, to measure the position of the electromagnetic showers inside the calorimeter. MicroMegas have general advantages for this purpose, like having a sufficiently precise spatial resolution ($\sim 50\mu m$) and a small longitudinal extent of only a few cm. In this talk we present simulation studies of different calorimeter designs with high-precision MicroMegas layers and of the achievable angular resolution of electromagnetic showers.

T 86.9 Do 18:35 Z6 - SR 2.002

Study of performance of electro-magnetic calorimeter of SHiP experiment — •Gia Khoriauli — Johannes Gutenberg-Universität Mainz, Staudingerweg 7, 55128 Mainz, Rheinland-Pfalz

The SHiP experiment is a new fixed target experiment proposed at the CERN SPS accelerator facility to search for very weakly interacting particles with masses of $\mathcal{O}(10)$ GeV or below and long lifetimes. The goal is to accumulate 2×10^{20} 400 GeV/c protons on target extracted from the SPS during five years of operation. The experiment has a potential to explore the parameter space regions of hidden-sector particles originating from charm and beauty meson decays not reachable by existing or planned experiments in the near future. The electromagnetic calorimeter will be one of the key detectors of the experiment. Its main purpose is to measure energies as well as directions of photons coming e.g. from decays of axion-like particles with high detection efficiency. The design concepts and performance studies of the SHiP electro-magnetic calorimeter are reviewed.

T 86.10 Do 18:50 Z6 - SR 2.002

Simulation and Hardware Studies on a Highly Granular Elec-

tromagnetic Calorimeter for the DUNE Near Detector — •Lorenz Emberger and Frank Simon — Max-Planck-Institut für Physik

The near detector of the Deep Underground Neutrino Experiment (DUNE) will play an important role in search for leptonic CP violation and other neutrino oscillation measurements, in addition to providing a rich physics program on its own. It will consist of different subdetectors, among them an electromagnetic calorimeter to reconstruct neutral pions, photons and electrons. A key aspect of the calorimeter performance will be its capability of locating the point of origin of neutral pions, to allow their association to neutrino interactions observed in the tracking elements of the near detector. We present a GEANT4 simulation study of an electromagnetic calorimeter inspired by the highly granular scintillator / SiPM based calorimeters of the CALICE collaboration, highlighting the benefits of granularity on neutral pion reconstruction and the influence of specific geometry choices for the detector. Results of ongoing laboratory studies of scintillator elements that may deliver the required granularity will also be presented.

T 87: Datenanalyse

Zeit: Donnerstag 16:30–19:00 Raum: Z6 - SR 2.005

T 87.1 Do 16:30 Z6 - SR 2.005

Adversarial networks used in a single-top-quark analysis in ATLAS — •Rui Zhang and Ian C. Brock — Rheinische Friedrich-Wilhelms-Universität Bonn

Multivariate analysis (MVA) techniques are widely used in high energy physics to separate interesting signal processes from a large amount of background events. The training of the MVA is usually done using nominal signal and background samples. However, the imperfect knowledge of the detector performance and physics model results in the presence of systematic uncertainties that affect the classifier. A step further would be to construct a classifier insensitive to systematic variations, which are usually parametrised by nuisance parameters (NP). Adversarial networks, which consist of a system of neural networks contesting each other, are a clear candidate to solve such problem. This talk will investigate the possibilities of using this technique in a single-top-quark analysis in ATLAS. Monte Carlo events are split into training and test samples for both nominal and systematic variations. Adversarial networks are built by Keras, where the discriminative network is trying to distinguish signal and backgrounds while cheating the generative network, which tries to predict NP values.

T 87.2 Do 16:45 Z6 - SR 2.005

Modernized track reconstruction in ATLAS with the ACTS software project — •Paul Gessinger[1,2], Andreas Salzburger[2], and Stefan Tapprogge[1] — [1]Johannes Gutenberg-Universität Mainz — [2]CERN

Track reconstruction is the process of forming particle trajectories from individual track detector measurements in specialized tracking geometries. In presence of high event activity, e.g. due to pile-up, it is usually the most CPU intensive part of event reconstruction. The LHC experiments have led successful data taking campaigns during the first LHC runs and continuously improved the event reconstruction software. However, the planned increase of pile-up for the high luminosity LHC era and beyond will create the need for further optimization. The ACTS (A Common Tracking Software) project aims to encapsulate the current ATLAS tracking software, and apply modern language patterns and computing concepts. A central strategy is to allow concurrent usage of the ACTS toolkit in order to react to future computing architectures. Eventual re-integration into the ATLAS software suite is one of the primary goals. This talk will focus on the improvements which ACTS enables, and establishes a proof-of-concept which demonstrates that current and future ATLAS tracking geometries can be accommodated.

T 87.3 Do 17:00 Z6 - SR 2.005

Deep Learning mit unbalancierten Datensätzen — •Stefan Geisselsöder für die ANTARES-KM3NeT-Erlangen-Kollaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

Deep Learning bezeichnet eine gegenwärtig in vielen Anwendungsbereichen sehr erfolgreiche und flexibel einsetzbare Gruppe von Algorithmen, die einen hohen Grad an automatisch erzielter Abstraktion gemeinsam haben. Gleichzeitig benötigen moderne Großexperimente in der Teilchenphysik oft unerreichte Präzision bei ihren Messungen um auch subdominante Effekte beobachten zu können. Die dabei simulierten und gemessenen, oft sehr großen Datensätze sind zwar einerseits gut zur Verarbeitung mit Deep Learning geeignet, andererseits sind sie häufig sehr unbalanciert. Beispielsweise können viele, für eine angestrebte Datenanalyse aber unerhebliche Daten enthalten sein, ein Energiespektrum resultiert in unterschiedlich vielen Ereignisse für verschiedene Energiebereiche oder möglicherweise besonders interessante Extremfälle sind selten.

Der Vortrag vergleicht Methoden, wie das Training und die Anwendung von Convolutional Neural Networks an diese stark unbalancierten Datensätze angepasst werden können, um eine möglichst hohe Genauigkeit bei der Datenanalyse zu erzielen. Die Vergleiche werden teilweise anhand von Simulationen für das KM3NeT Neutrinoteleskop gezeigt, das gegenwärtig am Grund des Mittelmeeres im Aufbau ist.

T 87.4 Do 17:15 Z6 - SR 2.005

Distributed make-like Analyses on the Grid based on Spotify's Pipelining Package luigi — •Marcel Rieger, Martin Erdmann, Benjamin Fischer, and Ralf Florian von Cube — III. Physikalisches Institut A, RWTH Aachen University

In particle physics, workflow management systems are primarily used as tailored solutions in dedicated areas such as Monte Carlo production. However, physicists performing data analyses are usually required to steer their individual workflows manually which is time- consuming and often leads to undocumented relations between particular workloads. We present the luigi analysis workflow (law) Python package which is based on the open- source pipelining package luigi, originally developed by Spotify. It entails a generic analysis design pattern with make-like execution allowing for the definition of arbitrary workloads and all dependencies between them in a scalable structure which shifts the focus from executing to defining an analysis. To cope with the sophisticated demands of end-to-end HEP analyses, it provides remote execution on WLCG infrastructure, remote file access through Grid File Access Library (GFAL2), and a software sandboxing mechanism with support for Docker and Singularity containers. The novel approach was successfully applied in a ttH cross section measurement with CMS.

T 87.5 Do 17:30 Z6 - SR 2.005

KM3NeT/ORCA data analysis using unsupervised Deep Learning — •Stefan Reck for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

KM3NeT/ORCA is a water-Cherenkov neutrino detector, currently under construction in the Mediterranean Sea at a depth of 2450 meters. Its main goal will be to determine the neutrino mass hierarchy by measuring the energy- and zenith angle dependency of the oscillation probabilities of atmospheric neutrinos after travelling through the Earth.

Deep Learning provides a promising method to analyse the signatures produced by the particles travelling through the detector. A common point of critique of the popular supervised Deep Learning techniques is their dependency on simulated data. If this data contains features that deviate from measured data, networks can become sensitive to them, and their performance on measurements will fall behind expectations. Ultimately, the network might fixate on effects only present in the simulations, or become unaware of properties of measured data.

This talk will cover an unsupervised learning approach with convolutional autoencoders, which tackles the problem of learning unwanted features by making it possible to train large parts of the network on measured data.

T 87.6 Do 17:45 Z6 - SR 2.005

Jet-Rekonstruktion mit neuronalen Netzen im ATLAS Level-1 Kalorimeter Trigger — •Bastian Schlag[1], Volker Büscher[1],

Christian Schmitt[1], Stefan Kramer[2] und Andreas Karwath[2] — [1]Institut für Physik, Johannes Gutenberg Universität Mainz — [2]Institut für Informatik, Johannes Gutenberg Universität Mainz

In den kommenden Ausbaustufen des LHCs werden Schwerpunktsenergie und Luminosität weiter steigen. Die Entwicklung neuer Methoden zur Jet-Rekonstruktion in der ersten Stufe des FPGA-basierten ATLAS-Triggersystems ist somit essentiell, um eine effiziente Selektion gewünschter Ereignisse gewährleisten zu können.

Fasst man die Kalorimeter-Informationen als zweidimensionales Bild auf, so sind moderne Verfahren der Bilderkennung wie *Convolutional Deep Neural Networks* vielversprechende Kandidaten für diese komplexe Aufgabe. Hierbei müssen 40 Millionen Bilder pro Sekunde analysiert werden, wobei pro Bild lediglich eine Zeit von max. 125ns zur Verfügung steht. Die angestrebte Implementierung auf FPGAs beschränkt zudem die Architektur des neuronalen Netzes sowie die verfügbaren Aktivierungsfunktionen.

Ziel ist es, ein neuronales Netz zu entwickeln, welches die konventionellen Methoden der Jet-Rekonstruktion im Level-1 Trigger übertrifft und zugleich eine mögliche Implementierung auf FPGAs gestattet. Im Vortrag wird der aktuelle Stand der Arbeit präsentiert.

T 87.7 Do 18:00 Z6 - SR 2.005

Studies on Convolutional Neural Networks with deconvolution methods on galaxy image data — •Andriy Borovkov, Christoph Garbers, Peter Schleper, and Hartmut Stadie — Universität Hamburg, Hamburg, Deutschland

Machine learning tools advance in different areas of science, not least in particle physics. Therefore it is crucial to get a deeper understanding of its mechanisms especially with regard to future applications in particle physics. As convolutional neural networks are the main tools for visual data classifications, different studies on these networks have been performed. The focus is on deconvolution methods to visualize the learned classification rules. For these studies image data of galaxies from the Galaxy Zoo has been used as an example.

T 87.8 Do 18:15 Z6 - SR 2.005

Studies for Top Quark Reconstruction with Deep Learning — •Tim Kallage, Johannes Erdmann, Olaf Nackenhorst, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Deep learning techniques are attracting attention in recent years and show potential in high energy physics applications. In analyses of $t\bar{t}$ processes, a reconstruction of the association of measured jets to partons in the decay topology is often useful. A deep neural network approach for this goal is presented in this talk for semileptonic $t\bar{t}$ decays. The algorithm is trained and tested on pp collisions at $\sqrt{s} = 13$ TeV using a simplified simulation of the ATLAS detector. The performance is studied and compared with a commonly used kinematic likelihood fit (KLFitter).

T 87.9 Do 18:30 Z6 - SR 2.005

Jet-Klassifizierung mithilfe von „domain adaption“ in tiefen künstlichen neuronalen Netzen — Matthias Mozer, Thomas Müller und •David Walter — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Am CMS-Experiment beim LHC entstehen beim hadronischen Zerfall von hochenergetischen Teilchen wie Quarks und Gluonen Teilchenschauer, sogenannte Jets, die nur schwer ihren Ausgangsteilchen zuzuordnen sind. Bei der höheren Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ bei Run II steigt außerdem die Wahrscheinlichkeit, dass mehrere Zerfallsteilchen als ein Jet rekonstruiert werden (z.B. $Z \to b\bar{b} \to$ Jet).

Mit multivariaten Verfahren wird versucht diese Jets ihren Ausgangsteilchen zuzuordnen. Eine recht neue Methode mit künstlichen neuronalen Netzen liefert bisher bei simulierten Daten gute Ergebnisse. Die Klassifizierung auf Messdatenaten ist im Vergleich dazu schlechter. Unter der Zuhilfenahme von Informationen aus den Messdaten beim Training solcher Netze soll versucht werden, die Übereinstimmung von Simulation und Daten zu verbessern.

T 87.10 Do 18:45 Z6 - SR 2.005

Tau neutrino appearance studies with KM3NeT-ORCA using Deep Learning techniques — •Michael Moser for the ANTARES-KM3NeT-Erlangen-Collaboration — Friedrich-Alexander-Universität Erlangen-Nürnberg, ECAP

An important open question in neutrino physics is the unitarity of the PMNS matrix. Currently, the uncertainties on several matrix elements are too large to draw significant conclusions on the unitarity. This is mostly due to the low experimental statistics in the tau neutrino sector.

KM3NeT-ORCA is a water Cherenkov detector under construction with several megatons of instrumented volume. It will observe about 2400 tau neutrinos per year and it will significantly improve the available tau neutrino statistics. In ORCA, tau neutrinos will be identified by observing a statistical excess of cascade-like events with respect to the electron neutrino expectation from the atmosphere. Hence, the development of an algorithm for the separation of track-like ($\nu_\mu - CC$) and cascade-like (other flavors) neutrino events is necessary.

Currently, event properties inspired by the different event types are used with shallow machine learning, in order to discriminate the two classes. Recent advances in computational performance have made it possible to employ deep artificial neural networks. In this approach, the experimental raw data is used for training a deep neural network. Here, the network builds a representation of the typical event properties that can be exploited to distinguish track-like from shower-like events. In this talk, the current status of the ORCA deep learning efforts with respect to the measurement of tau neutrino appearance is presented.

T 88: Flavor Physik III

Zeit: Donnerstag 16:30–18:30 Raum: Z6 - SR 2.006

T 88.1 Do 16:30 Z6 - SR 2.006

Test of lepton flavour universality using the branching fraction ratio R_ϕ — •Simon Nieswand, Sarah Beranek, Christoph Langenbruch, Stefan Schael, and Eluned Smith — I. Physikalisches Intitut, RWTH Aachen University

The LHCb detector at the LHC is designed for the search for New Physics (NP) beyond the Standard Model (SM) in decays of heavy flavour. Of particular interest are rare decays of b-hadrons that occur via $b \to s$ transitions. These flavour changing neutral currents are forbidden at tree-level in the SM. At loop-level they can be influenced by heavy non-SM particles. Therefore, the branching fractions of decays like $B_s^0 \to \phi\ell^+\ell^-$ constitute sensitive probes for NP.

Particularly clean theory predictions can be made for the ratios of rare semileptonic $b \to s$ decays with muons and electrons in the final state. Due to lepton universality, those ratios should be close to unity in the SM. For the ratios R_{K^*} and R_K interesting tensions with the SM predictions were observed by the LHCb collaboration, corresponding to $2.4 - 2.5$ and $2.6\ \sigma$, respectively. Therefore, it is interesting to study further rare B decays for a similar behavior.

In this talk the analysis strategy to measure the branching fraction ratio $R_\phi = \mathcal{B}\left(B_s^0 \to \phi\mu^+\mu^-\right) / \mathcal{B}\left(B_s^0 \to \phi e^+ e^-\right)$ and the current status of the on-going analysis of the Run 2 LHCb data sample will be presented.

T 88.2 Do 16:45 Z6 - SR 2.006

Programm zur Umgewichtung semileptonischer B-Zerfälle: HAMMER — •Stephan Duell[1], Jochen Dingfelder[1], Florian Bernlochner[2], Dean Robinson[3], Michele Papucci[4] und Zoltan Ligeti[4] — [1]Universität Bonn — [2]Karlsruher Institut für Technologie — [3]University Cincinnati — [4]Lawrence Berkeley National Laboratory

Moderne Flavour-Physik-Experimente, wie Belle II oder LHCb, benötigen für ihre Präzisionsmessungen große simulierte Datensätze mit generierten Monte Carlo Ereignissen. Diese simulierten Ereignisse werden in einer technisch ausgefeilten Produktionskette erzeugt, die das Ansprechverhalten des gesamten Detektorsystems simuliert. Die Erzeugung und Rekonstruktion solch umfassender Datensätze ist sehr ressourcen- und zeitintensiv und müsste prinzipiell jedes Mal wiederholt werden werden, wenn sich die zugrundeliegenden theoretischen Modelle der B-Zerfälle ändern. Um die Neuerzeugung solch großer Datensätze zu vermeiden, arbeiten wir an einem Programm zur Umgewichtung von Ereignissen mit semileptonischen $b \to c\,\ell\,\bar{\nu}_\ell$ Zerfällen (mit $\ell = e, \mu, \tau$) in Szenarien mit neuer Physik beziehungsweise neu-

en Modellparametern, wobei die gesamte Zerfallskette berücksichtigt wird: Das "Helicity Amplitude Module for Matrix Element Reweighting" oder kurz "HAMMER". In diesem Vortrag werden der Status der HAMMER-Implementierung und seine Funktionalitäten vorgestellt.

T 88.3 Do 17:00 Z6 - SR 2.006

Measurement of inclusive $|V_{ub}|$ and the shape function of the B meson — Florian Bernlochner, Lu Cao, William Sutcliffe, and •Raynette van Tonder — Karlsruhe Institute of Technology, Germany

$|V_{ub}|$ is the least known element of the CKM matrix and plays an important role in testing the unitary of the CKM matrix. One method to determine this parameter is to measure the rate of inclusive $B \to X_u l\nu$ decays in a region of phase space where the abundant background from the CKM flavoured $B \to X_c l\nu$ decays is suppressed. However, predictions in this region are sensitive to the Fermi motion of the b-quark inside the B meson which is described by a non-perturbative distribution function called the shape function. In order to make use of the experimentally precise regions of phase space an alternative approach has been proposed in which key kinematic differential distributions of $B \to X_u l\nu$ decays are measured and combined into a single global fit to simultaneously determine $|V_{ub}|$, as well as the shape function. This analysis on the full dataset of the Belle experiment consisting of 772 million $B\bar{B}$ pairs, recorded at the KEK-B factory, aims to perform the first measurement of the differential distributions of $B \to X_u l\nu$ decays. By making use of the fully reconstructed hadronic B tag various kinematic variables of the signal side can be accessed, for example the hadronic mass spectrum. This talk presents the current analysis status, with a focus on optimising the event selections necessary for background suppression.

T 88.4 Do 17:15 Z6 - SR 2.006

Background studies of $B \to K^{(*)}\nu\bar{\nu}$ decays at Belle II — •James Kahn and Thomas Kuhr — LMU Munich

The $B \to K^{(*)}\nu\bar{\nu}$ decays provide theoretically clean, experimentally measurable instances of the flavour changing neutral current process $b \to s\nu\bar{\nu}$, which presents an excellent opportunity to investigate physics beyond the standard model. The missing energies of the two neutrinos make the measurement experimentally challenging and require the reconstruction of the spectator B meson in $e^+e^- \to \Upsilon(4S) \to B\bar{B}$ events. Observation of the $B \to K^{(*)}\nu\bar{\nu}$ decays will only become possible with the large data set that will be collected at the upgraded Belle II detector at the SuperKEKB accelerator in Tsukuba, Japan. A challenge of this decay analysis will be the understanding and suppression of the backgrounds. This talk presents a status update on the ongoing analysis preparation and progress of the development of new techniques to identify and simulate background events in sufficient volumes for statistical analysis.

T 88.5 Do 17:30 Z6 - SR 2.006

Improvements in JetFitter reconstruction algorithm — •Arunika Sahu — University of Wuppertal

The tagging of b jets is a key ingredient of data analysis in the realm of high energy physics. The long lifetime of b-hadrons and their relatively high mass are the main features which are exploited in b tagging algorithms.

The JetFitter algorithm belongs to the category of secondary vertex reconstruction algorithms. The topological structure of weak b and c hadron decays inside a jet are exploited. The assumption of the Jetfitter algorithm is that the primary vertex and the b and c hadron decay vertices all lie on the same line of flight path of b hadron.

In order to improve the performance of the algorithm, the rejection of the two track vertices corresponding to fake vertices formed in light jets, needs to be optimised. These fake vertices are mostly originating from interactions in detector material leading to production of long lived particles like Ks mesons and lambda baryons or photon conversions. The rejection of these fake vertices results in an improvement of the performance of the algorithm. This improvement has been studied and will be shown in this presentation.

T 88.6 Do 17:45 Z6 - SR 2.006

Teilchenidentifikation mit dem LHCb-Experiment für Tests der Lepton-Flavour-Universalität — •Alex Seuthe und Johannes Albrecht — Technische Universität Dortmund

Die Unterscheidung von Myonen, Elektronen und Hadronen ist einer der wichtigsten Bestandteile von Physikanalysen des LHCb-Experiments, welche nach Physik jenseits des Standardmodells in seltenen Zerfällen suchen. Aktuelle Messungen weisen auf Abweichungen der Theorieerwartungen in Tests zur Lepton-Flavour-Universalität, wie zum Beispiel dem Verhältnis R_{K^*} der Verzweigungsverhältnisse der Zerfälle $B \to K^*\mu^+\mu^-$ und $B \to K^*e^+e^-$, hin. Unter der Annahme der Lepton-Flavour-Universalität ist die schwache Kopplung an Elektronen und Myonen gleich. Die Teilchenidentifikation ist ein wichtiges Werkzeug, um zwischen den Leptonen der beiden Endzustände des Verhältnisses unterscheiden zu können. In diesem Vortrag wird eine aktuelle Studie zur Teilchenidentifikation und deren Kalibrierung in Tests der Lepton-Flavour-Universalität mit R_{K^*} vorgestellt.

T 88.7 Do 18:00 Z6 - SR 2.006

Photon rejection at the NA62 experiment for the measurement of $K^+ \to \pi^+\nu\bar{\nu}$ and the search for $\pi^0 \to$ *invisible* decays — •Letizia Peruzzo — Johannes Gutenberg University Mainz

In September 2016 the NA62 experiment at CERN began its physics data taking to collect in three years around 100 $K^+ \to \pi^+\nu\bar{\nu}$ events and measure the branching ratio with a precision of about 10%.
Well predicted inside the Standard Model, $\mathcal{BR}(K^+ \to \pi^+\nu\bar{\nu}) = (8.4 \pm 1.0) \cdot 10^{-11}$, this decay is closely related to the CKM matrix elements $|V_{td}|$ and $|V_{ts}|$ and any deviation from the theoretical branching ratio would be a clear sign of physics beyond the Standard Model.
The suppression of the main K^+ decays, which have branching fractions several orders of magnitude higher than the $K^+ \to \pi^+\nu\bar{\nu}$ signal, is crucial for the success of NA62. A rejection power of 10^{-12} on the decay $K^+ \to \pi^+\pi^0$ ($\mathcal{BR} \sim 21\%$) is required using kinematic $\mathcal{O}(10^{-4})$ and π^0 rejection $\mathcal{O}(10^{-8})$.
A direct spin-off of the $K^+ \to \pi^+\nu\bar{\nu}$ measurement is the search for the decay $\pi^0 \to$ *invisible* where the π^0 is tagged by $K^+ \to \pi^+\pi^0$ decays. The same signature of $\pi^0 \to$ *invisible* with respect to the $K^+ \to \pi^+\nu\bar{\nu}$ signal allows to perform the two measurements using the same dataset and analysis.
This talk describes the analysis of the photon rejection using the NA62 data collected in 2016.

T 88.8 Do 18:15 Z6 - SR 2.006

Weiterentwicklungen des Flavour-Taggings am LHCb-Experiment — Alex Birnkraut, •Quentin Führing, Kevin Heinicke und Vanessa Müller — Experimentelle Physik 5, TU Dortmund

Die indirekte Suche nach Neuer Physik mit Hilfe von Präzisionsmessungen ist wesentlicher Bestandteil des LHCb-Physikprogramms. Dieses beinhaltet Messungen von *CP*-Verletzung in der Interferenz zwischen Zerfall und Zerfall nach Mischung neutraler B-Mesonen. Der hierzu benötigte initiale Flavour der B-Mesonen wird unter Verwendung verschiedener Algorithmen des sogenannten Flavour-Taggings bestimmt.

Durch die auf 13 TeV erhöhte Schwerpunktsenergie der in 2015 angelaufenen zweiten Datennahmeperiode ergeben sich veränderte Bedingungen, wie größere Teilchenimpulse und erhöhte Spurmultiplizitäten. Daher werden die Flavour-Tagging-Algorithmen im Zuge einer Reoptimierung an die neuen Gegebenheiten angepasst.

Um das Flavour-Tagging darüber hinaus weiter zu verbessern werden weitere Optionen neuer Algorithmen getestet. Eine solche Neuentwicklung ist der SSK^*-Tagging-Algorithmus. Dieser soll unter Ausnutzung von $K^{*0}(892)$-Mesonen, die bei der pp-Kollision entstehen, zu einer besseren Performanz bei der Bestimmung des initialen Flavours der B^0-Mesonen führen.

T 89: Detektorsysteme III

Zeit: Donnerstag 16:30–19:00 Raum: Z6 - SR 2.007

T 89.1 Do 16:30 Z6 - SR 2.007

Particle track reconstruction at BelleII using a Combinatorial Kalman Filter — •Miriam Künzel — DESY Hamburg — LMU Munich

This talk presents implementations of a Combinatorial Kalman Filter approach for the track reconstruction in the BelleII detector. After shortly presenting main features of the BelleII tracking framework, the general concept of a Kalman filter is described and why it is useful for tracking algorithms. To go into more detail, the workflow of one of the current Kalman filter implementations is presented. Current results and impact on to the BelleII physics are shown as well.

T 89.2 Do 16:45 Z6 - SR 2.007

Validierung eines auf tiefen neuronalen Netzen basierenden Flavor Tagging Algorithmus am Belle und Belle II-Experiment — Florian Bernlochner, Michael Feindt, Thomas Hauth, Martin Heck, •Jochen Gemmler und Pablo Goldenzweig — KIT

Das Belle II-Experiment am SuperKEKB Speicherring in Japan befindet sich derzeit im Aufbau und wird Anfang 2019 B-Mesonen-Paare in einer noch nie dagewesenen instantanen Luminosität erzeugen. Messungen zur CP-verletzenden Asymmetrie beim Zerfall eines $B^0\bar{B}^0$-Paares in einen CP-Eigenzustand f_{CP} und den Endzustand f_{tag} sind ein wichtiges Forschungsvorhaben des Experiments. Zur Bestimmung der zeitabhängigen CP-Asymmetrie wird der Flavor des zu f_{tag} gehörigen B-Mesons aus einem flavor-spezifischen Zerfallskanal von den Endzustandsteilchen abgeleitet. Dieser Prozess wird als Flavor Tagging bezeichnet und nutzt bestimmte Attribute der jeweiligen Zerfallstopologie. Der Einsatz eines tiefen neuronalen Netzes bietet eine Alternative zu dem bisherigen, auf Boosted Decision Trees basierenden, Ansatz bei dem Eingangsvariablen konstruiert werden müssen, die über den grundlegenden Ereignisinhalt wie Spuren und Cluster hinausgehen.

In diesem Vortrag wird eine erstmalige Validierung des auf neuronalen Netzen basierenden Ansatzes auf dem vollen Datensatz des Belle Experiments, der 772 Millionen B-Mesonpaare beinhaltet, vorgestellt.

T 89.3 Do 17:00 Z6 - SR 2.007

Pileup effect removal in shower shape of photon ID — •Binish Batool, Ivor Fleck, and Yichen Li — University of Siegen, Siegen, Germany

In this presentation the shower shapes of photons in the calorimeter of the ATLAS detector are investigated. The presence of in-time pile up causes some deviation in the distribution of the shower shapes of photons. This deviation is studied by using an efficient estimator i.e. average energy density in eta regions; $|\eta| < 1.5$ (central energy density) and $1.5 < |\eta| < 3.0$ (forward energy density). The choice of this estimator depends on its correlation with shower shapes. The correction of shower shapes employs a subtraction method at derivation level, to remove the pile up effect. For this, an eta dependent energy density and area of corresponding cells are used, which results in a removal of the pile-up effect.

T 89.4 Do 17:15 Z6 - SR 2.007

Track-based Mulitple Scattering Tomography — •Paul Schütze and Hendrik Jansen — Deutsches Elektronen-Synchrotron DESY, Hamburg, Deutschland

In detectors for particle physics experiments, not only the minimization, but also the determination and localization of the material budget is crucial due to its large impact on simulation and event reconstruction. Using a charged particle beam in the GeV-range and a high-resolution beam telescope, the material budget of any device can be determined and localized precisely by measuring the position-resolved scattering angle distribution of the particle beam. Illuminating the sample from various directions and using an inverse radon transform, this method furthermore enables three-dimensional, tomographic imaging.

With these techniques, samples of high density can be investigated, exceeding the corresponding limits of X-ray imaging by far. Therefore, the method of material budget imaging has the potential of becoming a highly valuable tool also for applications outside of high-energy physics.

In this contribution, we will present the method of material budget imaging and its potential and limits and show first results of track-based multiple scattering tomography measurements performed at the DESY Test Beam Facility.

T 89.5 Do 17:30 Z6 - SR 2.007

Simulationsstudien zur Abschirmung eines Germanium-Detektors — Marcel Gerhardt, Claus Gössling, Kevin Kröninger, Christian Nitsch und •Hannah Rullkötter — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, Otto-Hahn-Straße 4a, 44227 Dortmund

Die Dortmund Low Background Facility (DLB) besteht aus einem hochreinen Germanium-Detektor, welcher von einer inneren Abschirmung bestehend aus Blei, Polyethylen und Elektrolytkupfer und einer massiven äußeren Abschirmung bestehend aus Barytbeton und Gusseisen umgeben ist. Die äußere Abschirmung entspricht 10 Meter Wasseräquivalent. Aufgrund dieser Abschirmungen erreicht die DLB eine hohe Untergrundreduktion im Vergleich zu Systemen mit kleinerer Abschirmung.

Ziel des Projektes ist es auch für Systeme mit einer weniger aufwendigen Abschirmung einen möglichst geringen Untergrund und damit eine hohe Sensitivität zu erreichen. Dazu wird ein Untergrundspektrum simuliert und dessen Reduktion durch geeignete Variation von Abschirmungen quantifiziert. Der Einfluss der Umgebungsradioaktivität lässt sich zum Beispiel mit einer Bleischicht stark reduzieren. Allerdings leisten auch intrinsische Effekte in der Abschirmung einen Beitrag zum Untergrund. Um die intrinsische Radioaktivität abzuschirmen werden weitere Materialschichten benötigt, welche in den Simulationen berücksichtigt werden.

T 89.6 Do 17:45 Z6 - SR 2.007

Tracking of charged particles using an FE-I4B pixel telescope and moving emulsion films — Markus Cristinziani, Fabian Hügging, Jens Janssen, Vadim Kostyukhin, •Nikolaus Owtscharenko, and David-Leon Pohl — Physikalisches Institut der Universität Bonn

The SHiP collaboration plans a general purpose fixed-target experiment to search for hidden particles at a new beam-dump facility at the CERN SPS. To estimate the total charm cross-section in the final experiment, which includes hadronic cascade production, a dedicated measurement will be performed in 2018. Protons from the SPS interact with a multilayer target, that is interleaved with tracking emulsion films. Silicon pixel detectors behind the target will complement the high spatial resolution of emulsions with a high timing resolution.

In order to develop this tracking system, a telescope with five planes of ATLAS IBL modules has been operated in the SPS beam together with two emulsion films moving perpendicularly to the beam. This talk reports on the combined operation and first results of the 2017 test beam.

T 89.7 Do 18:00 Z6 - SR 2.007

The Mu3eGamma upgrade to the Mu3e experiment — •Hendrik Leuschner for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment investigates the potential LFV decay $\mu \to eee$ with a final target sensitivity of 1 in 10^{16} at the Paul Scherrer Institute. Muons from a high intensity beam are stopped on a hollow double cone-shaped target. The primary setup consists of four thin silicon detector layers built from high-voltage monolithic active pixel sensors (HV-MAPS). Due to the low momentum of the decay particles, the resolution is mainly determined by multiple scattering. The reconstruction is therefore based on a fast 3-dimensional multiple scattering fit with high performance of up to 100 tracks per 50ns readout frame. Different LFV decay channels can be searched for in addition to $\mu \to eee$. With a potential upgrade called *Mu3eGamma*, the channel $\mu \to e\gamma$ and subsequent $\gamma \to ee$ can be investigated.

The simulated modifications include an additional photon conversion layer and two silicon detector layers with larger radii. The implementation in the Geant4 simulation setup is presented and studies on reconstruction performance and optimization are shown.

T 89.8 Do 18:15 Z6 - SR 2.007

Helium Cooling System for the Mu3e Experiment —

•Constantin Tormann for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment will search for the charged lepton flavour violating decay $\mu \to eee$ with a target sensitivity of one in 10^{16} decays. To reach this sensitivity the Mu3e detector is based on a combination of a silicon pixel tracking system, a scintillating fibre detector and a scintillating tile detector. In order to minimize the effects of multiple coulomb scattering the detector and its cooling system require an ultra low material budget. Cooling with gaseous helium has been chosen as it offers a reasonable compromise between radiation length and cooling potential. For a maximum heat load of 400 mW/cm^2 dissipated by the pixel modules, the cooling system needs to be capable of keeping the temperature below 70°C and temperature gradients as low as possible.

Computational fluid dynamics (CFD) simulations have been used to study the cooling system. This method provides many insights into the temperature and pressure distribution, making it possible to optimize the design. To verify the computational results on the one hand and test the system for mechanical and thermal stress on the other hand, an experimental test stand has been designed.

After a general overview of the cooling system, this talk will focus on the results of the CFD simulations and present the latest progress on the experimental tests.

T 89.9 Do 18:30 Z6 - SR 2.007

Simulation studies of the technical prototype for the Mu3e Tile Detector — •Hannah Klingenmeyer for the Mu3e-Collaboration — Kirchhoff-Institut für Physik, Universität Heidelberg

The goal of the Mu3e experiment is to search for the decay $\mu \to eee$, which violates lepton flavour conservation, with a sensitivity of 10^{-16}. To determine the vertex of the three decay electrons, precise spatial and timing measurements are necessary. One of the detector systems which will determine the time information of the electrons is the Tile Detector, which is based on plastic scintillator tiles read out by Silicon PhotoMultipliers (SiPMs).

In this talk, the status of the technical prototype of the Tile Detector, which is currently under development, will be presented. The design of the prototype has been implemented in a 3D-CAD software, which can be used for simulation studies, e.g. of the heat flow in the detector. These simulations are of particular importance for the optimisation of the mechanical design of the detector, which is constrained by the limited space available within the planned setup of the Mu3e experiment. The simulation results, which will be used to determine the final detector design, will be shown and compared to first measurements taken with the prototype in a laboratory setup.

T 89.10 Do 18:45 Z6 - SR 2.007

Dezentrales Synchronisationsystem für ein Sensornetzwerk — •Simon Zierke, Dirk Heinen, Peter Linder, Lars Steffen Weinstock und Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University

Für eine synchronisierte Datenerfassung von räumlich verteilten Detektorsystemen, müssen die einzelnen Einheiten mit einer gemeinsamen Zeitbasis arbeiten. Eine solche Zeitbasis kann durch eine dedizierte Synchronisationsleitung verteilt werden. Um diese zusätzliche Leitung zu vermeiden, können weitere Signale wie z.B. GPS oder eine gemeinsame AC-Spannungsversorgung genutzt werden. Das hier vorgestellte Synchronisationssystem nutzt die Nulldurchgänge einer gemeinsamen AC-Spannungsversorgung als zeitliche Referenz und kann einen Trigger mit einem Jitter < 50 ns generieren. Dieses System wurde im Rahmen des EnEx-RANGE Projekts für ein Netzwerk von akustisch-instrumentierten Eisschmelzsonden zur Navigation in Gletschereis entwickelt. Es kann jedoch auch Verwendung in anderen verteilten Detektorsystemen finden. In diesem Vortrag wird das hierfür entwickelte dezentrale Synchronisationssystem und Resultate aus verschiedenen Testszenarien präsentiert.

T 90: DAQ / Trigger II

Zeit: Donnerstag 16:30–19:00 Raum: Z6 - SR 2.010

T 90.1 Do 16:30 Z6 - SR 2.010

Entwicklung von algorithmischer Firmware für den Ausbau des ATLAS Level-1 Jet/Energiesummen-Triggers — •Marcel Weirich, Volker Büscher, Christian Kahra, Elena Rocco, Ulrich Schäfer und Stefan Tapprogge — Johannes Gutenberg-Universität Mainz

In den kommenden Ausbaustufen des LHC werden immer höhere Luminositäten erreicht. Dadurch werden auch immer größere Herausforderungen an das Triggersystem des ATLAS Detektors gestellt. Zusätzlich zu den steigenden Ereignisraten werden die Daten aus den elektromagnetischen und hadronischen Kalorimetern mit erhöhter Granularität übertragen. Um dies für eine effiziente Selektion von Ereignissen zu nutzen, muss das existierende System ausgebaut werden. Bei einer Datenrate von 40 MHz muss in der ersten Triggerstufe eine Entscheidung innerhalb von 2.5 μs getroffen werden.

Der jet Feature EXtractor, kurz jFEX, bildet eine Neuerung für den Ausbau des ATLAS Level-1 Triggers. Ab 2020 wird jFEX in erster Linie für die Identifikation von Jet-Kandidaten und zur Berechnung von Energiesummen eingesetzt. Pro Modul ist eine Eingangsbreite von bis zu 3.1 Tb/s erforderlich, die sich auf 4 Xilinx US+ FPGAs verteilt. Für die dort laufenden Algorithmen stehen maximal 125 ns zur Verfügung. Aus diesem Grund müssen diese eine hochparallele Struktur aufweisen.

In diesem Vortrag wird der aktuelle Stand der Algorithmen-Implementierung vorgestellt.

T 90.2 Do 16:45 Z6 - SR 2.010

A vertical slice of the Mu3e readout system — •Sebastian Dittmeier for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment searches for the charged lepton flavor violating decay $\mu^+ \to e^+e^-e^+$ with an ultimate target sensitivity of one in 10^{16} decays (Phase II). Therefore, a continuous beam of up to 10^9 muons per second is stopped on a target and the decay products are observed.

The Mu3e detector consists of an ultra-thin silicon pixel tracking detector using High Voltage Monolithic Active Pixel Sensors to measure the vertex position and momentum of the decay products, and scintillating fibres and tiles for precise timing. The pixel detector consists of more than 180 million pixels. The resulting data rate that has to be processed is of the order of 1 Terabit per second. All detector components send their data continuously to a software filter farm, where data reduction takes place.

This talk covers the readout components of the pixel detector. The pixel sensors send their hit information continuously via fast serial data links to FPGAs located on the front-end boards where the data is time ordered. Via fast optical links, this data is sent to the switching boards where the data from several detector segments is merged into time slices of the full detector and provided to the computing nodes that perform online event reconstruction and filtering based on graphics processing units. The status of the vertical slice of the readout system is described.

T 90.3 Do 17:00 Z6 - SR 2.010

Kalibrations-Scans und Timing-Studien mit dem ATLAS Pixel Detektor — Marcello Bindi, Jörn Grosse-Knetter, Arnulf Quadt und •Fabian Sohns — II. Physikalisches Institut, Georg-August-Universität Göttingen

Während des laufenden Betriebs des ATLAS Pixel Detektors ist es notwendig, z.B. aufgrund von Strahlungsschäden, die detektornahe Ausleseelektronik kontinuierlich zu überwachen und Parameter neu zu kalibrieren. In der von der ATLAS-Kollaboration entwickelten PixelDAQ-Software sind verschiedene Scans implementiert, welche zwischen den einzelnen Läufen des LHCs den aktuellen Status der einzelnen Module und Pixel überprüfen sowie die Parameter systematisch nachregeln.

Eine wesentliche Aufgabe in Bezug auf die Kalibration ist die Weiterentwicklung des zugrundeliegenden Codes. Insbesondere nach der Anpassung der PixelDAQ-Software an die seit 2015 schrittweise erneuerte Auslese-Hardware gibt es Möglichkeiten zur Optimierung.

In diesem Vortrag werden grundlegende Aspekte der Kalibration vorgestellt sowie Einblicke in den Optimierungsprozess, insbesondere bezogen auf die Laufzeit, gegeben. Eines der Ergebnisse ist ein Zeitprofil verschiedener Scans welches deutlich macht, an welcher Stelle eine Optimierung angebracht ist.

T 90.4 Do 17:15 Z6 - SR 2.010

A DAQ Test System for the CMS Phase 2 Tracker Upgrade — Thomas Eichhorn, •Mykyta Haranko, and Andreas Mussgiller — DESY, Hamburg, Germany

For the upcoming high-luminosity phase of the LHC, the tracking detector of the CMS experiment has to be upgraded. Two types of detector modules are foreseen to be used for the outer tracker regions: so-called 2S and PS modules. Each module type consists of two semiconductor sensors with corresponding front-end electronics for the readout.

As a part of the tracker upgrade R&D, testing infrastructure is being developed, based on the FC7 board. The FC7 is a μTCA-compatible Advanced Mezzanine Card for generic data acquisition and control applications, which is built around the Xilinx Kintex 7 FPGA. The developed firmware is able to control various hardware options, such as different revisions of the readout chips existing now, and is going to be further extended. The resulting DAQ system was tested in the test beams at DESY and FNAL.

This talk will present the current functionality and the development status of the FC7 firmware, and qualification results.

T 90.5 Do 17:30 Z6 - SR 2.010

The XENON Trigger & Data Acquisition System — •Alexey Elykov — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

The XENON1T experiment at the Laboratori Nazionali del Gran Sasso is a liquid xenon-based ton-scale dark matter detector. The scintillation and photoionisation signals that occur in it due to particle interactions are amplified, digitised and recorded by a Trigger and Data Acquisition (TDAQ) system. This system is based on commercial electronics and is equipped with custom-developed firmware. In combination with the High Energy Veto module, it can operate with high efficiency both during the acquisition of dark matter search data and throughout calibration efforts. The successor of the XENON1T experiment, XENONnT will allow us to probe new parameter space of potential dark matter candidates and long sought-after processes, like neutrinoless double beta decay. In this talk, the latest research and developments towards the construction of XENONnT TDAQ will be presented and discussed.

T 90.6 Do 17:45 Z6 - SR 2.010

The Data Handling Processor of the Belle II DEPFET Detector — •Leonard Germic, Tomasz Hemperek, Botho Paschen, Florian Lütticke, Hans Krüger, Carlos Marinas, Jochen Dingfelder, and Norbert Wermes — Physikalisches Institut, Universität Bonn, Deutschland

A two layer highly granular DEPFET pixel detector will be operated as the innermost subsystem of the Belle II experiment, at the new Japanese super flavor factory (SuperKEKB). Such a finely segmented system will allow to improve the vertex reconstruction in such ultra high luminosity environment but, at the same time, the raw data stream generated by the 8 million pixel detector will exceed the capability of real-time processing due to its high frame rate, considering the limited material budged and strict space constrains. For this reason a new ASIC, the Data Handling Processor (DHP) is designed to provide data processing at the level of the front-end electronics, such as zero-suppression and common mode correction. The driving capability of the Gigabit Serial Link of the DHP is summarized and simulations of the signal integrity including the back-end-transmission-line system is shown.

T 90.7 Do 18:00 Z6 - SR 2.010

Spurfindung im SciFi-Tracker des LHCb-Experimentes mit Grafikkarten — Lars Funke, •Holger Stevens und Julian Surmann — Experimentelle Physik 5, TU Dortmund

Das LHCb-Upgrades im Jahr 2019 umfasst den Austausch der bisherigen Tracking-Stationen durch den SciFi-Tracker. Dieser besteht aus szintillierenden Fasern mit einem Durchmesser von 0,25 mm, die zu Matten verklebt werden. Nach dem Upgrade gibt es keine Hardwarekomponente mehr im Triggersystem, da dieses vollständig in Software umgesetzt wird.

Um die Datenmenge der triggerlosen Auslese online verarbeiten zu können, muss die Leistungsfähigkeit der Rechnerfarm erhöht werden. Eine Möglichkeit ist die Integration von Grafikprozessoren (GPU). Die Architektur einer GPU ist für die parallele Ausführung von vielen Prozessen optimiert. Da die Spuren im SciFi-Tracker unabhängig voneinander sind, kann eine Rekonstruktion parallel durchgeführt werden. In diesem Vortrag werden die aktuellen Ansätze zur Spurfindung und die bisherigen Ergebnisse vorgestellt.

T 90.8 Do 18:15 Z6 - SR 2.010

Entwicklung und Test des "jet Feature Extractor" Trigger-Moduls für den ATLAS Level-1 Kalorimeter-Trigger — Volker Büscher, •Christian Kahra, Stefan Rave, Elena Rocco, Ulrich Schäfer, Stefan Tapprogge, Julio Vieira de Souza und Marcel Weirich — Inst. für Physik, Universität Mainz

Mit dem bevorstehenden "Phase-I" Ausbau des Large Hadron Colliders (LHC) werden zeitgleich auch die Triggersysteme der Experimente am LHC erweitert, um trotz der höheren Ereignisrate weiterhin sensitiv für seltene Prozesse zu sein. In diesem Vortrag wird die Hardware-Entwicklung für eines der neuen Trigger-Systeme, dem *jet Feature EXtractor* (jFEX), für den ATLAS Level-1 Kalorimeter-Trigger vorgestellt. Aufgabe dieses neuen Systems wird die Identifikation von Jets und Taus sowie die Berechnung von Energiesummen sein. Jedes der insgesamt sechs Module des jFEX wird kontinuierlich ≈ 3.1 Tbit/s an Kalorimeter-Daten empfangen, welche in den vier Prozessor-FPGAs des Moduls in ≈ 300 ns in Echtzeit verarbeitet werden. Diese hohe Bandbreite wird benötigt, um sowohl eine feinere Kalorimeter-Granularität als auch die Identifikation von wesentlich größeren Jets und Taus als bisher zu erreichen.

Die Einhaltung der Signal-Integrität der Hochgeschwindigkeits-Datenleitungen wie auch der hohe Leistungsbedarf der FPGAs stellten hohe Anforderungen an das Hardware-Design. Der Vortrag stellt die Entwicklung dieses dichtbestückten ATCA-Moduls, die Simulation der Leiterplatine und die Test-Ergebnisse der Prototypen vor.

T 90.9 Do 18:30 Z6 - SR 2.010

Online data reduction with FPGA-based track reconstruction for the Belle II DEPFET Pixel Detector — •Bruno Deschamps, Christian Wessel, Jochen Dingfelder, and Carlos Marinas — University of Bonn

The innermost two layers of the Belle II vertex detector at the KEK facility in Tsukuba, Japan, will be covered by high-granularity DEPFET pixel sensors (PXD). The large number of pixels leads to a maximum data rate of 256 Gbps, which has to be significantly reduced by the Data Acquisition System. For the data reduction the hit information of the surrounding Silicon strip Vertex Detector (SVD) is utilized to define so-called Regions of Interest (ROI). Only hit information of the pixels located inside these ROIs are saved. The ROIs for the PXD are computed by reconstructing track segments from SVD data and extrapolating them to the PXD. The goal is to achieve a data reduction of up to a factor of 10 with this ROI selection. All the necessary processing stages, the receiving, decoding and multiplexing of SVD data on 48 optical fibers, the track reconstruction and the definition of the ROIs will be performed by the Data Acquisition Tracking and Concentrator Online Node (DATCON). The planned hardware design is based on a distributed set of Advanced Mezzanine Cards (AMC) each equipped with a Field Programmable Gate Array (FPGA). In this talk, the current status of the DATCON hardware as well as the plans for the upcoming PHASE2 are presented

T 90.10 Do 18:45 Z6 - SR 2.010

Improved timing of the ATLAS Level-1 Calorimeter Trigger to 1 ns precision — •Fabrizio Napolitano and Oleg Brandt — Kirchhoff-Institut für Physik, U. Heidelberg

The Level-1 Calorimeter Trigger (L1Calo) is an important part of the ATLAS Level-1 Trigger system, designed to identify electrons, jets, photons and hadronic tau candidates, as well to measure their transverse energies, total transverse energy and missing transverse energy. The correct timing of the 7168 trigger towers ensures an optimal performance of the L1Calo system. The timing information can be extracted by analysing the shapes of the L1Calo signals. Using beam splash and proton-proton collision data recorded in 2017, a timing precision of 1 ns is achieved. A similar performance is attained for the on-board timing scans, which serve to monitor the stability of the timing over time.

T 91: Experimentelle Methoden der Astroteilchenphysik IV

Zeit: Donnerstag 16:30–19:00 Raum: Z6 - SR 2.011

T 91.1 Do 16:30 Z6 - SR 2.011

Characterization tests of the photomultipliers for XENONnT — •Oliver Wack for the XENON collaboration — MPIK, Heidelberg, Germany

For the upgrade of XENON1T to the XENONnT TPC, about 300 additional photomultipliers (PMTs) are required. The Hamamatsu R11410-21 PMT was chosen for XENON1T due to its very low intrinsic radioactivity and high quantum efficiency. Recent investigations on light emission from within the tube led to slight improvements in the design of the new PMTs for XENONnT. In addition to the characterization test performed before, the procedure is improved in order to identify possible vacuum losses at cryogenic temperatures. This includes several cooling cycles to also investigate the stability of the dark-count-rate and effects of light-emission during cryogenic operation. The possible leakage into the tube is identified by a change in the after-pulse spectra before and after cooling.

This talk will also cover the performance of the PMTs during the operation in XENON1T.

T 91.2 Do 16:45 Z6 - SR 2.011

Low-energy calibration of liquid xenon detectors using an Ar-37 internal source — •Daniel Wenz[1], Matteo Alfonsi[1], Christopher Geppert[2], Christopher Hils[1], David Maksimovic[1], Melanie Scheibelhut[1], Pierre Sissol[1], and Uwe Oberlack[1] — [1]Johannes Gutenberg-Universität Institut für Physik — [2]Johannes Gutenberg-Universität Institut für Kernchemie

Liquid xenon time projection chambers (LXeTPC) for Dark Matter search have reached the ton-scale (XENON1T), and due to the excellent self shielding properties of the medium, internal radiation sources have become a standard tool for electronic recoil calibrations. The focus has been on low-energy beta emitters such as tritiated methane or Rn-220, and on Kr83m, which, however, yields two photons in short time sequence. At the low-energy threshold, a well-defined line source is still missing. We present an approach for such a calibration with the MainzTPC, a local LXeTPC developed by the group, together with an Ar-37 source generated at the Mainz TRIGA reactor from Ar-36. Ar-37 decays through electron capture to Cl-37 and allows a calibration of mono-energetic electron recoil events at 0.27 keV and 2.8 keV.

T 91.3 Do 17:00 Z6 - SR 2.011

Optical simulations of the XENON1T experiment and comparison to data — •Lutz Althüser — IKP, Westfälische Wilhelms-Universität Münster

The XENON Dark Matter Project uses a dual-phase xenon time projection chamber (TPC) for a direct detection of weakly interacting massive particles (WIMPs). The current operating step, XENON1T, is the most sensitive direct detection dark matter experiment in the world.

Therefore, the TPC is build to detect low intensity light signals, generated directly by the recoil of incoming scattered particles (S1) or through proportional scintillation (S2) from the electrons generated in the scattering process and drifted into the xenon gas phase. The light collection efficiency (LCE) of these signals depends on the position of the interaction in the active volume and on optical properties of the materials. The resulting LCE map is used as an input parameter for waveform simulations which converts GEANT4 interactions to actual photomultiplier tube (PMT) signals that can be processed with the XENON1T data processor.

A validation of the generated LCE maps with calibration data using simulations as well as the comparison of simulated and measured waveforms will be shown.

This work is supported by BMBF under contract 05A17PM2.

T 91.4 Do 17:15 Z6 - SR 2.011

Radon mitigation for rare-event searches using surface treatments — •Guillaume Eurin, Hardy Simgen, and Florian Joerg — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

In the current state of rare event searches such as direct dark matter detection with the XENON1T detector, radon is a dominating background source. Present in the natural radioactivity decay chains of ^{238}U and ^{232}Th, it is a noble gas that can be emanated from any detector material.

Several strategies have been adopted by low-background experiments in astro-particle physics to tackle this issue. Materials are screened and selected for radio-purity, detector manufacturing is tightly controlled and surface cleaning techniques are explored. A novel solution could be the coating of the surface of materials emanating radon with a thin metallic layer to reduce radon emanation. Investigations have been carried out with industrial partners in order to quantify this reduction and compatibility tests with the operation of a liquid noble gas time projection chamber will be demonstrated in a dedicated setup.

This talk will highlight the promising results already obtained and potential leads for future improvement.

T 91.5 Do 17:30 Z6 - SR 2.011

Investigation of PEN as structural self vetoing material for cryogenic low background experiments — •Felix Fischer for the GERDA-Collaboration — Max-Planck-Institut für Physik, München, Deutschland

Polyethylene Naphthalate (PEN) has recently been shown to scintillate in the deep blue spectrum. It can be produced with high radiopurity which makes it suitable for a wide field of applications in low background experiments like the search for neutrinoless double-beta decay. It is known that some scintillators change in efficiency and behaviour when cooled down to cryogenic temperatures. In order to investigate whether PEN shows similar behaviour, an experiment has been designed and constructed at the Max-Planck-Institute for physics in Munich. First results of PEN properties at cryogenic temperatures will be shown.

T 91.6 Do 17:45 Z6 - SR 2.011

Improved liquid argon scintillation light readout for Gerda Phase II — •Patrick Krause[1], Maria Fomina[1,2], Konstantin Gusev[1,3], Jozsef Janicsko[2], Oskar Moras[1], Vlad Samoil[1], Stefan Schönert[1], Egor Shevchik[2], Christoph Wiesinger[1], and Marisa Zengerle[1] — [1]Physik-Department and Excellence Cluster, Technische Universität München, Garching, Germany — [2]Joint Institute for Nuclear Research, Dubna, Russia — [3]now at Leibniz-Institut für Kristallzüchtung, Berlin, Germany

Liquid Argon (LAr) scintillates upon interaction with ionizing radiation. In this process light with a wavelength of 128 nm is emitted. With the help of so-called wave length shifting (WLS) fibers and silicon photomultipliers (SiPMs) this property is exploited in Gerda's active background suppression strategy to reject events with coincident energy deposition in the germanium detectors and the surrounding LAr. An improved version of the WLS fiber-modules and the SiPM-readout has been developed. This talk will report the changes, challenges and improvements compared to the previous design.

This work has been supported by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

T 91.7 Do 18:00 Z6 - SR 2.011

Characterization of surface cleaning procedures for liquid noble gas detectors — •Pablo Herrero Gómez — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Adequate surface cleaning procedures of materials constituting fiducial volumes are crucial in many liquid noble gas detectors used in direct dark matter or $0\nu\beta\beta$ decay searches. On one hand, surface cleaning reduces residual lubricants from the production processes as well as potential background sources like radon daughters plated out on the detector's materials. On the other hand, inappropriate cleaning procedures might have a negative effect on the gas purity of noble gas detector due to outgassing. In this talk I introduce strategies to probe standard surface cleaning procedures for their applicability in liquid noble gas detectors. With dedicated experimental setups, various possibilities for background mitigation, so as outgassing minimization, can be investigated and mutual influences between each other can be studied.

T 91.8 Do 18:15 Z6 - SR 2.011

Performance of a custom designed prototype inverted coaxial HPGe detector for Legend — •Tommaso Comellato, Matteo Agostini, Andrea Lazzaro, Christoph Wiesinger, and Stefan

Schönert — Technische Universität München, Garching, Germany

Initially, the newly formed Legend collaboration plans to operate up to 200 kg of enriched germanium detectors in the upgraded Gerda infrastructure at Lngs, Italy. The science goal is to search for the neutrinoless double beta decay of ^{76}Ge. In the current Gerda and Majorana Demonstrator experiments, enriched HPGe detectors with excellent pulse shape discrimination (PSD) properties are being operated. Their masses are however typically below one kilogram. To reduce backgrounds from close by parts as cables and holders, larger mass detectors without compromising the PSD performance are required for Legend. A novel detector geometry, referred to as inverted coaxial, is now the baseline design of Legend HPGe detectors. A custom designed inverted coaxial detector with 1.6 kg mass was produced in collaboration with Baltic Scientific Instruments and the Helmholtz Research Center Rossendorf, and is currently comprehensively characterized at TUM. In this talk I will present the latest results about the performance of this detector including the charge collection, signal shape properties and pulse shape discrimination performance.

This work has been supported by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

T 91.9 Do 18:30 Z6 - SR 2.011

Extraction of Stopping Muons in IceCube Using Machine Learning — •Tobias Hoinka, Mathis Börner, Mirco Hünnefeld, Joshua Luckey, Max Meier, Thorben Menne, Felix Neubürger, Jan Soedingrekso, and Jan Spinne — TU Dortmund

IceCube is a neutrino observatory located at the South Pole, consisting of digital optical modules that detect Cherenkov light emitted from charged particles traversing the Antarctic ice sheet. The most dominant source of background in the search for neutrinos are atmospheric muons produced in interactions of cosmic rays in the upper atmosphere. At a trigger rate of about 3000 Hz, they also provide a valuable source of information about cosmic rays. A special subset of atmospheric muon events are muon events that contain only muon tracks that end within the detector volume. These stopping muons exhibit features that have interesting implications for both cosmic-ray physics and calibration purposes. In order to extract a sample of stopping muons of high purity, a supervised machine learning approach is used.

In this talk, an overview of the employed methods is given. The properties of the extracted sample are discussed and an unfolding of the muon range spectrum is presented.

T 91.10 Do 18:45 Z6 - SR 2.011

Studies on the time-over-threshold readout of the multi-PMT optical module — •Daniel Guderian and Alexander Kappes — Institut für Kernphysik, Westfälische Wilhelmsuniversität Münster

The multi-PMT Digital Optical Module is a promising candidate for the optical sensors in the planned upgrade of the IceCube detector. It offers, amongst other properties, superior directional sensitivity and larger effective volume when compared to the current sensors. Due to tight energy budget restrictions in a multi-PMT design a power-efficient multi-level time-over-threshold (ToT) readout will be utilized. Studies on optimizing the threshold levels have been carried out using a simulation of the ToT sampling of input signals and the subsequent deconvolution of pulses. The studies include the generation and reconstruction of single photoelectron pulses as well as the directional reconstruction of real high-energy IceCube events with complex PMT signals applying a ToT algorithm. Results characterizing an optimized setup will be presented.

T 92: Neutrinophysik IV

Zeit: Donnerstag 16:30–18:40 Raum: Z6 - SR 2.012

Gruppenbericht T 92.1 Do 16:30 Z6 - SR 2.012

Results on the search for neutrinoless double beta decay from GERDA Phase II — •Anna Julia Zsigmond for the GERDA-Collaboration — Max-Planck-Institut für Physik

The Gerda (GErmanium Detector Array) experiment, located at the Laboratori Nazionali del Gran Sasso, is searching for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Since the end of 2015, in Phase II of the experiment, 35 kg of enriched high-purity germanium detectors are operated in liquid argon (LAr), that serves as cooling medium for the detectors as well as active shield against external radiation. The aim is to reach a sensitivity on the $0\nu\beta\beta$ decay half-life larger than 10^{26} yr. This is possible with a background level of 10^{-3} cts/(keV·kg·yr) and an exposure of about 100 kg·yr. The background level has been achieved by using the scintillation light of the LAr for background rejection and by using BEGe type detectors with superior pulse shape discrimination properties. In this talk the details of the analysis and the latest half-life limit of the $0\nu\beta\beta$ decay search will be presented.

T 92.2 Do 16:50 Z6 - SR 2.012

Understanding Pulse Shape Discrimination in Germanium Detectors: Diffusion Effects — •Barbara Schweisshelm for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

The Gerda experiment is searching for neutrinoless double beta ($0\nu\beta\beta$) decay in ^{76}Ge using high purity Germanium detectors. To reach sensitivities for the $0\nu\beta\beta$ decay half-life of $>10^{26}$ years the energy region of interest needs to be background free during the run time of the experiment. A crucial requirement to assure this is an excellent discrimination of signal and background like events. For this purpose pulse shape discrimination of the germanium detector signals is utilized. In the case of BEGe type detectors the ratio of the maximum amplitude of the current pulse and the energy, A/E, is used to distinguish between signal and background like events. In order to achieve a better understanding on how the A/E parameter depends on energy, simulations of the signal pulses have been performed. The simulations of charge carrier behavior make it possible to study the effects of charge diffusion, self-repulsion, and the initial charge cloud size on A/E. In this talk the implementation of the diffusion effects in the simulation will be summarized and their influence on the discrimination parameter will be discussed.

T 92.3 Do 17:05 Z6 - SR 2.012

Investigation of the double beta decay of Ge-76 into excited states of Se-76 with Gerda — •Birgit Schneider and Thomas Wester for the GERDA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

Gerda is an experiment searching for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. The observation of such a decay would prove that the neutrino is its own antiparticle, a so called Majorana particle. This could give an indication of the effective Majorana neutrino mass and of the mass hierarchy realized in nature.

The neutrino accompanied double beta ($2\nu\beta\beta$) decay from the 0^+ ground state of ^{76}Ge into the 0^+ ground state of ^{76}Se has been measured by Gerda and its half life could be determined with unprecedented precision. Additionally, ^{76}Ge can also decay into excited states of ^{76}Se, however these transitions are phase space suppressed. The predicted half lives from theoretical calculations vary by several orders of magnitude, because of different nuclear models and their internal parameters. The observation of the $2\nu\beta\beta$ decay of ^{76}Ge into excited states would be able to constrain these models and decrease their uncertainties. Additionally, models of the $0\nu\beta\beta$ decay, that rely on similar assumptions, would be improved.

The excited states analysis of the Gerda data is performed by counting coincident events within the Ge detector array and optimized with the help of Monte Carlo simulations. The talk will present the analysis technique and the first preliminary results of Gerda Phase II.

This project is partially funded by BMBF.

T 92.4 Do 17:20 Z6 - SR 2.012

The cosmic muon induced background in Gerda and its implications for Legend — •Christoph Wiesinger[1], Luciano Pandola[2], and Stefan Schönert[1] — [1]Physik-Department and Excellence Cluster Universe, Technische Universität München, Garching, Germany — [2]INFN Laboratori Nazionali del Sud, Catania, Italy

In-situ production of long-lived isotopes by cosmic muon interactions may generate a non-negligible background for deep underground rare

event searches. Previous Monte Carlo studies identified the delayed decay of $^{77(m)}$Ge as dominant cosmogenic background in the search for neutrinoless double beta decay of ^{76}Ge. This might limit the sensitivity of next generation experiments and thereby define a minimum depth requirement. A re-evaluation of the $^{77(m)}$Ge background for the GERDA (GERmanium Detector Array) experiment at LNGS (Laboratori Nazionali del Gran Sasso) has been carried out by a set of Monte Carlo simulations. State-of-the art active background suppression and simple delayed coincidence cuts lead to a background contribution of $(2.7\pm0.3)\cdot10^{-6}$ cts/(keV·kg·yr) at a reasonable life-time loss of $< 4\%$. Exploiting this active suppression strategy opens the way for next generation rare event searches with LEGEND (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) at LNGS. This work has been supported by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

T 92.5 Do 17:35 Z6 - SR 2.012

Light Detectors Development and Characterization for Cupid $0\nu\beta\beta$ Decay Experiment — •MARIA TERESA BARRERA ROJAS for the CUPID-0-Collaboration — INFN Laboratori Nazionali di Legnaro, Legnaro, Italy

The CUORE Upgrade project CUPID (Cryogenic Underground Observatory for Rare Events Upgrade with Particle IDentification) scientific goal is to explore the inverted hierarchy of neutrino masses and search for the violation of the lepton number due to $0\nu\beta\beta$ decay. One of its R&D lines of the CUPID project combines semiconducting light detectors and $Zn^{82}Se$ bolometric-scintillator crystals to simultaneously detect the light emitted by an event in the bolometer itself, allowing the discrimination of α particles from γ/e.

Identification of the natural induced radioactivity (mostly α) allows to reach the zero-background operation conditions. One of the main challenges is the small amount of light transmitted to the detector, but it can be enhanced by incorporating anti-reflective coatings. This talk will discuss the status of the experiment, the optimization of the light transmittance and optical characterization of the detectors.

Gruppenbericht T 92.6 Do 17:50 Z6 - SR 2.012

The Stereo Experiment: the Search for eV Sterile Neutrinos — •HELENA ALMAZÁN, CHRISTIAN BUCK, JULIA HASER, MANFRED LINDNER, CHRISTIAN ROCA, and STEFAN SCHOPPMANN — Max-Planck-Institut für Kernphysik (Heidelberg)

Nuclear reactors are an intense and pure source of low energy electron antineutrinos. In combination with other sources, they have been used to discover and understand neutrino oscillations. However, two unsolved anomalies have appeared during the study of the reactor neutrinos: one related to the neutrino spectral shape, and another to the absolute neutrino flux. The latter, known as the Reactor Antineutrino Anomaly, presents a deficit in the observed flux compared to the expected at very short baselines (distance < 100 meters). This anomaly could point to the existence of a light sterile neutrino participating in the oscillation phenomena, and a way to prove it is the study of the reactor neutrino flux at very short baselines.

The Stereo experiment, taking data since November 2016, is trying to resolve this anomaly. It is placed at 10 meters from the compact, highly enriched ^{235}U fuel element of the research reactor of the Institut Laue Langevin (Grenoble, France). The detector target is segmented in six cells providing a multiple baselines analysis. Oscillations to a sterile neutrino in the eV mass scale can be identified by characteristic distortions in the neutrino energy spectrum of the different cells.

The most recent results of this experiment are going to be presented in this talk.

T 92.7 Do 18:10 Z6 - SR 2.012

Calibration of the Stereo Experiment — •CHRISTIAN ROCA, HELENA ALMAZÁN, CHRISTIAN BUCK, JULIA HASER, MANFRED LINDNER, and STEFAN SCHOPPMANN — Max-Planck-Institut für Kernphysik

The Stereo experiment, running since November 2016 at the ILL Grenoble, aims to test the hypothesis of sterile neutrinos being the cause of the reactor antineutrino anomaly observed at short baselines. The detector is divided in two main volumes each filled with liquid scintillator. The inner volume is segmented in six independent cells corresponding to the neutrino target (TG). It is doped with gadolinium to enhance the detection of the correlated signal produced by the inverse beta decay. Surrounding the TG there is the gamma catcher (GC) volume, optimized to capture escaping gammas originating from interactions in the TG. The energy deposited in the detector is measured as scintillation light that is collected by a set of photomultiplier tubes. The readout charge signals are converted to visible energy by a dedicated non-linear energy scale. To determine the energy scale, detection efficiency and to observe the detector stability, several gamma and neutron sources have been deployed by means of three different calibration systems: an internal set of tubes located within the TG cells, a central rail underneath the detector crossing the TG and GC volume, and an outer pantograph-rail system for 2d calibration around the GC. The calibration runs performed during the phases I and II of Stereo and their use on the energy scale and detection efficiency determination are discussed in this talk.

T 92.8 Do 18:25 Z6 - SR 2.012

Cryogenic Platform and readout for the ECHo experiment — •DOROTHEA FONNESU for the ECHo-Collaboration — Kirchhoff-Institut fuer Physik, Universitaet Heidelberg

The ECHo experiment is designed to investigate electron neutrino mass below 1 eV/c^2 by analyzing the endpoint region of the calorimetrically measured ^{163}Ho electron capture spectrum. Large arrays of low temperature metallic magnetic calorimeters with ^{163}Ho enclosed in the particle absorber are used in ECHo. These detectors are operated well below 100 mK. To run the first phases of ECHo, a costumized dilution refrigerator has been equipped with cable for parallel and multiplexed readout.In this talk the commissioning of the cryogenic platform will be discussed with particular emphasis to the cabling concepts.

For the first phase of the ECHo experiment ECHO-1k, a 64-pixel parallel readout scheme has been optimized for the first measurement of high statistics spectra. We describe the design of the modules to host the chip with the detector array and the front-end SQUIDs as well as of the modules for SQUID-array amplification stage. Finally, we present the performance achieved in first characterization runs for the ECHo-1k experiment.

T 93: Experimentelle Methoden der Astroteilchenphysik V

Zeit: Donnerstag 16:30–19:00 Raum: Z6 - SR 2.013

T 93.1 Do 16:30 Z6 - SR 2.013

Coincident air shower measurements with IceCube and IceTop — •DENNIS SOLDIN for the IceCube-Collaboration — University of Delaware, Bartol Research Institute and Dept. of Physics and Astronomy, Newark, DE 19716, USA

IceCube observes high energy ($\gtrsim$ 500 GeV) muons produced in cosmic ray air showers which are often in time-coincidence with surface data from IceTop. This unique data has been used in various previous analyses of cosmic rays. IceCube's main cosmic ray mass composition analysis, for example, relies on coincident events and the comparison of deep muon and surface energy. This analysis is constrained to events that are contained in IceTop to get a reliable primary energy estimate with existing air shower reconstruction techniques. Thereby, a large fraction of air shower events is discarded, especially from large inclinations above zenith angles of approximately $\theta \simeq 30°$.

We will present a new approach for the reconstruction of in-time coincident events in IceCube and IceTop. It uses events contained in the deep in-ice detector together with information from the surface array at the same time. It will be shown that this method generally improves the resolution of air shower reconstructions. Moreover, accounting for the in-ice information allows reconstruction of events which are far outside of the IceTop surface array. This enables studying events from zenith angles up to roughly $\theta \simeq 60°$ and significantly improves the statistics of successfully reconstructed air shower events. It will be shown that this new technique significantly extends the IceTop acceptance for air shower measurements towards low and high energies.

T 93.2 Do 16:45 Z6 - SR 2.013

Lateral distribution study for the IceTop scintillator ar-

ray — •Agnieszka Leszczyńska[1], Aswathi Balagopal V.[1], Andreas Haungs[1], Thomas Huber[1,2], Donghwa Kang[1], and Max Renschler[1] for the IceCube-Gen2-Collaboration — [1]KIT, Karlsruhe, Germany — [2]DESY, Zeuthen, Germany

IceTop, a surface component of IceCube, is planned to be upgraded with a prospective scintillator array. As a first motivation, the enhancement will provide a reference signal for the IceTop Cherenkov detectors improving the accuracy of shower reconstruction. In the long term it is foreseen to constitute a large veto array discriminating the astrophysical neutrino signal from an atmospheric background. The accompanying improvement of the air-shower measurements has to be preceded with detailed studies of the foreseen array. The generic simulations allow to obtain a parameterization for the particle lateral distributions in the air showers. In addition, more precise simulations of a deposited energy were performed for a deployed prototype module. The proper description of particle lateral distributions registered by scintillation detectors can significantly improve the reconstruction process and optimization of cosmic-ray parameters. This talk will show a simulation study of air-shower properties reconstructed by the proposed scintillator array.

T 93.3 Do 17:00 Z6 - SR 2.013

A prototype hybrid particle and radio detector for the IceCube experiment — •Max Renscher[1], Aswathi Balagopal[1], Andreas Haungs[1], Thomas Huber[1,2], Agnieszka Leszczynska[1], Marie Oehler[1], Harald Schieler[1], Frank G. Schroeder[1], and Andreas Weindl[1] for the IceCube-Gen2-Collaboration — [1]Karlsruher Institut für Technologie - KIT — [2]Deutsches Elektronen-Synchrotron - DESY

A new hybrid particle and radio detector is currently under development to upgrade the IceTop array of the IceCube experiment facing IceCube-Gen2. Using hybrid particle and radio detectors at the IceCube site will not only improve the veto capabilities of IceTop but will also enable the enhanced measurement and reconstruction of Extensive Air Showers (EAS) induced by cosmic rays. Especially with an array of radio antennas triggered by particle detectors, highly inclined EAS can be detected. This gives rise to new science cases, e.g. the search for PeV gamma rays coming from the galactic center which is visible from the IceCube site all over the year at an inclination of 61°. In this presentation, the actual state of the development of the proposed hybrid detectors will be shown, focusing on the radio detection techniques. A possible antenna type will be introduced, first measurements with a prototype array of hybrid detectors will be presented and possible options for a DAQ of the detectors will be discussed.

T 93.4 Do 17:15 Z6 - SR 2.013

Cloud Detection using All Sky Cameras — •Helena Nawrath[1] and Max Nöthe[2] — [1]Technische Universität Dortmund — [2]Technische Universität Dortmund

The observation time of gamma ray telescopes is limited due to bad weather, e.g. clouds or rain; exact knowledge of the atmospheric conditions is therefore crucial for the development of an efficient observation schedule. In clear nights all stars in the sky are observable; with partial cloudiness only certain parts of the sky are observable. It is important to find these cloudless regions in order to make the best use of the available observation time. The search for clouds in the night sky can be carried out using all sky cameras with an opening angle of 180° mounted at the telescope sites. In this master thesis, a method for the detection of clouds in the all sky camera image is developed by searching for bright blobs in the image and comparing them with different star catalogues afterwards. In addition, the determination of the cloudiness over a long period of time is used to characterize future telescope sites with regard to the available observation time in starry nights. This presentation gives a short overview of the developed method and shows how a cloudiness level can be determined. Furthermore, the primary aim of the work, the estimation of the observation time for IceAct, is briefly motivated.

T 93.5 Do 17:30 Z6 - SR 2.013

Measurement of radio emission induced by ultra-high energy cosmic rays at energies above 1 EeV with the Pierre Auger Observatory — •Florian Briechle, Martin Erdmann, and Felix Schlüter for the Pierre Auger-Collaboration — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

Radio emission of extensive air showers is used to reconstruct properties of the ultra-high energy cosmic rays. Owing to the area of 17 km^2 covered by the radio array AERA of the Pierre Auger Observatory, sufficient event statistics for measurements above 1 EeV have been recorded in recent years. Especially interesting are air showers at large zenith angles because they induce sizable footprints covering many radio stations. New challenges in reconstructing these showers arise from the superposition of the two emission mechanisms leading to the radio signal. This leads to an asymmetric energy fluence distribution on ground, even more so for air showers at large zenith angles. This distribution needs to be described with high precision to enable a high quality reconstruction of the properties of the cosmic ray.

We discuss the shower reconstruction with emphasis on the energy estimation where the aim is to provide an absolute energy measurement of the primary cosmic ray from radio techniques exclusively.

T 93.6 Do 17:45 Z6 - SR 2.013

Analytical Multivariate Fit in the Borexino Solar Neutrino Analysis — •Ömer Penek[1], Simone Marcocci[2], and Alina Vishneva[3] for the Borexino-Collaboration — [1]IKP-2, Forschungszentrum Jülich, 52428, Jülich, Germany — [2]Gran Sasso Science Institute, 67100, L'Aquila, Italy — [3]Joint Institute for Nuclear Research, 141980, Dubna, Russia

The Borexino detector, located at the Laboratori Nazionali del Gran Sasso in Italy, is a liquid scintillator detector with a primary goal to measure the solar neutrino fluxes. The spectral fit of the energy spectrum has been performed for the first time in the whole energy range from ~200 keV up to ~2 MeV. This approach made it possible to obtain the fluxes of 7Be, pp, and pep solar neutrinos simultaneously. To increase the sensitivity for pep neutrinos, the multivariate fit technique has been developed, which takes into account additional information of the radial and pulse shape distributions of events. To combine the respective likelihoods with the one of the spectral fit of energy spectra, a consistent theoretical description is needed. An additional challenge is represented by the convergence time of the fit itself. The talk shows the analytical multivariate fitting strategy used to obtain the new Borexino results for the 7Be, pp, and pep rates. We focus ourselves on the construction of the likelihood used in this analysis. This talk is presented in the name of the Borexino Collaboration.

T 93.7 Do 18:00 Z6 - SR 2.013

Neutrinos from Supernovae collapsing into Black Holes in JUNO — •Max Büsken[1], Josina Schulte[1], Florian Kiel[1], Livia Ludhova[2], Achim Stahl[1], Jochen Steinmann[1] und Christopher Wiebusch[1] — [1]III. Physikalisches Institut B, RWTH Aachen University — [2]Institut für Kernphysik, Forschungszentrum Jülich

The 20kt liquid scintillator experiment JUNO (**J**iangmen **U**nderground **N**eutrino **O**bservatory) under construction in southern China, will begin examining the neutrino mass hierarchy in 2020. Due to its large target mass JUNO will be an excellent detector for extraterrestrial neutrinos. If a galactic core-collapse supernova occurs within the lifetime of the detector, it will measure thousands of neutrino events in a timespan of 20 seconds. Core-collapse supernovae have two possible final states, a neutron star or a black hole. With the formation of a black hole the neutrino flux will be cut off almost instantaneously. Based on simulation data an estimation on the neutrino mass limit by delayed neutrinos will be presented in this talk.

T 93.8 Do 18:15 Z6 - SR 2.013

Das Minidex-Experiment zur Vermessung Myonen-induzierter Neutronen — •Raphael Kneissl[1], Iris Abt[1], Allen Caldwell[1], Christopher Gooch[1], Xiang Liu[1], Bela Majorovits[1], Matteo Palermo[2], Qiang Du[3], Oliver Schulz[1] und Laura Vanhoeffer[1] — [1]Max-Planck-Institut für Physik, Deutschland — [2]Now University of Hawaii, US — [3]Sichuan University, China

Die Beobachtung sehr seltener Prozesse, wie z.B des neutrinolosen Doppelbetazerfalls, erfordert extrem strahlungsarme Umgebungen und Detektoren. Um die nötige Sensitivität zu erreichen, ist es wichtig, die noch vorhandenen Strahlungsuntergründe zu unterdrücken und zu verstehen. Ein solcher Untergründe sind Myon-induzierte Neutronen, die außerhalb im Gestein oder direkt in den Abschirmungsmaterialien des Experiments erzeugt werden. Die Neutronenproduktionsraten durch Myonen in verschiedenen Materialien sind nicht genau vermessen. Um genauere Vorhersagen darüber machen zu können, welcher Untergrundbeitrag in zukünftigen Experimenten erwartet wird, wurde der Minidex (Muon induced neutrons indirect detection experiment) Aufbau im Tübinger Untergrundlabor errichtet. Mit diesem Aufbau können Neutronen, die im untersuchten Material durch Myonen induziert wurden,

nachgewiesen werden. Dies geschieht mit HPGe Detektoren, die den thermischen Einfang von Neutronen an Wasserstoffatomen nachweisen. Es sollen Neutronenproduktionsraten in verschiedenen Abschirmmaterialien untersucht werden. Im Vortrag werden Aufbau, Datenanalyse sowie neue Ergebnisse des Minidex-Experiments vorgestellt.

T 93.9 Do 18:30 Z6 - SR 2.013

Demonstrating Electromagnetic Properties of a MADMAX prototype booster — •Jacob Egge for the MADMAX-Collaboration — Max-Planck-Institut für Physik

Axions are a promising candidate for dark matter. The Magnetized Disc and Mirror Axion Experiment (MADMAX) uses dielectric discs to boost axion to photon conversion by the Primakoff-effect. A small scale prototype for the MADMAX experiment is being developed. The purpose of this setup is to demonstrate the ability to understand the electromagnetic properties of a future dielectric haloscope with a given boost factor. This is done by arranging 20 saphire discs with micrometer precision motors in different configurations and measuring reflections of microwaves with a vector network analyzer. By comparing the electromagnetic properties with simulations a boost factor can be inferred. We will present the latest results of this ongoing process with emphasis on the procedure used to optimize discs arrangements.

T 93.10 Do 18:45 Z6 - SR 2.013

KWISP - Hunting Chameleons with the CAST Experiment at CERN — •Justin Baier — University of Freiburg, Germany

The KWISP (Kinetic Weakly Interacting Slim Particle) detector is part of the CAST experiment at CERN exploring the dark sector. It utilizes an ultra-sensitive opto-mechanical force sensor for the search for solar chameleons. A chameleon is a hypothetical scalar particle postulated as dark energy candidate, which has a local density-dependent direct coupling to matter. Considering this characteristic a flux of solar chameleons hitting a solid surface at a grazing incidence angle will, under certain conditions, reflect and exert the equivalent of a radiation pressure. To exploit this trait the KWISP sensor consists of a thin and rigid dielectric membrane placed inside a resonant optical Fabry-Pérot cavity utilizing an active electrooptical feedback system to keep the laser frequency-locked. The reflection of the chameleons off the membrane surface causes a displacement from its equilibrium position, which again will cause cavity mode frequencies to experience a shift. This shift is then sensed in the feedback correction signal. The sensitivity of the detector is determined by the finesse of the cavity and can be enhanced by exploiting the property of the membrane as a mechanical resonator and cooling it down to sub-K temperatures resulting in a projected force sensitivity as low as $\approx 8.0 \times 10^{-18}\mathrm{N}/\sqrt{\mathrm{Hz}}$, yielding various possible applications for the study of new physics.

T 94: Mitgliederversammlung des Fachverbandes Teilchenphysik

Convenor: Thomas Hebbeker

Zeit: Donnerstag 19:15–20:15 Raum: Z6 - HS 0.001

Dauer ca 60 Minuten.

T 95: Hauptvorträge IV

Zeit: Freitag 9:00–10:30 Raum: Z6 - HS 0.004

Hauptvortrag T 95.1 Fr 9:00 Z6 - HS 0.004

Fünf Jahre Higgs-Boson - Was wissen wir? — •Karsten Köneke — Universität Freiburg

Das Higgs-Boson wurde mit den Daten, welche am Large Hadron Collider (LHC) in den Jahren 2011 und 2012 bei Proton-Proton-Schwerpunktsenergien von 7 und 8 TeV von den ATLAS- und CMS-Experimenten aufgezeichneten wurden (Run 1), entdeckt und dessen Kompatibilität mit den Vorhersagen des Standardmodels experimentell bestätigt. Kombinationen der Ergebnisse der ATLAS- und CMS-Kollaborationen haben dabei maßgeblich zu unserer Kenntnis der Eigenschaften des Higgs-Bosons beigetragen. Der Vortrag wird einen Überblick über den aktuellen Kenntnisstand der Eigenschaften des Higgs-Bosons geben, unter anderem dessen Masse und dessen Kopplungseigenschaften an Teichen des Standardmodels. Hierbei werden neueste Ergebnisse der ATLAS- und CMS-Kollaborationen diskutiert, die auf aktuellen Daten des Run 2 basieren, welcher 2015 begonnen hat. Hierbei wurde bei einer höheren Schwerpunktsenergie von 13 TeV bereits ein vielfaches an Higgs-Bosonen im Vergleich zum Run 1 produziert. Diese große Anzahl an Higgs-Bosonen ermöglicht weiterführende Interpretationen der Ergebnisse, die es erlauben detailliertere Informationen über Parameter allgemeiner Modelle zu bestimmen. Direkte Suchen nach weiteren Higgs-Bosonen in erweiterten Modellen werden ebenfalls kurz diskutiert werden.

Hauptvortrag T 95.2 Fr 9:30 Z6 - HS 0.004

Flavour Physics - Prepare for the Rare — •Thorsten Feldmann — Theoretische Physik 1, Universität Siegen

The physics of the different quark flavours has always played an essential role in the construction and confirmation of the Standard Model (SM) of particle physics. Nowadays, dedicated flavour experiments - in particular for rare decays of bottom quarks at "B-factories" or at LHCb - allow to test SM predictions with a high level of precision. In turn, this implies that dynamical effects from energy scales far beyond the direct reach of the Large Hadron Collider could possibly be revealed from the global analysis of flavour observables. In this talk I will give a brief overview about what kind of theoretical challenges have to be addressed in order to connect the phenomenology of hadronic flavour observables with explicit models for flavour physics beyond the SM.

Hauptvortrag T 95.3 Fr 10:00 Z6 - HS 0.004

Solars, steriles and coherent scattering - what is new in low-energy neutrinos? — •Michael Wurm — Johannes Gutenberg Universität Mainz

Low-energy neutrinos have proven to be versatile probes for the investigation of oscillation physics and study of astrophysical neutrino sources. Only recently, Borexino has released data from its second observation phase, once again improving our understanding of the solar pp chain and providing new input data for the debate on solar metallicity. Meanwhile, the hunt for light eV-mass sterile neutrinos is proceeding: With several short-baseline oscillations experiments underway, the first results emerging are yet inconclusive on the occurrence of active-to-sterile neutrino oscillations. Most excitingly, a decades-long effort to detect the coherent elastic scattering of neutrinos on atomic nuclei came to a conclusion when in summer 2017 the COHERENT collaboration announced a first positive result.

T 96: Hauptvorträge V

Zeit: Freitag 11:00–13:00 Raum: Z6 - HS 0.004

Hauptvortrag T 96.1 Fr 11:00 Z6 - HS 0.004

Präzisionstest des Standardmodells am LHC (Starke und elektroschwache Wechselwirkung) — •Raimund Ströhmer — Universität Würzburg

Die sehr erfolgreiche Datennahme, mit sehr gut kalibrierten Detektoren, am LHC bei Schwerpunktsenergien von 7 TeV, 8 TeV und 13 TeV machen Präzisionstests des Standardmodells möglich. Bei der starken Wechselwirkung reichen diese von der Messung von Protonstrukturfunktionen sowie der Bestimmung von α_s über Tests von QCD Korrekturen bei hohen Transversalimpulsen bis zur Untersuchung nichtstörungstheoretischer Effekte bei der Produktion der Hadronen. Bei der elektroschwachen Wechselwirkung wird das Standardmodell durch Messungen der Eichkopplungen, des schwachen Mischungswinkels sowie der W Masse getestet.

In diesem Vortrag wird sowohl ein Überblick über die neuesten Ergebnisse gegeben, wie auch ausgewählte Messungen detaillierter vorgestellt.

Hauptvortrag T 96.2 Fr 11:30 Z6 - HS 0.004

New developments for scattering amplitudes — •Stefan Weinzierl — Universität Mainz

The simplest scattering amplitudes are the tree-level amplitudes. We know how to compute them in terms of Feynman diagrams. As the number of external particles increases, these calculations become rather cumbersome, although the final result is often rather compact. There should be a better way to compute and understand these objects. In this talk I will report on recent developments, which relate these scattering amplitudes to objects in algebraic geometry. It turns out that the amplitudes are just intersection numbers of two differential forms, twisted by a third form. This gives a very appealing geometric interpretation of scattering amplitudes.

Hauptvortrag T 96.3 Fr 12:00 Z6 - HS 0.004

LHCb - Status und Highlights — •Evelina Gersabeck — University of Manchester, Manchester, UK

The LHCb experiment has been designed for studies of beauty and charm hadron decays. In the last year of the second LHC data taking run, some of the most recent results obtained with Run I and Run II data are reviewed. Improved measurements on CP violation, unitary triangle and mixing parameters are shown. Recent progress on heavy flavoured hadrons spectroscopy and on recent rare decays is presented.

Hauptvortrag T 96.4 Fr 12:30 Z6 - HS 0.004

A new era in multi-messenger astronomy — •Marek Kowalski — Humboldt-Universität zu Berlin — Deutsches Elektronen-Synchrotron

With the recent discoveries of gravitational waves and high-energy cosmic neutrinos we are witnessing the beginning of a new era in Multi-Messenger astronomy. The exploration of the Universe through these new messengers, along with electromagnetic radiation and cosmic rays, provides for new insights into the most extreme, energetic cosmic events, environments and particle accelerators. The objects of interest range from galaxies with accreting supermassive black holes in their center to coalescing stellar neutron stars. In my talk I will discuss some of the recent observations in gravitational wave and neutrino astronomy, the gains from combining the information from the various messengers, as well as highlight selected future directions.