Fachverband Teilchenphysik (T)

Klaus Desch
Physikalisches Institut
Universität Bonn
Nussallee 12
53115 Bonn
desch@physik.uni-bonn.de

Übersicht der Hauptvorträge und Fachsitzungen

(Hörsäle VMP4 Audimax 1, VMP5 HS A, B1, B2, SR 0077, 0079, VMP6 HS B, D, E, F, VMP8 HS, SR 05, 105, 106, 205, 206, VMP9 HS, SR 07, 08 und 27–30; Poster VMP4 Foyer)

Plenarvorträge

PV I	Di	11:00–11:45	VMP4 Audimax 1	**Quantum Gravity: An Overview** — •Abhay Ashtekar
PV II	Di	11:45–12:30	VMP4 Audimax 1	**State-of-the-art and physics research opportunities in ion beam therapy** — •Katia Parodi
PV III	Mi	9:00– 9:45	VMP4 Audimax 1	**Microscopic black holes and their significance in quantum theories of gravity** — •Gerard 't Hooft
PV IV	Mi	9:45–10:30	VMP4 Audimax 1	**Erste Ergebnisse des LHC bei einer Schwerpunktsenergie von 13 TeV** — •Alexander Schmidt
PV V	Mi	11:45–12:30	VMP4 Audimax 1	**Hochenergie-Gamma-Astronomie mit den H.E.S.S.-Teleskopen: der Himmel in einem neuen Licht** — •Werner Hofmann
PV VI	Mi	20:00–21:00	VMP8 HS	**Experimente an den Grenzen der Physik** — •Peter Schleper
PV VII	Do	9:50–10:35	VMP4 Audimax 1	**Die Entdeckung der Neutrino-Oszillationen** — •Kai Zuber

Hauptvorträge

T 1.1	Mo	9:00– 9:45	VMP4 Audimax 1	**Cosmology and the LHC** — •Geraldine Servant
T 1.2	Mo	9:45–10:30	VMP4 Audimax 1	**The Direct Search for Dark Matter: Status and Perspectives** — •Marc Schumann
T 43.1	Di	8:30– 9:10	VMP4 Audimax 1	**Suche nach neuer Physik am LHC** — •Frederik Rühr
T 43.2	Di	9:10– 9:50	VMP4 Audimax 1	**CERN physics programme** — •Eckhard Elsen
T 43.3	Di	9:50–10:30	VMP4 Audimax 1	**Low energy precision experiments with muons** — •Niklaus Berger
T 85.1	Do	8:30– 9:10	VMP4 Audimax 1	**Messung der Eigenschaften der kosmischen Strahlung mit dem LOFAR Radio-Teleskop** — •Jörg R. Hörandel
T 85.2	Do	9:10– 9:50	VMP4 Audimax 1	**Die Entschlüsselung des Higgs-Bosons: Neue Resultate vom LHC** — •Christian Weiser
T 86.1	Do	11:00–11:45	VMP4 Audimax 1	**Neues aus der experimentellen Top-Quark-Physik** — •Sebastian Schätzel
T 86.2	Do	11:45–12:30	VMP4 Audimax 1	**Neutrino Oscillations: from the current status to the future** — •Achim Stahl
T 108.1	Fr	8:45– 9:25	VMP4 Audimax 1	**Standardmodellphysik am LHC: Präzisionsmessungen bei höchsten Energien** — •Matthias Mozer
T 108.2	Fr	9:25–10:05	VMP4 Audimax 1	**Precision theory simulations for the LHC** — •Stefano Pozzorini
T 108.3	Fr	10:05–10:45	VMP4 Audimax 1	**New results from flavour physics** — •Christoph Langenbruch
T 109.1	Fr	11:15–11:55	VMP4 Audimax 1	**Mehr als reiner Zufall: Neue Entwicklungen in Monte Carlo-Ereignisgeneratoren für den LHC** — •Frank Siegert
T 109.2	Fr	11:55–12:35	VMP4 Audimax 1	**The hunt for cosmic accelerators: neutrinos** — •Elisa Resconi
T 109.3	Fr	12:35–13:15	VMP4 Audimax 1	**Supernova Simulations in Three Dimensions: Models Confronting Observations** — •Hans-Thomas Janka

Eingeladene Vorträge

T 44.1	Di	13:45–14:15	VMP4 Audimax 1	**Der Ausbau des Inneren Spurdetektors am ATLAS-Experiment** — •Susanne Kühn
T 44.2	Di	14:15–14:45	VMP4 Audimax 1	**The SNO+ experiment: current status and future prospects** — •Valentina Lozza
T 44.3	Di	14:45–15:15	VMP4 Audimax 1	**Messung von *CP*-Verletzung im System neutraler *B*-Mesonen mit dem LHCb-Experiment** — •Julian Wishahi
T 44.4	Di	15:15–15:45	VMP4 Audimax 1	**Aiming for a precise Measurement of $K^+ \to \pi^+\nu\bar{\nu}$: the Start of the NA62 Experiment** — •Gia Khoriauli
T 44.5	Di	15:45–16:15	VMP4 Audimax 1	**Suche nach neuen Phänomenen mit Topquarks beim ATLAS-Experiment** — •Johannes Erdmann
T 45.1	Di	13:45–14:15	VMP8 HS	**Hadronic vector-boson pair production at NNLO QCD** — •Stefan Kallweit
T 45.2	Di	14:15–14:45	VMP8 HS	**Auslesekonzepte für zukünftige Teilchendetektoren** — •Tobias Flick
T 45.3	Di	14:45–15:15	VMP8 HS	**Hunting dark matter in the sky and at colliders** — •Kai Schmidt-Hoberg
T 45.4	Di	15:15–15:45	VMP8 HS	**Preparing the start of neutrino mass measurements with KATRIN** — •Kathrin Valerius
T 45.5	Di	15:45–16:15	VMP8 HS	**Magnetic fieds and cosmic rays in galaxy clusters** — •Annalisa Bonafede
T 87.1	Do	13:45–14:15	VMP4 Audimax 1	**Reconstruction of tau lepton decays and applications in the ATLAS experiment** — •Peter Wagner
T 87.2	Do	14:15–14:45	VMP4 Audimax 1	**Auf der Suche nach neuer Physik mit geboosteten Bosonen bei CMS** — •Andreas Hinzmann
T 87.3	Do	14:45–15:15	VMP4 Audimax 1	**Hunting for new, weakly coupled particles with high intensities** — •Babette Döbrich
T 87.4	Do	15:15–15:45	VMP4 Audimax 1	**Probing low mass dark matter with the CRESST direct search** — •Federica Petricca
T 87.5	Do	15:45–16:15	VMP4 Audimax 1	**The Top Quark and the Higgs Boson: Vital Actors at LHC** — •Johannes Hauk
T 88.1	Do	13:45–14:15	VMP8 HS	**Mass composition of ultra-high energy cosmic rays: new results from the Pierre Auger Observatory and their astrophysical implications** — •Alexey Yushkov
T 88.2	Do	14:15–14:45	VMP8 HS	**Particle Flow Calorimetry** — •Eva Sicking
T 88.3	Do	14:45–15:15	VMP8 HS	**Flavour physics as a microscope for new phenomena** — •Martin Jung
T 88.4	Do	15:15–15:45	VMP8 HS	**Neue Ergebnisse der B-Fabriken und Ausblick auf Belle II** — •Florian Bernlochner
T 88.5	Do	15:45–16:15	VMP8 HS	**The DEAP-3600 Dark Matter Search Experiment - Updates and Commissioning Results** — •Tina Pollmann

Dissertationspreis-Symposiums SYDI

Am Montag, 29.2.2016, 14:00h, findet im VMP4 Audimax 1 das Dissertationspreis-Symposiums der Fachverbände Gravitation und Relativitätstheorie (GR), Hadronen und Kerne (HK) und Teilchenphysik (T) statt. Die Kurzfassungen zu den Beiträgen der Kandidatinnen und Kandidaten werden rechtzeitig vor der Tagung auf http://www.dpg-verhandlungen.de veröffentlicht.

Hauptvorträge des fachübergreifenden Symposiums SYQG

Das vollständige Programm dieses Symposiums ist unter SYQG aufgeführt.

SYQG 1.1	Mi	13:30–14:10	VMP4 Audimax 1	**Quantum Tests of Gravity** — •Markus Aspelmeyer
SYQG 1.2	Mi	14:10–14:50	VMP4 Audimax 1	**A Practitioner's View on Quantum Gravity** — •Renate Loll
SYQG 1.3	Mi	14:50–15:30	VMP4 Audimax 1	**Standard Model Fermions and N=8 Supergravity** — •Hermann Nicolai
SYQG 1.4	Mi	15:30–16:10	VMP4 Audimax 1	**Quantum and gravity: blend or mélange?** — •Christian Wüthrich

Fachsitzungen

T 1.1–1.2	Mo	9:00–10:30	VMP4 Audimax 1	**Hauptvorträge**
T 2.1–2.6	Mo	11:00–12:30	VMP5 HS A	**Higgs-Boson (Zerfall in Tau-Leptonen) I**
T 3.1–3.6	Mo	11:00–12:30	VMP5 HS B1	**Higgs-Boson (assoziierte Produktion) I**
T 4.1–4.6	Mo	11:00–12:30	VMP5 HS B2	**Suche nach Supersymmetrie I (Stops)**
T 5.1–5.6	Mo	11:00–12:30	VMP5 SR 0077	**BSM Suchen I (Diboson-Resonanzen)**
T 6.1–6.6	Mo	11:00–12:35	VMP5 SR 0079	**Neutrinomasse I**
T 7.1–7.6	Mo	11:00–12:30	VMP6 HS B	**BSM Suchen II**
T 8.1–8.6	Mo	11:00–12:30	VMP6 HS E	**Myondetektoren I**
T 9.1–9.6	Mo	11:00–12:35	VMP6 HS F	**Experimentelle Methoden der B-Physik**
T 10.1–10.6	Mo	11:00–12:30	VMP8 HS	**Halbleiterdetektoren I (Streifen)**
T 11.1–11.5	Mo	11:00–12:15	VMP8 SR 05	**Top Quark Tagging**
T 12.1–12.4	Mo	11:00–12:00	VMP8 SR 105	**Experimentelle Methoden I**
T 13.1–13.4	Mo	11:00–12:00	VMP8 SR 106	**Quantenfeldtheorie und Gittereichtheorie (Theorie)**
T 14.1–14.6	Mo	11:00–12:30	VMP8 SR 206	**Starke Wechselwirkung (Experiment) I**
T 15.1–15.5	Mo	11:00–12:15	VMP9 HS	**Top Quark I (Ladungsasymmetrie, Spin)**
T 16.1–16.6	Mo	11:00–12:35	VMP9 SR 07	**Neutrinoloser Doppelbeta-Zerfall I**
T 17.1–17.6	Mo	11:00–12:35	VMP9 SR 08	**Neutrinoastronomie I**
T 18.1–18.6	Mo	11:00–12:35	VMP9 SR 27	**Gammaastronomie I**
T 19.1–19.6	Mo	11:00–12:35	VMP9 SR 28	**Suche nach dunkler Materie I**
T 20.1–20.6	Mo	11:00–12:30	VMP9 SR 29	**Kosmische Strahlung I**
T 21.1–21.6	Mo	11:00–12:30	VMP9 SR 30	**Theorie und Experiment in Kosmologie und Neutrinophysik**
T 22.1–22.6	Mo	11:00–12:30	VMP11 HS	**Trigger und DAQ I**
T 23.1–23.16	Mo	13:30–14:30	VMP4 Foyer	**Postersitzung**
T 24.1–24.9	Mo	16:45–19:00	VMP5 HS A	**Higgs-Boson (Zerfall in Tau-Leptonen) II**
T 25.1–25.9	Mo	16:45–19:00	VMP5 HS B1	**Higgs-Boson (assoziierte Produktion) II**
T 26.1–26.9	Mo	16:45–19:00	VMP5 HS B2	**Suche nach Supersymmetrie II (Leptonische Endzustände)**
T 27.1–27.9	Mo	16:45–19:00	VMP6 HS B	**BSM Suchen III (Vektorartige Quarks)**
T 28.1–28.9	Mo	16:45–19:00	VMP6 HS E	**Myondetektoren II**
T 29.1–29.9	Mo	16:45–19:00	VMP6 HS F	**B-Meson Zerfälle**
T 30.1–30.9	Mo	16:45–19:00	VMP8 HS	**Halbleiterdetektoren II (Pixel)**
T 31.1–31.7	Mo	16:45–18:35	VMP8 SR 105	**Elektroschwache Wechselwirkung und BSM (Theorie)**
T 32.1–32.9	Mo	16:45–19:00	VMP8 SR 106	**Flavourphysik (Theorie)**
T 33.1–33.9	Mo	16:45–19:05	VMP8 SR 205	**Detektorsysteme I**
T 34.1–34.7	Mo	16:45–18:30	VMP8 SR 206	**Starke Wechselwirkung (Experiment) II**
T 35.1–35.9	Mo	16:45–19:00	VMP9 HS	**Top Quark II (Masse, Kin. Fits, Jets in tt)**
T 36.1–36.9	Mo	16:45–19:05	VMP9 SR 07	**Neutrinoloser Doppelbeta-Zerfall II**
T 37.1–37.9	Mo	16:45–19:05	VMP9 SR 08	**Neutrinoastronomie II**
T 38.1–38.8	Mo	16:45–18:45	VMP9 SR 27	**Gammaastronomie II**
T 39.1–39.9	Mo	16:45–19:05	VMP9 SR 28	**Suche nach dunkler Materie II**
T 40.1–40.9	Mo	16:45–19:05	VMP9 SR 29	**Kosmische Strahlung II**
T 41.1–41.9	Mo	16:45–19:00	VMP9 SR 30	**Neutrinoastronomie**
T 42.1–42.8	Mo	16:45–18:45	VMP11 HS	**Trigger und DAQ II**
T 43.1–43.3	Di	8:30–10:30	VMP4 Audimax 1	**Hauptvorträge**
T 44.1–44.5	Di	13:45–16:15	VMP4 Audimax 1	**Eingeladene Vorträge I**
T 45.1–45.5	Di	13:45–16:15	VMP8 HS	**Eingeladene Vorträge II**
T 46.1–46.8	Di	16:45–18:45	VMP5 HS A	**Higgs-Boson (Zerfall in Tau-Leptonen) III**
T 47.1–47.9	Di	16:45–19:00	VMP5 HS B1	**Higgs-Boson (Eigenschaften) (theo.+exp.)**
T 48.1–48.9	Di	16:45–19:00	VMP5 HS B2	**Supersymmetrie (theo.+exp.)**
T 49.1–49.8	Di	16:45–18:45	VMP5 SR 0077	**BSM Suchen IV (Dunkle Materie und LED)**
T 50.1–50.9	Di	16:45–19:00	VMP5 SR 0079	**Neutrinomasse II**
T 51.1–51.8	Di	16:45–18:50	VMP6 HS E	**Kalorimeter I**
T 52.1–52.9	Di	16:45–19:00	VMP6 HS F	**CP-Verletzung im B-Meson-System**
T 53.1–53.9	Di	16:45–19:00	VMP8 HS	**Halbleiterdetektoren III (Strahlenhärte)**
T 54.1–54.8	Di	16:45–18:50	VMP8 SR 05	**Seltene Zerfälle und BSM im Flavourbereich**
T 55.1–55.9	Di	16:45–19:00	VMP8 SR 105	**Monte Carlo, Partonschauer, QCD (Theorie)**
T 56.1–56.9	Di	16:45–19:00	VMP8 SR 106	**Beyond the Standard Model (Theorie)**
T 57.1–57.9	Di	16:45–19:00	VMP8 SR 205	**Detektorsysteme II**

T 58.1–58.7	Di	16:45–18:30	VMP8 SR 206	**Elektroschwache Wechselwirkung (Experiment) I**
T 59.1–59.9	Di	16:45–19:00	VMP9 HS	**Top Quark III (tt+X)**
T 60.1–60.9	Di	16:45–19:10	VMP9 SR 07	**Niederenergie-Neutrinophysik I**
T 61.1–61.9	Di	16:45–19:05	VMP9 SR 08	**Neutrinoastronomie III**
T 62.1–62.9	Di	16:45–19:05	VMP9 SR 28	**Suche nach dunkler Materie III**
T 63.1–63.9	Di	16:45–19:05	VMP9 SR 29	**Kosmische Strahlung III**
T 64.1–64.9	Di	16:45–19:10	VMP9 SR 30	**Neutrinos, Dunkle Materie und Luftschauer**
T 65.1–65.9	Di	16:45–19:05	VMP11 HS	**Gammaastronomie III**
T 66.1–66.5	Mi	16:45–18:00	VMP5 HS A	**Higgs-Boson (exotische Zerfälle)**
T 67.1–67.9	Mi	16:45–19:00	VMP5 HS B1	**Higgs-Boson (assoziierte Produktion) III**
T 68.1–68.9	Mi	16:45–19:00	VMP5 HS B2	**Suche nach Supersymmetrie III (Hadronische, Tau, Photon Endzustände)**
T 69.1–69.9	Mi	16:45–19:05	VMP5 SR 0079	**Neutrinomasse III**
T 70.1–70.7	Mi	16:45–18:30	VMP6 HS E	**Kalorimeter II**
T 71.1–71.9	Mi	16:45–19:00	VMP6 HS F	**Flavour-Physik und CP-Verletzung im D- und K-System**
T 72.1–72.9	Mi	16:45–19:05	VMP8 HS	**Halbleiterdetektoren IV (MAPS, CMOS)**
T 73.1–73.8	Mi	16:45–18:50	VMP8 SR 05	**Spurkammern**
T 74.1–74.7	Mi	16:45–18:30	VMP8 SR 105	**Experimentelle Methoden II**
T 75.1–75.7	Mi	16:45–18:30	VMP8 SR 205	**Detektorsysteme III**
T 76.1–76.8	Mi	16:45–18:45	VMP8 SR 206	**Elektroschwache Wechselwirkung (Experiment) II**
T 77.1–77.9	Mi	16:45–19:00	VMP9 HS	**Top Quark IV (single top, FCNC)**
T 78.1–78.10	Mi	16:45–19:15	VMP9 SR 07	**Niederenergie-Neutrinophysik II**
T 79.1–79.10	Mi	16:45–19:20	VMP9 SR 08	**Neutrinoastronomie IV**
T 80.1–80.9	Mi	16:45–19:05	VMP9 SR 27	**Gammaastronomie IV**
T 81.1–81.9	Mi	16:45–19:00	VMP9 SR 28	**BSM Suchen V (Leptoquarks und exotische top-Quarks)**
T 82.1–82.9	Mi	16:45–19:05	VMP9 SR 29	**Kosmische Strahlung IV**
T 83.1–83.9	Mi	16:45–19:05	VMP9 SR 30	**Kosmische Strahlung**
T 84.1–84.9	Mi	16:45–19:00	VMP11 HS	**Trigger und DAQ III**
T 85.1–85.2	Do	8:30– 9:50	VMP4 Audimax 1	**Hauptvorträge**
T 86.1–86.2	Do	11:00–12:30	VMP4 Audimax 1	**Hauptvorträge**
T 87.1–87.5	Do	13:45–16:15	VMP4 Audimax 1	**Eingeladene Vorträge III**
T 88.1–88.5	Do	13:45–16:15	VMP8 HS	**Eingeladene Vorträge IV**
T 89.1–89.9	Do	16:45–19:05	VMP5 HS B1	**Higgs-Boson (Zerfall in WW/ZZ)**
T 90.1–90.8	Do	16:45–18:45	VMP5 HS B2	**Suche nach Supersymmetrie IV (langlebige Zustände, RPV)**
T 91.1–91.9	Do	16:45–19:00	VMP5 SR 0077	**BSM Suchen VI**
T 92.1–92.9	Do	16:45–19:05	VMP5 SR 0079	**Neutrinomasse IV**
T 93.1–93.5	Do	16:45–18:00	VMP6 HS D	**Andere Gebiete der Theorie**
T 94.1–94.7	Do	16:45–18:30	VMP6 HS E	**Kalorimeter III (SiPM)**
T 95.1–95.7	Do	16:45–18:30	VMP6 HS F	**Flavour-Physik**
T 96.1–96.8	Do	16:45–18:45	VMP8 HS	**Halbleiterdetektoren V (DEPFET)**
T 97.1–97.9	Do	16:45–19:00	VMP8 SR 05	**Grid-Computing**
T 98.1–98.9	Do	16:45–19:10	VMP8 SR 105	**Experimentelle Methoden III**
T 99.1–99.9	Do	16:45–19:00	VMP8 SR 205	**Detektorsysteme IV**
T 100.1–100.8	Do	16:45–18:45	VMP8 SR 206	**Elektroschwache Wechselwirkung (Experiment) III**
T 101.1–101.8	Do	16:45–18:45	VMP9 HS	**Top Quark V (Wirkungsquerschnitte)**
T 102.1–102.9	Do	16:45–19:05	VMP9 SR 07	**Niederenergie-Neutrinophysik III**
T 103.1–103.9	Do	16:45–19:05	VMP9 SR 08	**Neutrinoastronomie V**
T 104.1–104.5	Do	16:45–18:00	VMP9 SR 27	**Gammaastronomie V**
T 105.1–105.9	Do	16:45–19:00	VMP9 SR 29	**Kosmische Strahlung V**
T 106.1–106.9	Do	16:45–19:10	VMP9 SR 30	**Kosmische Strahlung VI (Radio)**
T 107.1–107.9	Do	16:45–19:00	VMP11 HS	**Trigger und DAQ IV**
T 108.1–108.3	Fr	8:45–10:45	VMP4 Audimax 1	**Hauptvorträge**
T 109.1–109.3	Fr	11:15–13:15	VMP4 Audimax 1	**Hauptvorträge**

Mitgliederversammlung Fachverband Teilchenphysik

Donnerstag 19:30h Raum VMP6 HS D

T 1: Hauptvorträge

Zeit: Montag 9:00–10:30 Raum: VMP4 Audimax 1

Hauptvortrag T 1.1 Mo 9:00 VMP4 Audimax 1
Cosmology and the LHC — •Geraldine Servant — Deutsches Elektronen-Synchrotron DESY, Theory group, Notkestrasse 85, D-22607 Hamburg — Institute of Theoretical Physics, Univ. Hamburg, D-22761 Hamburg

I will review implications of electroweak symmetry breaking for cosmology, in particular for baryogenesis. I will also discuss what can and cannot be learnt with the LHC on early universe cosmology.

Hauptvortrag T 1.2 Mo 9:45 VMP4 Audimax 1
The Direct Search for Dark Matter: Status and Perspectives — •Marc Schumann — Albert Einstein Center, University of Bern, Switzerland

There is overwhelming indirect evidence that dark matter exists, however, the dark matter particle has not yet been directly detected in laboratory experiments. In order to be able to identify the rare dark matter interactions with the target nuclei, such instruments have to feature a very low threshold and an extremely low radioactive background. They are therefore installed in underground laboratories to reduce cosmic ray backgrounds. I will review the status of direct dark matter searches and will discuss the perspectives for the future.

T 2: Higgs-Boson (Zerfall in Tau-Leptonen) I

Zeit: Montag 11:00–12:30 Raum: VMP5 HS A

T 2.1 Mo 11:00 VMP5 HS A
Measurement of the Z $\to \tau\tau$ cross-section at 13 TeV with the CMS experiment — •Fabio Colombo, Rene Caspart, Raphael Friese, Andrew Gilbert, Thomas Müller, Günter Quast, and Roger Wolf — Institut für Experimentelle Kernphysik (IEKP), KIT

With the restart of operation in the summer of 2015, the Large Hadron Collider, LHC, has provided proton-proton collisions with the unprecedented center of mass energy of 13 TeV. A precise understanding of the detector and a reliable reconstruction of all physics objects under these new running conditions are mandatory for all LHC experiments. For complex objects like tau leptons, whose reconstruction relies on different sub-detectors, the decay of Z bosons can be used as a standard candle. In the talk, the measurement of the $Z \to \tau\tau$ cross-section with the data collected by the CMS experiment during the 2015 run period will be presented. Besides technically proving the performance of the reconstruction algorithms, it will pave the way for future short and long term measurements targeting at the study of the properties of the discovered Higgs boson in the decay mode with two tau leptons in the final state or at searches for additional resonances in this final state pointing to new physics.

T 2.2 Mo 11:15 VMP5 HS A
The Z$\to \tau\tau \to e + \mu$ cross section measurement in Run 2 with the CMS experiment — •Yiwen Wen — DESY, Hamburg, Germany

The discovery of a 125 GeV Higgs boson at the Large Hadron Collider was a great success for standard model particle physics. Drell-Yan $Z \to \tau\tau$ production can be used as standard candle for the $H \to \tau\tau$ analysis. This work focuses on $Z \to \tau\tau$ decay in $e + \mu$ final states with Run 2 data, collected at a proton-proton centre of mass energy of 13 TeV by the CMS experiment, and corresponding to an integrated luminosity of 2.1 fb^{-1}.

T 2.3 Mo 11:30 VMP5 HS A
Study of Z boson events in the decay to a tau lepton pair in the semileptonic channels with the CMS experiment at 13 TeV — •Valeria Botta — DESY, Hamburg

The talk focuses on the commissioning of the tau lepton objects using Z boson events as standard candle, which is the first step towards the analysis of the Higgs boson decays to a pair of tau leptons. The analysis is performed with data from proton-proton collisions at a centre-of-mass energy of 13 TeV, recorded with the CMS detector at the LHC during 2015. Semileptonic final states are considered, in which one tau lepton decays to hadrons and the other one decays to a muon or an electron (and neutrinos). The presence of an isolated lepton in the final state provides a handle for triggering and rejecting the background from QCD processes. The trigger and lepton identification efficiencies have been measured with a tag-and-probe method using electron and muon pairs from Z boson decays. The cross section of Z-boson production in the di-tau final state has been measured and compared to standard model predictions.

T 2.4 Mo 11:45 VMP5 HS A
Lepton efficiency measurements in the context of a $Z \to \tau\tau$ cross section measurement — •Gregor Köhler, Fabio Colombo, Thomas Müller, Roger Wolf, and Günter Quast — Institut für Experimentelle Kernphysik, KIT

In all of High Energy Physics Monte Carlo methods are used to simulate physics processes and detector response to predict the outcome of the experiment and to determine estimates for systematic uncertainties on this outcome. Parts of the simulated detector performance can be cross checked and the agreement between data and simulation generally improved via experimental techniques like the tag and probe method. This presentation illustrates the application of a tag and probe method for the determination of the efficiencies to trigger and to reconstruct leptons in the context of a $Z \to \tau\tau$ cross section measurement based on the LHC run-2 data at 13 TeV that have been taken already with the CMS detector.

T 2.5 Mo 12:00 VMP5 HS A
Measurement of fake rates for hadronically decaying τ leptons in the ATLAS experiment — •Timo Dreyer, Michel Janus, and Stan Lai — II. Physikalisches Institut, Georg-August-Universität Göttingen

The τ lepton is the heaviest lepton in the standard model and an important probe of physics at high energy scales. The joint observation of the $H \to \tau\tau$ signal in 2015 by the CMS and ATLAS experiments, for example, was the first direct observation of the Higgs boson coupling to fermions.

For signatures involving hadronically decaying τ leptons, it is important to have a good understanding of the τ reconstruction and identification algorithms that are used for data analysis in the ATLAS experiment. In particular, the probability for jets originating from quarks and gluons to be misidentified as hadronically decaying τ leptons (the so-called *fake rate*), is important for background estimation from a variety of sources. This fake rate depends on many kinematic variables, as well as the quark-gluon composition of the process in question.

This talk presents an approach using 13 TeV ATLAS data, to measure the fake rate using the tag-and-probe technique. The dependence of the fake rate on the above mentioned factors is also discussed.

T 2.6 Mo 12:15 VMP5 HS A
Search for H–>tautau decays in the semi-leptonic final state and measurement of the tau identification efficiency using LHC pp data at sqrt(s)=13 TeV collected with the ATLAS detector — •Théo Megy, Lei Zhang, and Karsten Köneke — Albert-Ludwigs-Universität Freiburg

The discovery of a Higgs-like particle in 2012 led to several studies aiming to measure the properties of this new particle, amongst which are the measurements of its couplings to Standard Model particles. The most accessible way to measure Higgs couplings to leptons is to study its decay into a pair of taus. A discovery of this decay channel of the Higgs boson was made in a combined analysis of the full LHC run 1 data collected by the ATLAS and CMS detectors. The large expected integrated luminosity of the LHC run 2 will enable enable an observation of the H->tautau decays using data collected by the ATLAS detector alone. Therefore, this talk will discuss the techniques that will be used for this analysis for the case where one tau decays

leptonically and the other hadronically. A prerequisite for such an analysis is a precise understanding of the reconstruction and identification of hadronically decaying tau leptons. The methodology of determining the hadronic-tau identification efficiency with 13 TeV data will be descibed and the results of this measurement will be discussed.

T 3: Higgs-Boson (assoziierte Produktion) I

Zeit: Montag 11:00–12:30 Raum: VMP5 HS B1

T 3.1 Mo 11:00 VMP5 HS B1

Improvement of bottom-quark associated Higgs-boson production predictions for LHC using HERA data — •Gizhko Andrii and Geiser Achim — Deutsches Elektronen-Synchrotron, Hamburg

The dependence of the inclusive total cross section of the bottom-quark associated Higgs-boson production predictions at the LHC, pp $\rightarrow$ (b$\bar{b}$)H+X on the treatment of the beauty quark mass is studied in the context of CMS measurements. For two different schemes (four flavour scheme (4FS) and five flavour scheme (5FS)) the theoretical uncertainty due to the beauty quark mass is estimated, and the potential improvement arising from a QCD analysis of HERA beauty data is demonstrated.

T 3.2 Mo 11:15 VMP5 HS B1

Suche nach dem Higgs-Boson im Zerfallskanal H -> bb mit den Run-2-Daten des ATLAS-Detektors am LHC — •Ilona Weimer, David Joseph, Sandra Kortner, Felix Müller und Dan Nebe — Max-Planck-Institut für Physik, München

Das Higgs-Boson wurde 2012 mit den Experimenten ATLAS und CMS am Large Hadron Collider entdeckt. Obwohl der Zerfall des Higgs- Bosons in ein bottom-Quark-Antiquark-Paar laut theoretischen Be- rechnungen die größte Wahrscheinlichkeit besitzt, konnte das Higgs- Teilchen in diesem Kanal aufgrund des hohen Untergrunds bisher nicht nachgewiesen werden.

Ein neuer Ansatz zur Verbesserung der Signalsignifikanz ist das sogenannte Higgs-Tagging in Ereignissen mit hohem transversalen Impuls des Higgs-Bosons. In diesen Ereignissen sind die zwei b-Quarks aus dem Higgs-Boson-Zerfall stark kollimiert und bilden einen Jet mit großem Radiusparameter. Durch Anforderungen an die im großen Jet enthalteten b-Jets, deren invariante Masse sowie der Substruktur des Jets kann der Untergrund stark unterdrückt werden.

Die vorgestellte Studie basiert auf ATLAS-Daten bei einer Kollisionsenergie von 13 TeV. Das Hauptaugenmerk der Studie liegt auf der Optimierung des Higgs-Taggings im Bereich moderater Transversimpulse oberhalb von etwa 250 GeV und der Frage, welche Substruktur-Variablen die Unterdrückung der Untergrundbeiträge verbessern können.

T 3.3 Mo 11:30 VMP5 HS B1

Improved Identification of Boosted Higgs Bosons with the ATLAS Detector — •Merve Sahinsoy — Ruprecht-Karls-Universitaet Heidelberg, Kirchhoff-Institute for Physics

The identification of highly boosted particles becomes more significant in many new physics searches with the increased center of mass energy in Run 2 of LHC. Methods for the identification of high-momentum Higgs bosons decaying to bb pairs have been developed and used. This study investigates the effect of different jet substructure techniques on Higgs mass reconstruction from large radius jets, with a particular focus on the high invariant mass region of H->bb pairs. In previous studies, a significant contribution from misreconstructed H->bb decays has been observed. This work studies the origin of this contribution through a systematic study of jet substructure techniques, and attemps to identify configurations which ameliorate this effect.

T 3.4 Mo 11:45 VMP5 HS B1

Analyse von $H\rightarrow b\bar{b}$ Zerfällen mit dem topologischen Prozessor des Level 1-Triggers bei ATLAS — •Johannes Damp, Sebastian Artz, Volker Büscher, Frank Fiedler und Christian Schmitt — Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudingerweg 7, 55099 Mainz

Im Jahr 2012 wurde durch die Auswertung bosonischer Zerfällskanäle ein Boson entdeckt, welches kompatibel mit den Vorhersagen des Standardmodells für das Higgs-Boson ist. Um die Eigenschaften dieses Bosons vollständig zu untersuchen, ist es notwendig, sämtliche Zerfallskanäle zu betrachten, insbesondere auch die fermionischen Kanäle.

Im Standardmodell ist der Zerfall $H\rightarrow b\bar{b}$ mit einem Verzweigungsverhältnis von $\sim$57% dominant. Eine Untersuchung dieses Zerfalls ist aufgrund des dominanten QCD-Multijetuntergrundes jedoch schwierig. Ein möglicher Lösungsansatz ist die Analyse assoziierter Higgsproduktion mit einem Vektorboson, indem leptonische Zerfallskanäle des Vektorbosons zum Triggern oder zur Untergrundunterdrückung verwendet werden.

In diesem Vortrag wird ein neuer Ansatz vorgestellt, welcher zur Untersuchung rein hadronischer Produktion den topologischen Prozessor des Level 1-Triggers am ATLAS-Experiment verwendet. Da dieses Modul programmierbar ist, können online Histogramme erzeugt und gespeichert werden, es kann also eine Analyse ohne die Notwendigkeit einer Triggerselektion durchgeführt werden. In diesem Vortrag wird eine Machbarkeitsstudie vorgestellt, welche Ansätze zur Identifizierung von b-Jets und zur Behandlung des QCD-Untergrundes diskutiert.

T 3.5 Mo 12:00 VMP5 HS B1

Bestimmung und Abschätzung von MC-Unsicherheiten für die t$\bar{t}$H-Analyse bei CMS — Karim El Morabit, •Marco A. Harrendorf, Ulrich Husemann, Hannes Mildner, Andrej Saibel, Matthias Schröder, Korbinian Schweiger und Shawn Williamson — Institut für Experimentelle Kernphysik (IEKP), KIT

Der pp $\rightarrow$ t$\bar{t}$H Prozess erlaubt die modellunabhängige Studie der Top-Higgs-Yukawa-Kopplung. Für die Analyse dieses Prozesses sind neben den Messdaten des CMS-Detektors Simulationsdaten von entscheidener Bedeutung, da die unter Verwendung von MC-Ereignisgeneratoren erzeugten Simulationsdaten samt ihren Unsicherheiten unter anderem im großen Umfang für das Training und das Testen der angewandten multivariaten Analysetechniken eingesetzt werden. Für die Sensitivität der Analyse ist dabei eine sorgfältige und genaue Abschätzung dieser sogenannten MC-Unsicherheiten essentiell.
Im Vortrag wird die Bestimmung und Abschätzung dieser MC-Unsicherheiten im Rahmen der t$\bar{t}$H-Analyse bei CMS diskutiert. Ein besonderer Fokus wird dabei auf den t$\bar{t}$H- und t$\bar{t}$-Ereignissamples und deren zugehörigen Unsicherheiten liegen.

T 3.6 Mo 12:15 VMP5 HS B1

Study of the production of Higgs bosons in association with a top-antitop quark pairs for Run2 with the ATLAS experiment — •Matteo Mantoani, Maria Moreno LLacer, Arnulf Quadt, and Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

The $t\bar{t}H(H \rightarrow b\bar{b})$ channel is a very important and challenging channel to measure the production of the Higgs Boson because its cross section is proportional to the Yukawa couplings of the Higgs boson to top and bottom quarks and because it is a channel in which the Higgs Boson only couples to quarks. The main background to $t\bar{t}H(H \rightarrow b\bar{b})$ is the $t\bar{t}b\bar{b}$ process. Since it is an irreducible background, sophisticated techniques are required to distinguish the signal from this overwhelming background. The goal of this work is to search of the Higgs Boson in the $t\bar{t}H(H \rightarrow b\bar{b})$ channel during Run II at the LHC using events recorded by the ATLAS detector. The analysis uses multivariate techniques (MVA) to discriminate the signal from the background in the selection regions with significant $t\bar{t}H$ contribution. The MVA are built using Neural Networks (NN). The NN are particularly useful when no single variable which exhibits a clear separation between signal and background is available. Variables used to build the NN can be defined and validated in order to increase the separation power of the NN as much as possible.

T 4: Suche nach Supersymmetrie I (Stops)

Zeit: Montag 11:00–12:30 Raum: VMP5 HS B2

T 4.1 Mo 11:00 VMP5 HS B2

Suche nach der Produktion von supersymmetrischen, skalaren Top-Quark-Paaren mit zwei Taus im Endzustand in Run-2 bei ATLAS — •Michael Holzbock und Alexander Mann — LMU München

Supersymmetrie ist einer der vielversprechendsten Ansätze, um Schwachstellen im Standardmodell (SM) zu beheben. Hierfür wird eine Symmetrie zwischen Bosonen und Fermionen formuliert, womit die Existenz von neuen Teilchen, sogenannten supersymmetrischen Partnern der SM-Teilchen, vorhergesagt wird. Insbesondere die skalaren Partner der Fermionen der dritten Generation sind auf Grund der großen Beiträge zu Schleifenkorrekturen der Higgs-Masse von Interesse.

Es wird eine Suche nach skalaren Top-Quark-Paaren vorgestellt, der ein Modell zugrunde liegt, in denen Stops über ein virtuelles Chargino in ein Stau, ein Bottom-Quark und ein Neutrino zerfallen. Das Stau zerfällt weiter in ein Tau und ein Gravitino, welches als leichtestes supersymmetrisches Teilchen stabil ist. Wir präsentiereren die Analyse des Endzustands, welcher ein leptonisch und ein hadronisch zerfallendes Tau enthält.

Die Kinematik des Zerfalls hängt stark von der Stau-Masse ab. Dies muss sowohl bei der Auswahl der Trigger als auch bei der Entwicklung der Signalregionen berücksichtigt werden, um auf einem möglichst großen Bereich des simulierten Massenspektrums sensitiv zu sein. Im Hinblick auf die erste Veröffentlichung in Run-2 werden Projektionen der Sensitivität für 10 fb^{-1} an Daten bei $\sqrt{s} = 13$ TeV durchgeführt.

T 4.2 Mo 11:15 VMP5 HS B2

Suche nach dem supersymmetrischen Partner des Top Quarks mit dem ATLAS Experiment — Katharina Bierwagen, Volker Buescher, Katharina Jakobi, Manuel Lornatus, Andreas Reiss, •Jan Schäffer und Pedro Urrejola — 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. Der Vortrag beschreibt die Analyse zur Suche nach dem Stop-Quark in diesem Zerfallskanal, unter Ausnutzung von Abstrahlungen im Anfangszustand und der Rekonstruktion von Jets aus Charm-Quarks. Es wird die Optimierung der Signal- und Kontrollregionen, basierend auf dem 2015er Datensatz von $\int Ldt = 3.2\text{fb}^{-1}$ bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV, präsentiert.

T 4.3 Mo 11:30 VMP5 HS B2

Suche nach Top Squarks in Endzuständen ohne Leptonen bei ATLAS – elektroschwache Untergründe und aktuelle Entwicklungen — •Philipp Mogg, Christian Lüdtke, Frederik Rühr und Kilian Rosbach — Physikalisches Institut, Universität Freiburg

Der supersymmetrische Partner des Top-Quarks, genannt Top-Squark oder Stop, ist ein vielversprechendes Ziel auf der Suche nach Supersymmetrie. In bisherigen Suchen am LHC konnten bereits große Bereiche des Phasenraums nahe der elektroschwachen Skala ausgeschlossen werden, mit 13 TeV ist dank erhöhten Wechselwirkungsquerschnitts ein Vorstoß in höhere Massenregionen möglich. Stops können direkt als Paar erzeugt werden; ist die Stop-Masse höher als die kombinierte Masse des Tops und des leichtesten Neutralinos zusammen, erfolgt ein Zerfall in jene zwei Produkte. Eine Methode, nach diesem Prozess zu suchen, ist im Endzustand ohne Leptonen, mit leichten Jets, b-Jets und fehlender Transversalenergie. Aktuelle Entwicklungen der Analyse werden präsentiert, inklusive Kontrollregionen zu elektroschwachen Untergrundprozessen und Studien zu Triggern mit fehlender Transversalenergie.

T 4.4 Mo 11:45 VMP5 HS B2

Optimierung der Schnitte und Abschätzung des Multijet-Untergrunds der ATLAS-Suche nach schweren Top-Squarks im hadronischen Endzustand — •Christian Lüdtke, Philipp Mogg, Kilian Rosbach und Frederik Rühr — Physikalisches Institut, Universität Freiburg

Von vorherigen Suchen nach supersymmetrischen Teilchen wissen wir, dass Top-Squarks mit niedrigen Massen wahrscheinlich nicht existieren. Mit der höheren Schwerpunktsenergie von 13 TeV am LHC eröffnen sich neue Möglichkeiten für die Suche bei hohen Massen. In meinem Vortrag werde ich darauf eingehen, wie durch geeignete Schnitte eine sensitive und robuste Phasenraumregion für die Analyse definiert wird.
Ein Untergrund zu diesem Signal ist die Multijet-Produktion durch reine QCD-Prozesse oder $t\bar{t}$ mit hadronischem Endzustand. Durch die Forderung nach hoher fehlender Transversalenergie wird dieser Untergrund stark unterdrückt, aber durch Fehlmessung der Jetenergie können solche Ereignisse dennoch in der Signalregion beitragen und sind schwierig zu quantifizieren. Ich werde das Jet-Smearing-Verfahren vorstellen, das benutzt wird um diese Untergrundquelle abzuschätzen.

T 4.5 Mo 12:00 VMP5 HS B2

Datenbasierte Untergrundabschätzung für die Suche nach top-Squarks im vollhadronischen Zerfallskanal mit dem ATLAS-Detektor — •Nicolas Köhler, Claudia Giuliani, Oliver Kornter und Hubert Kroha — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Eines der Hauptziele des ATLAS-Experiments am LHC ist die Suche nach Supersymmetrie. Dabei stehen, motiviert durch das Hierarchieproblem, besonders die Superpartner der top-Quarks im Fokus. Die in Run 2 des LHC erhöhte Schwerpunktsenergie von $\sqrt{s} = 13$ TeV führt zu einem höheren Produktionsquerschnitt und somit zu einer deutlich erhöhten Sensitivität für schwere top-Squarks bzw. zu wesentlich stärkeren Ausschlussgrenzen als denen von Run 1.

Bei der Suche nach top-Squarks bilden die top-Quark Paarproduktion sowie die Erzeugung einzelner top-Quarks mit zusätzlichen Jets den Großteil des reduziblen Untergrunds, der verlässlich mit datenbasierten Methoden unter Benutzung sogenannter Kontrollregionen, die vom Untergrund dominiert sind, abgeschätzt werden muss.

Die Auswahl und Optimierung dieser Kontrollregionen werden vorgestellt und Verbesserungen gegenüber Run 1 diskutiert.

T 4.6 Mo 12:15 VMP5 HS B2

Suche nach Top Squarks in Endzuständen mit einem Lepton, Jets und fehlender transversaler Energie in pp Kollisionen bei $\sqrt{s} = 13$ TeV am ATLAS Experiment — •Jan Küchler, Peter Mättig und Sophio Pataraia — Bergische Universität Wuppertal

Die Analyse zielt auf die Produktion von Top Squarks in dem Zerfall von dem supersymmetrischen Partner des Gluons, dem Gluino, in ein Top Quark und den zugehörigen Superpartner. Das Top Squark zerfällt weiter in einen Endzustand mit dem Neutralino als leichtestem SUSY Teilchen, wobei angenommen wird dass die Massen von Top Squark und Neutralino fast degeneriert sind und weitere Zerfallsprodukte unterhalb der Akzeptanz liegen.

Der untersuchte Endzustand zeichnet sich durch den semileptonischen Zerfall des Top Anti-Top Paares, sowie einer hohen fehlenden transversalen Energie aus. Der hohen Massenunterschiede zwischen Gluino und Top Squark führt zu einem starken Boost des Top Quarks, der sich in einer kollimierte Zerfallstopologie äußert.

T 5: BSM Suchen I (Diboson-Resonanzen)

Zeit: Montag 11:00–12:30 Raum: VMP5 SR 0077

T 5.1 Mo 11:00 VMP5 SR 0077

Modellunabhängige Grenzen in der Suche nach Zwei-Boson-Resonanzen im semileptonischen Zerfallskanal — •Daniela Schäfer, Matthias Mozer und Thomas Müller — Institut für Experimentelle Kernphysik (IEKP), KIT

Auf der Suche nach Physik jenseits des Standardmodells wird nach neuen Resonanzen gesucht, die in zwei elektroschwache Bosonen zerfallen. Solche Resonanzen werden in vielen Kaluza-Klein-artigen Modellen wie zum Beispiel dem Bulk-Graviton-Modell vorhergesagt. Mit den Daten des CMS-Detektors aus Proton Proton Kollisionen am LHC wird bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV nach solchen neuen Resonanzen gesucht.

Im Vortrag wird eine Analyse vorgestellt, die eine bereits bestehende CMS-Analyse für den semileptonischen Zerfallskanal von schmalen Resonanzen zu Modellen beliebiger Breite erweitert.

T 5.2 Mo 11:15 VMP5 SR 0077

Search for heavy resonances in diboson final states with the CMS detector at LHC — Thomas Esch, Thomas Hebbeker, Kerstin Hoepfner, and •Swagata Mukherjee — Physics Institute III A, RWTH Aachen University

The search strategy for heavy resonances decaying to a pair of bosons in proton-proton collisions in the CMS detector at LHC is presented. Several New Physics scenarios including the recently proposed heavy vector triplet (HVT) simplified model predict the existence of Beyond Standard Model (BSM) resonances that have enhanced couplings to boson pairs. This search is particularly challenging, since for large resonance masses the two bosons are boosted and the final decay products are difficult to separate. This requires the development and use of dedicated techniques such as special tau reconstruction and lepton isolation approaches. In the absence of a significant deviation from the Standard Model expectation, upper limits are set on the signal cross section times branching ratio for the HVT signal model.

T 5.3 Mo 11:30 VMP5 SR 0077

Search for a new heavy resonance in the decay channel $V' \to VH \to l\nu/ll/\nu\nu + b\bar{b}$ with the ATLAS experiment — •Ruth Jacobs, Götz Gaycken, Stephan Hageböck, Vadim Kostyukhin, Tatjana Lenz, Elisabeth Schopf, Eckhard von Törne, and Norbert Wermes — Physikalisches Institut, University of Bonn, Germany

One of the aims of the LHC Run-2 is the search for BSM physics. Many BSM models predict heavy resonances with masses in the TeV range. Some of these resonances are predicted to decay into a SM Higgs boson and a massive electroweak boson. A search for new heavy resonances in the decay mode $V' \to VH \to l\nu/ll/\nu\nu + b\bar{b}$ using data collected with the ATLAS detector in 13 TeV pp-collisions is presented. For the reconstruction of the final state, the presence of a boosted Higgs boson is exploited that decays into two b-quarks collimated in a single large-Radius jet. The search is performed by studying the invariant mass distribution of the VH system and testing for an excess. An optimization of the statistical model used to obtain upper limits on the resonance cross section is presented. The aim of this study is to reduce the complexity and improve the stability of the profile-likelihood fit. Additionally, an optimization of the event selection is presented that is intended to improve the sensitivity of the search.

T 5.4 Mo 11:45 VMP5 SR 0077

Suche nach Heavy Vector Triplets im Zerfallskanal $V' \to VH$ mit dem ATLAS-Experiment — •Daniel Büscher und Christian Weiser — Universität Freiburg

Mit der Entdeckung eines Higgs-Bosons mit einer Masse von ca. 125 GeV im Jahre 2012 durch die Experimente am CERN scheint das letzte fehlende Teil des Standardmodells (SM) gefunden. Damit stellt sich die Frage, wie mögliche Erweiterungen des SM aussehen können. Es gibt verschiedene Modelle, motiviert z. B. durch das Hierarchieproblem, welche neue Vektorbosonen mit Massen im TeV-Bereich vorhersagen.

Dieser Vortrag beschäftigt sich mit der Suche nach schweren Vektorbosonen V' (W' und Z'), welche jeweils in ein SM-Vektorboson und ein Higgs-Boson zerfallen: $V' \to VH$. Dabei werden die leptonischen Zerfälle der Vektorbosonen, $W \to l\nu$ und $Z \to \nu\nu, ll$, sowie der Zerfall des Higgs-Bosons in b-Quarks, $H \to bb$, betrachtet. Dieser Zerfallskanal weist für das SM Higgs-Boson mit $m_H = 125$ GeV die größte Zerfallsbreite auf. Die schweren Vektorbosonen werden mit Hilfe einer phänomenologischen Lagrangedichte beschrieben, welche ein *Heavy Vector Triplet* (HVT) beinhaltet.

Es werden die Analyse und ersten Ergebnisse aus der zweiten Datennahmeperiode (*Run 2*) mit dem ATLAS-Experiment bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV vorgestellt. Die Analyse behandelt speziell den hohen Massenbereich $m_{VH} \geq 1$ TeV, welcher im *Run 1* bei $\sqrt{s} = 8$ TeV schwerer zugänglich war. Hierzu werden sogenannte *boosted* Techniken verwendet.

T 5.5 Mo 12:00 VMP5 SR 0077

Search for heavy diboson resonances decaying into $W \to \ell\nu$ and $H \to \tau\tau$ with CMS — Thomas Hebbeker, Kerstin Hoepfner, Swagata Mukherjee, and •Thomas Esch — III. Physikalisches Institut A, RWTH Aachen

Heavy resonances that decay to two bosons could be an interesting signature for new physics. With increasing resonance masses, the two bosons get higher momenta and their decay products get closer to each other.

This talk shows the strategy for a search for heavy WH resonances with the CMS experiment where the W boson decays leptonically and the H boson decays to τ leptons. It will concentrate on semileptonic and fully hadronic $H \to \tau\tau$ decays and their reconstruction techniques, as well as on the selection criteria to seperate the signal against the background. In the end, an estimate for the sensitivity of this channel will be shown.

T 5.6 Mo 12:15 VMP5 SR 0077

Studies on searches for narrow resonances decaying into WZ or ZZ boson pairs — •Daniel Narrias-Villar and Oleg Brandt — Kirchhoff-Institute for Physics, Heidelberg University, Heidelberg, Germany

The increased centre-of-mass energy of 13 TeV in Run 2 of the LHC provides an excellent ground to search for resonances in the diboson invariant mass spectrum above 1 TeV, where the sensitivity in Run 1 was limited by data statistics. Studies of such resonances decaying into WZ or ZZ boson pairs, where one Z decays into a pair of charged leptons and the other W or Z decays hadronically, are presented. In the kinematic boosted regime considered, the hadronic decay products of W or Z bosons form a single large-R jet, which is identified as a boson jet using jet substructure properties. The invariant mass distribution of the system of such jet and highly energetic lepton pair from a Z boson decay is used as discriminator for the diboson resonance search. Studies on further kinematic distributions for SM backgrounds and various beyond-SM signal models are investigated in order to potentially improve the background rejection.

T 6: Neutrinomasse I

Zeit: Montag 11:00–12:35 Raum: VMP5 SR 0079

Gruppenbericht T 6.1 Mo 11:00 VMP5 SR 0079

Status of the KATRIN experiment — •Marco Röllig for the KATRIN-Collaboration — Karlsruher Institut für Technologie (KIT), Deutschland

A model-independent measurement of the neutrino mass is one of the most important open issues in neutrino physics. The KArlsruhe Tritium Neutrino Experiment (KATRIN) aims for it with an unprecedented sensitivity of $m_{\bar{\nu}_e} < 200$ meV (90% C.L.). While the commissioning of the high resolution MAC-E Filter and the main detector is ongoing also all tritium related components have arrived at KIT. At

the Tritium Laboratory Karlsruhe the on-site finalization and commisioning of the tritium related parts has started. A status report on all source and transport components of KATRIN as well as the spectrometer and detector section is given. Also the integration into the existing tritium infrastructure is described.

T 6.2 Mo 11:20 VMP5 SR 0079

Project8: ein neuer Ansatz zur Bestimmung der Neutrinomasse — •Christine Claessens und Sebastian Böser — Johannes Gutenberg-Universität Mainz

Obwohl das Konzept der Zyklotron-Strahlung seit über einem Jahrhundert bekannt ist, wurde diese aufgrund der geringen abgestrahlten Leistung bislang nicht für einzelne Elektronen beobachtet. Durch den Einschluss der Elektronen in einer magnetischen Falle und den so erreichbaren langen Integrationszeiten ist dem Project8-Experiment vor kurzem die direkten Beobachtung der Zyklotron-Strahlung einzelner schwachrelativistischer Elektronen gelungen. Die präzise Vermessung der Zyklotronfrequenz $f = \frac{eB}{2\pi\gamma m_e}$ erlaubt dabei eine hochpräzise Energiebestimmung einzelner Elektronen in-situ, und etabliert so das neue Feld der *Cyclotron-Radiation Emission Spectroscopy* (CRES). Eine vielversprechende Anwendung dieser neuartigen Detektionsmethode ist insbesondere die Vermessung des β-Zerfallsspektrums von Tritium zur Bestimmung der Neutrinomasse. Die Ergebnisse erster Messungen der CRES und neue Ansätze zur weiteren Verbesserung der Energiebestimmung werden vorgestellt.

T 6.3 Mo 11:35 VMP5 SR 0079

Background Analysis and Reduction for the ECHo Experiment — •Stephan Scholl for the ECHo-Collaboration — Kepler Center for Astro and Particle Physics, Eberhard-Karls Universität Tübingen

ECHo–1K is a new experiment designed for the investigation of the electron Neutrino mass with the microcalorimetric measurement of the electron capture spectrum of ^{163}Ho. In this presentation, an overview of our Monte–Carlo background simulations and our radiopurity measurements is given.

T 6.4 Mo 11:50 VMP5 SR 0079

Radon-induced backgrounds in the KATRIN Main Spectrometer — •Fabian Harms for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Experimental Nuclear Physics (IEKP)

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV/c^2 (90% C.L.) by investigating the kinematics of tritium β-decay. One crucial prerequisite to reach this unsurpassed sensitivity is a background level of ≤ 0.01 counts per second within the 1240-m^3 vessel of the KATRIN Main Spectrometer.

In 2014/15, a dedicated series of commissioning measurements was performed in order to identify and characterize the various background sources in the spectrometer. This talk will focus on background generating processes that do follow the radioactive decays of radon atoms in the vessel volume. Besides a well-understood stored-electron induced background that is caused by the decay of the short-lived isotopes ^{219}Rn and ^{220}Rn, this also includes a newly identified background contribution due to a deposition of the progeny of the long-lived isotope ^{222}Rn on inner surfaces of the spectrometer. The characteristics of both background contributions, possible countermeasures, and the consequences for the absolute background level of KATRIN will be discussed.

This work has been supported by the Helmholtz Association and the German BMBF (05A14VK2).

T 6.5 Mo 12:05 VMP5 SR 0079

Gamma induced background in the KATRIN main spectrometer — •Philipp Chung-On Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The *KA*rlsruhe *TRI*tium *N*eutrino experiment (KATRIN) experiment aims to measure the electron neutrino mass with a sensitivity of $m(\nu_e) < 200\,\mathrm{meV}/c^2$. It utilizes a MAC-E-type spectrometer for high-resolution and high-statistics spectroscopy of the β-decay of ^{3}H close to its endpoint of 18.6 keV.

The KATRIN spectrometer and detector section has undergone 3 commissioning phases in recent years, with one of the major goals being the characterization and reduction of the background level. Secondary electrons, that are created inside the main spectrometer by external radiation, e.g. cosmic muons or natural radioactivity gammas, are considered to be one of the main contributions to the remaining background level.

The experimental investigation of the gamma induced background has been twofold. Firstly by exposing the spectrometer wall to an external 50 MBq ^{60}Co gamma source and secondly by introducing additional gamma shielding inside the experimental hall, effectively reducing the flux of natural radioactivity gammas to the spectrometer wall.

This talk gives an overview of the investigations and results concerning gamma induced background in the KATRIN main spectrometer.

The work of the author is supported by BMBF Verbundforschung under contract 05A14PMA.

T 6.6 Mo 12:20 VMP5 SR 0079

Vacuum simulation of the KATRIN radon background — •Joachim Wolf for the KATRIN-Collaboration — Karlsruher Institut für Technologie (KIT), IEKP, Postfach 3640, 76021 Karlsruhe

The objective of the KATRIN experiment at KIT is the measurement of the electron neutrino mass. A central component is the Main Spectrometer (1240 m^3), where the energy of the β-electrons from tritium decay (18.6 keV) will be measured close to the endpoint of the spectrum. The pumping system of the ultra-high vacuum vessel consists of turbo-molecular pumps, a large-scale getter pump (up to 3000 m NEG strips, St707) and three cryo-baffles at LN_2 temperature, designed to maintain a pressure in the range of 10^{-11} mbar. The NEG strips, as well as the stainless steel walls are known to emanate small amounts of radon atoms, increasing the intrinsic background rate, which would limit the sensitivity for the neutrino mass. The cryogenic copper baffles in front of the NEG pumps capture most of the radon, before it decays in the main volume. However, radon does not stick to the cold surface indefinitely. If it desorbs after a limited residence time, it can contribute again to the background rate.

This talk describes the simulation of this radon background with the Test-Particle Monte Carlo (TPMC) code MolFlow+ and compares the results with measurements. We modified the original MolFlow+ code, and added two new, time-dependent features, (i) a finite residence time for all adsorbing surfaces, and (ii) a finite half-life of the test particles. Results are presented for different radon isotopes. This work has been supported by the German BMBF (05A14VK2).

T 7: BSM Suchen II

Zeit: Montag 11:00–12:30 Raum: VMP6 HS B

T 7.1 Mo 11:00 VMP6 HS B

Suche nach angeregten Leptonen mit dem CMS Experiment — •Matthias Endres[1], Thomas Esch[1], Thomas Hebbeker[1], Kerstin Hoepfner[1], Shilpi Jain[2], Chia-Ming Kuo[2] und Pen-Hsuan Wang[2] — [1]III. Phys. Inst. A, RWTH Aachen University, Aachen — [2]National Central University, Jhongli City

Nach heutigem Wissensstand gehören die bekannten Leptonen zu den fundamentalen Bausteinen der Natur. Es ist jedoch vorstellbar, dass es eine verborgene Substruktur der Leptonen gibt, die bislang nicht entdeckt werden konnte. In diesem Fall sollten sich die Leptonen in einen schwereren Zustand anregen lassen können.

Sollten sie existieren, so wird erwartet, dass angeregte Leptonen bei Paarproduktionen gemeinsam mit einem nicht angeregten Lepton entstehen. Das angeregte Lepton kann dann unter Bosonabstrahlung zerfallen. Je nach Wahl der Theorieparameter dominiert dabei die Abstrahlung eines Photons oder eines schwachen Eichbosons.

Der Vortrag zeigt die Suchen nach angeregeten Elektronen und Myonen, die entweder ein Photon oder ein Z-Boson abstrahlen. Die entstehenden $2\ell + \gamma$, 4ℓ und 2ℓ+jets Signaturen sind gut zu rekonstruieren und wurden bei dieser Interpretation nun teilweise erstmals am LHC untersucht. Präsentiert werden einerseits Ergebnisse der Suche mit Daten, die 2012 bei einer Schwerpunktsenergie von $\sqrt{s} = 8$ TeV vom CMS Experiment aufgezeichnet wurden, sowie die Analyse bei 13 TeV. Letz-

tere profitiert von deutlich höheren Signal-Wirkungsquerschnitten, sodass trotz weniger aufgenommener Daten eine sensitive Suche möglich ist.

T 7.2 Mo 11:15 VMP6 HS B

Search for quantum black holes in the final state of one electron and one muon with CMS in 13 TeV data — •Sören Erdweg, Andreas Güth, Thomas Hebbeker, Henning Keller, Arnd Meyer, and Swagata Mukherjee — III. Physikalisches Institut A, RWTH Aachen

Many models of physics beyond the standard model predict charged lepton flavour violation. Low scale quantum gravity at the TeV scale could lead to the production of quantum black holes (QBH). They could decay into an electron and a muon and result in an excess of events at high invariant masses, thus leading to a striking signature with low standard model background.

The analysis of the 2015 dataset of CMS corresponding to an integrated luminosity of 2.5 fb^{-1} at a center of mass energy of 13 TeV is presented and interpreted in the context of quantum black holes.

T 7.3 Mo 11:30 VMP6 HS B

Bremsstrahlungskorrektur von Elektronen im Lepton-Flavor verletzenden Zerfall $B^+ \to K^+ e^\pm \mu^\mp$ am LHCb-Experiment — Johannes Albrecht[1], •Daniel Berninghoff[1] und Vladimir Gligorov[2] für die LHCb-Kollaboration — [1]Experimentelle Physik 5, TU Dortmund — [2]CERN

Die Suche nach Leptonflavor verletzenden Prozessen spielt eine wichtige Rolle bei der Suche nach Physik jenseits des Standardmodells. Eine aktuelle Messung vom LHCb-Experiment zur Leptonuniversalität steht in einer Spannung von 2,6 σ zur Standardmodell-Vorhersage und stellt damit einen möglichen Hinweis auf die Verletzung der Leptonuniversalität dar, welche ebenfalls eine Verletzung der Leptonflavor-Zahl impliziert.
Für die Suche nach Leptonflavor-Verletzung eignet sich der Zerfall $B^+ \to K^+ e^\pm \mu^\mp$, der aufgrund des Elektrons im Endzustand jedoch auch experimentelle Schwierigkeiten durch Bremsstrahlungsverluste mit sich bringt. Die emittierte Bremsstrahlung verringert die Impulsauflösung der Elektronen und erschwert dadurch die erfolgreiche Unterdrückung des Untergrunds.
In diesem Vortrag wird ein neuartiger multivariater Ansatz zur Berücksichtigung der Bremsstrahlungsverluste bei der Elektronenrekonstruktion im Hinblick auf den Zerfall $B^+ \to K^+ e^\pm \mu^\mp$ am LHCb-Experiment vorgestellt.

T 7.4 Mo 11:45 VMP6 HS B

Search for New Physics in Singly Cabibbo Suppressed D Decays at the Belle Experiment — •Dmytro Levit, Daniel Greenwald, Johannes Rauch, Andreas Hönle, Arseniy Tsipenyuk, and Stephan Paul for the Belle-Collaboration — Physikdepartment E18, TU München, Garching

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 current status of the analysis will be presented in the contribution.

T 7.5 Mo 12:00 VMP6 HS B

Limit on the quark-charge effective radius from inclusive ep scattering at HERA — •Oleksii Turkot[1], Katarzyna Wichmann[1], and Aleksander Filip Zarnecki[2] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]Faculty of Physics, University of Warsaw, Warsaw, Poland

The H1 and ZEUS experiments at HERA have recently presented the combined measurement of inclusive deep inelastic cross sections in neutral and charged current *ep* scattering corresponding to a luminosity of about 1 fb^{-1}. The high precision of the data makes searches for new contributions to electron-quark scattering possible up to TeV scales. A new approach to beyond the Standard Model (BSM) analysis of inclusive ep data is outlined, taking into account possible contributions to the QCD fit of parton distributions coming from "new physics" processes. Results are presented considering a finite radius of quarks within the quark form factor model. The resulting 95% C.L. upper limit for the radius of the electroweak charge of quarks is $0.43 \cdot 10^{-16}$ cm.

T 7.6 Mo 12:15 VMP6 HS B

Search for hidden particles with the SHiP experiment — •Caren Hagner, Daniel Bick, Stefan Bieschke, Joachim Ebert, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Many theories beyond the standard model predict long lived neutral (hidden) particles. There might be a whole Hidden Sector (HS) of weakly interacting particles, which cannot be detected in existing high energy experiments. The SHiP experiment (Search for Hidden Particles) requires a high intensity beam dump, which could be realized by a new facility at the CERN SPS accelerator. New superweakly interacting particles with masses below O(10) GeV could be produced in the beam dump and detected in a general purpose Hidden Sector (HS) detector. In addition there will be a dedicated tau neutrino subdetector. I will present the major requirements and technical challenges for the HS detector and discuss how the HS can be accessed through several portals: neutrino portal, scalar portal, vector portal and many more.

T 8: Myondetektoren I

Zeit: Montag 11:00–12:30 Raum: VMP6 HS E

T 8.1 Mo 11:00 VMP6 HS E

MMSW - a large-size micromegas quadruplet prototype: Design and Construction — •Fabian Kuger[1,2], Michele Bianco[2], Hans Danielson[2], Jordan Degrange[2], Rui de Oliveira[2], Eduardo Farina[2], Paolo Iengo[2], Francisco Perez Gomez[2], Givi Sekhniaidze[2], Federico Sforza[2], Ourania Sidiropoulou[1,2], Maurice Vergain[2], Joerg Wotschack[2], Andreas Düdder[3], Tai-Hua Lin[3], and Matthias Schott[3] — [1]Julius Maximilians Universität, Würzburg (Germany) — [2]CERN, Geneva (Switzerland) — [3]Johannes Gutenberg-Universität, Mainz (Germany)

Two micromegas detector quadruplets with an area of $0.5\mathrm{m}^2$ (MMSW) have been recently constructed and tested at CERN and University of Mainz. They serve as prototypes for the planned upgrade project of the ATLAS muon system.

Their design is based on the resistive-strip technology and thus renders the detectors spark tolerant. The applied ḿechanically floatingḿesh design allows for large area Micromegas construction and facilitates detector cleaning before assembly.

Each quadruplet comprises four detection layers with 1024 readout strips and a strip pitch of 415 μm. In two out of the four layers the strips are inclined by $\pm 1.5^\circ$ to allow for the measurement of a second coordinate. We present the detector concept and report on the experience gained during the detector construction.

T 8.2 Mo 11:15 VMP6 HS E

MMSW - A large-size micromegas quadruplet prototype: Mechanical Accuracy and Basic Performance Parameters — •Ourania Sidiropoulou[1,2], Michele Bianco[1], Hans Danielsson[1], Jordan Degrange[1], Rui De Oliveira[1], Edoardo Farina[4], Fabian Kuger[1,2], Paolo Iengo[1], Francisco Perez Gomez[1], Givi Sekhniaidze[5], Federico Sforza[1], Maurice Vergain[1], Joerg Wotschack[1], Andreas Düdder[3], Tai-Hua Lin[3], Matthias Schott[3], and Chrysostomos Valderanis[3] — [1]CERN, Switzerland — [2]University of Wuerzburg, Germany — [3]University of Mainz, Germany — [4]University of Pavia, Italy — [5]INFN and University of Naples, Italy

Two Micromegas quadruplet prototypes chambers (MMSW) following the general design foreseen for the ATLAS forward muon spectrometer upgrade were constructed and tested at CERN and the University of Mainz. These are the first Micromegas quadruplets ever built.

We report on the mechanical accuracy comprising measurements of

the planarity and the alignment of the two faces of a panel as well as panel to panel alignment. Furthermore basic performance parameters such as gain homogeneity after assembly have been tested with cosmic muons and X-ray measurements. These testing procedures, established with the MMSW prototypes, will become part of the quality control and validation procedure for the mass production of the Micromegas New Small Wheel detectors.

T 8.3 Mo 11:30 VMP6 HS E

MMSW - a large-size micromegas quadruplet prototype: Reconstruction Efficiency and Spatial Resolution — •Tai-Hua Lin[1], Andreas Düdder[1], Matthias Schott[1], Chrysostomos Valderanis[1], Michele Bianco[2], Hans Danielsson[2], Jordan Degrange[2], Rui De Oliveira[2], Edoardo Farina[2], Fabian Kuger[2], Paolo Iengo[2], Francisco Perez Gomez[2], Givi Sekhniaidze[2], Ourania Sidiropoulou[2], Maurice Vergain[2], and Jörg Wotschack[2] — [1]Johannes Gutenberg-Universität, Mainz, Germany — [2]CERN, Geneva, Switzerland

One of the upgrades of the ATLAS detector for Run III and beyond is the replacement of the inner part of end cap muon tracking spectrometer with eight layers of resistive micromegas detectors.

The performance of two prototype detectors, MMSW (MicroMegas Small Wheel), that adopt the design foreseen for this upgrade was studied. The prototype detectors were tested at the Mainz Microtron for the spatial resolution, with cosmic rays for the reconstruction efficiency and for high rate tests in the new Gamma Irradiation Facility (GIF++) at CERN. These measurements with analysis methods and results will be presented. First performance results are consistent with the ATLAS New Small Wheel requirements.

T 8.4 Mo 11:45 VMP6 HS E

Improvement of surface planarity measurements by temperature correction and structural simulations — •Maximilian Herrmann[1], Otmar Biebel[1], Jonathan Bortfeldt[1], Bernhard Flierl[1], Ralf Hertenberger[1], Philipp Loesel[1], Ralph Mueller[1], and Andre Zibell[2] — [1]LMU München — [2]JMU Würzburg

Novel micro pattern gaseous detectors, like Micromegas, for particle physics experiments require precise flat active layers of 2-3 m^2 in size. A construction procedure developed at LMU for 2 m^2 sized Micromegas achieves surface planarities with a RMS below 30 μm. The measurements were performed using a laser distance sensor attached to a coordinate measurement machine.
Studies were made to investigate the influence of temperature variations on these measurements. The temperature is monitored by several sensors. We present results containing corrections of the measurements in respect to temperature changes.
In addition simulations with the FEM program ANSYS are compared to measured detector panel deformations introduced by forces, in order to study their effect on the surface planarity.

T 8.5 Mo 12:00 VMP6 HS E

Planarity Certification of ATLAS Micromegas Detector Panels — •Ralph Müller[1], Otmar Biebel[1], Jonathan Bortfeldt[1], Bernhard Flierl[1], Ralf Hertenberger[1], Philipp Lösel[1], Maximilian Herrmann[1], and Andre Zibell[2] — [1]LMU München — [2]JMU Würzburg

During the second long LHC shutdown, 2019/20, the precision tracking detectors of the ATLAS muon spectrometer in the inner end caps will be replaced using Micromegas, a planar gas-detector technology. Modules of 2 m^2 area are built in quadruplets from five precisely planar sandwich panels that define the anodes and the cathodes of the four active detector planes. A panel is composed of three consecutive layers FR4 - aluminum honeycomb - FR4. Single plane spatial particle resolution below 100 μm is achievable when the deviations from planarity of the strip-anodes do not exceed 80 μm RMS over the whole active area and the parallelism of the readout strips is within 30 μm. In order to measure the dimensional accuracy of each panel, laser distance sensors combined with a coordinate measurement system have been investigated. The sensor requirements to measure the planarity of the panels are a resolution of 0.3 μm and a beam spot diameter of $\approx$ 20 μm, well below 100 μm the size of the smallest structures.
We report on achieved planarities of the panels and the performance of the laser sensor system. A panel with an RMS better than 30 μm was build and the evolution of its planarity due to humidity and temperature effects is shown.

T 8.6 Mo 12:15 VMP6 HS E

Study of APV preamplifier circuits for Micromegas detectors — •Quirin Steinbacher, Otmar Biebel, Jonathan Bortfeldt, Ralf Hertenberger, Philipp Lösel, Ralph Müller, and André Zibell — LMU München

Micromegas detectors are high-rate capable planar gaseous particle detectors with micro structured readout-anodes. The electronic signals are often read out using the analogue frontend chip APV25. An APV25 chip amplifies, buffers in a pipeline and multiplexes 128 analogue output channels on a single analogue output channel which is subsequently digitized by an ADC. A quantitative analysis of data enables the study of potential signal distortion as signal induced global baseline shifts or signal induced cross talk. The combination of two APVs into a pair of master and slave leads to different phases in the transmitted signal which affects the subsequent digitization. Possible signal corrections are deduced and tested for improvement of spatial resolution on experimental data acquired at the Garching Tandem accelerator and the LMU cosmic ray facility.

T 9: Experimentelle Methoden der B-Physik

Zeit: Montag 11:00–12:35 Raum: VMP6 HS F

Gruppenbericht T 9.1 Mo 11:00 VMP6 HS F

Die Belle II Software — Thomas Kuhr, •Martin Ritter und Tobias Schlüter für die Belle II-Kollaboration — Ludwig Maximillians Universität, München

Das Belle II Experiment ist ein B-Fabrik-Experiment, das 50-mal mehr Daten aufzeichnen wird als das Vorgängerexperiment Belle. Der durch die hohe Luminosität des SuperKEKB-Beschleunigers verursachte Okkupanzgrad erfordert grundlegende Verbesserungen des Detektors. Konsequenterweise müssen auch Simulations-, Rekonstruktions- und Analysesoftware tiefgreifend überarbeitet werden. Der größte Teil der Software wurde von Grund auf neu entwickelt, um Erfahrungen von Belle und anderen Experimenten sowie neue Technologien einfließen lassen zu können. Die erwartete große Menge an gemessenen und simulierten Ereignissen erfordert ein sehr hohes Maß an Zuverlässigkeit und Reproduzierbarkeit. Verschiedene Technologien, Werkzeuge und organisatorische Maßnahmen werden eingesetzt, um die Leistungsfähigkeit der Software während der Entwicklung zu bestimmen und überwachen.

T 9.2 Mo 11:20 VMP6 HS F

Flavor-Tagging mit tiefen neuronalen Netzen am Belle II-Experiment — Michael Feindt, •Jochen Gemmler, Thomas Hauth, Martin Heck und Thomas Keck für die Belle II-Kollaboration — Karlsruher Institut für Technologie

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} bilden eine der Grundlagen des Belle II-Experiments. Zur Bestimmung der zeitabhängigen 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. Bisher wurden für die Klassifikation Boosted Decision Trees oder neuronale Netze mit einer verborgenen Schicht eingesetzt, deren Eingangsvariablen aufwendig konstruiert werden müssen.

In diesem Vortrag wird der Einsatz eines tiefen neuronalen Netzes als alternativer Ansatz für das Flavor-Tagging vorgestellt und aktuelle Ergebnisse diskutiert. Insbesondere wird dabei auf die Verwendung von Konzepten aus dem Bereich „Deep Learning“ eingegangen.

T 9.3 Mo 11:35 VMP6 HS F

Neuste Entwicklungen zur V0 Rekonstruktion am Belle II Experiment — •Markus Prim, Michael Feindt, Thomas Hauth, Martin Heck und Pablo Goldenzweig für die Belle II-Kollaboration — EKP, KIT, Karlsruhe

Am Belle II Experiment können K_S^0 Mesonen, durch den Zerfall $K_S^0 \to \pi^+\pi^-$, und konvertierte Photonen eine charakteristische V0 Zerfallssignatur aufweisen. Außerhalb des Strahlrohrs müssen diese Vertices gesondert behandelt werden, da Spuren, die ihren Ursprung in diesen versetzten Vertices haben, Materialeffekten unterliegen und falsch zugewiesene Messpunkte enthalten können. Daher ist es notwendig, die V0 Signatur zu einem Zeitpunkt zu rekonstruieren, bevor die Messpunkte entlang der Teilchenspuren verworfen werden. Es wurde ein Algorithmus zur Rekonstruktion der V0 Signatur implementiert und auf K_S^0 Mesonen und konvertierte Photonen angewandt. Es konnte gezeigt werden, dass dadurch eine signifikante Verbesserung gegenüber der bisherigen Implementierung für Spuren aus V0 Signaturen erreicht wird.

T 9.4 Mo 11:50 VMP6 HS F

Vertex-Rekonstruktion am Belle II-Experiment — •Moritz Gelb, Michael Feindt, Pablo Goldenzweig, Thomas Hauth und Martin Heck für die Belle II-Kollaboration — Karlsruher Institut für Technologie

Bei einer Vielzahl von Analysen in der Flavour-Physik spielt das Auffinden und Fitten von Zerfallsvertices aus rekonstruierten Spuren eine elementare Rolle. Beim Belle II-Experiment, das mit der Datennahme voraussichtlich im Jahr 2018 beginnen wird, soll diese Aufgabe von dem externen Software-Paket RAVE übernommen werden. RAVE hat seine Ursprünge beim CMS-Experiment und bietet für die Rekonstruktion von Vertices verschiedene Algorithmen an. In Kombination mit dem neuen Vertex-Detektor konnte auf Monte-Carlo-Daten bereits eine verbesserte Auflösung im Vergleich zum Vorgänger-Experiment erreicht werden. Bei komplexen Analysen mit mehreren Zerfallskanälen muss oft eine Vielzahl von Vertices rekonstruiert werden. Um diesen Anforderungen hinsichtlich des Laufzeit- und Speicherbedarfs gerecht zu werden, wird die Software nun überarbeitet. Außerdem sollen weitere Funktionalitäten hinzugefügt werden. In diesem Vortrag soll der Status der Arbeit präsentiert werden.

T 9.5 Mo 12:05 VMP6 HS F

Spurrekonstruktion mithilfe multivariater Methoden am Belle II-Experiment — •Nils Braun, Michael Feindt, Pablo Goldenzweig, Thomas Hauth und Martin Heck für die Belle II-Kollaboration — EKP, KIT, Karlsruhe

Für präzise Messungen an Teilchendetektoren sind gut rekonstruierte Teilchenspuren unentbehrlich. Die für das Belle II-Experiment geplanten Spurfindungsalgorithmen bieten hierbei verschiedene Ansätze mit unterschiedlichen Eigenschaften, welche am Ende kombiniert werden sollen.

Zur automatisierten Entscheidungsfindung in den verschiedenen Kombinationsalgorithmen und zur Reduktion von Detektorsignalen, welche durch strahlinduzierten Hintergrund erzeugt werden, wurden multivariate Methoden (Boosted Decision Trees) angewendet und getestet. Dieser Vortrag zeigt deren Umsetzung und erste Ergebnisse anhand von Monte-Carlo Studien.

T 9.6 Mo 12:20 VMP6 HS F

Reoptimierung des Flavour-Taggings am LHCb-Experiment — •Kevin Heinicke und Julian Wishahi — Experimentelle Physik 5, TU Dortmund

Die indirekte Suche nach Neuer Physik mit Hilfe von Präzisionsmessungen ist wesentlicher Bestandteil des LHCb-Physikprogramms. Für die Messung von *CP*-Verletzung in der Interferenz zwischen Mischung und Zerfall neutraler *B*-Mesonen wird der initiale Flavour der Teilchen benötigt. Der Produktionszustand wird dabei durch das sogenannte Flavour-Tagging bestimmt.

Die Schwerpunktsenergie der *pp*-Kollisionen am LHC ist in der im Jahr 2015 angelaufenen, zweiten Datennahmeperiode (Run II) von 7/8 TeV während der ersten Periode (Run I) auf 13 TeV erhöht worden. Da dies zu veränderten Eigenschaften der rekonstruierten Ereignisse führt, ist eine Reoptimierung und -kalibrierung der Flavour-Tagging-Algorithmen, die auf multivariaten Methoden basieren, nötig. In diesem Zuge können neue Algorithmen zur Identifizierung des initialen Teilchenflavours getestet, sowie die Unterschiede vor und nach der Erhöhung der Schwerpunktsenergie untersucht werden.

T 10: Halbleiterdetektoren I (Streifen)

Zeit: Montag 11:00–12:30 Raum: VMP8 HS

T 10.1 Mo 11:00 VMP8 HS

Qualitätssicherung in der Produktion eines neuen Silizium-Streifendetektors für das ATLAS-Experiment — Ingo Bloch[1], Kristin Lohwasser[1], •Jason Mansour[2], Luise Poley[1] und Dennis Sperlich[3] — [1]DESY, Zeuthen — [2]Institute of High Energy Physics, Beijing, China — [3]Humboldt-Universität zu Berlin

Mit dem High-Lumi LHC Upgrade wird der ATLAS-Detektor einen verbesserten Spurdetektor benötigen, der auf die erhöhte Anzahl von Kollisionen und die größere Strahlenbelastung ausgelegt ist. Der geplante neue Silizium-Streifendetektor ist aus zahlreichen Modulen zusammengesetzt, die jeweils aus einem Sensor, Auslesechips (ASICs) und einer Versorgungsplatine (Hybrid) bestehen. Die Komponenten eines einzelnen Moduls werden miteinander verklebt. Die Dicke der Klebstoffschicht hat hierbei Einfluss auf das Rauschverhalten des Moduls, weshalb es nötig ist, diese genau zu bestimmen und zu kontrollieren.

Wir präsentieren eine neue Methode, mit Hilfe des in der Regel für die Produktion vorhandenen Drahtbonders (Modell Delvotec G5) die Klebstoffdicken zwischen Komponenten zu messen. Dabei wurde Wert darauf gelegt, dass die Messung einfach und schnell durchzuführen ist, und sich gut in den Produktionsablauf einpasst, ohne diesen zu behindern. Einmal gestartet erfolgt die Messung vollautomatisch, mit Rückmeldung anhand eines simplen Ampelsystems, welches zeigt ob die Schichtdicke innerhalb der erwünschten Parameter ist.

T 10.2 Mo 11:15 VMP8 HS

Werkzeugentwicklung und Elektronik-Hybride für Petal-Module des ATLAS Streifentracker-Upgrades — •Michael Schütz, Marc Hauser, Karl Jakobs, Susanne Kühn, Kambiz Mahboubi und Ulrich Parzefall — Universität Freiburg

Das ATLAS-Experiment am LHC wird für das Phase-II Upgrade einen komplett neuen Siliziumspurdetektor einbauen. Im Streifenbereich werden hochgradig integrierte Multimodul-Strukturen eingebaut. Diese bestehen im Vorwärtsbereich aus trapezförmigen Petals, welche auf beiden Seiten mit je 9 Modulen bestückt sind. Die Werkzeuge zum präzisen Bau dieser Module sowie die Elektronik-Hybride mit Ausleseelektronik werden u.a. an der Universität Freiburg entwickelt. Dieser Vortrag stellt die Präzisionswerkzeuge und ihren Einsatz beim Modulbau vor, und präsentiert den Stand der Entwicklung im Bereich der Elektronik-Hybride.

T 10.3 Mo 11:30 VMP8 HS

Upgrade des inneren Spurdetektors des ATLAS Experimentes: Untersuchung alternativer Si-Streifen-Sensoren Layouts — •Hannes Lasse Edvard Bein — Humboldt-Universität zu Berlin, Deutsches Elektronen Synchrotron

Im Zuge des Upgrades des LHC-Beschleunigers zum High-Luminosity LHC wird auch der ATLAS-Detekor eine Neugestaltung erfahren. Hierbei wird der innere Spurdetektor vollständig aus modularen Silizium-Sensoren aufgebaut werden. Im aus Streifen-Detektoren bestehenden Teil des geplanten Detektors werden die Sensoren der Module mit der Ausleseelektronik elektronisch über Drahtbonds miteinander verbunden. In der späteren Serienfertigung ist die elektrische Verbindung von Sensor und Chip der zeitintensivste Schritt. Um die Fertigung zu optimieren, wird im alternativen Layout der Streifen-Sensoren eine zweite Metallschicht als Pitchadapter eingefügt, die es ermöglicht, alle Auslesedrähte parallel anzuordnen. Hierdurch soll eine höhere Fertigungsgeschwindigkeit, sowie ein höherer Fertigungsertrag erreicht werden. Die zusätzlichen Metallstrukturen führen durch ihre kapazitiven Eigenschaften zu einem erhöhten Rauschen im Modul. Auch können Cross-Talk und Pick-Up zwischen den Auslesekanälen auftreten. Dieser Beitrag liefert einen Einblick in Untersuchungen am Photonen-Test-Strahl zu Cross-Talk und Pick-Up des alternativen Sensorlayouts.

T 10.4 Mo 11:45 VMP8 HS

Charakterisierung von Makropixelsensoren für das Phase II Upgrade des CMS-Trackers — Felix Bögelspacher, Alexander Dierlamm, Thomas Müller, Markus Nowak, Martin

Printz, •Daniel Schell und Pia Steck — Institut für Experimentelle Kernphysik (IEKP), KIT

Das für 2023/24 geplante Upgrade des Large Hadron Colliders (LHC), welches die instantane Luminosität von 2 auf $5 \cdot 10^{34}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}$ steigern soll, stellt neue Herausforderungen an alle beteiligten LHC-Experimente und deren Detektorkomponenten. Um die erhöhte Datenmenge, die aus der gesteigerten Teilchenrate resultiert effektiv auf eine zu verarbeitende Größe zu reduzieren, werden neue Modulkonzepte des CMS-Spurdetektors entwickelt, die zusätzliche Informationen für den Level-1 Trigger bereitstellen sollen. Eines dieser Konzepte ist das sogenannte PS-Modul, welches aus einem Makro(P)ixel- und einem (S)treifensensor aufgebaut ist. Durch die modulinterne Korrelation der Durchstoßpunkte in beiden Lagen, können Teilchen mit geringer Energie sehr gut identifiziert und verworfen werden, was die Datenmenge erheblich reduziert. Der Makropixelsensor, welcher aus über 30000 $100 \times 1446\,\mu\mathrm{m}^2$ Pixelzellen bestehen wird, ist eines der Schüsselelemente dieses Moduls. Mehrere Institute der CMS-Kollaboration untersuchen deshalb verschiedene Geometrien einiger kleinerer Protoypen um ein optimiertes und vor allem strahlenhartes Layout des finalen Sensors zu entwickeln. Dieser Vortrag gibt erste Einblicke in die ersten Ergebnisse verschiedener Charakterisierungs- und Leistungsfähigkeitsstudien dieser ersten Prototypen des Makropixelsensors.

T 10.5 Mo 12:00 VMP8 HS

Bau und Test von Prototypen für den ATLAS-Streifendetektor — Silke Altenheiner, Claus Gössling, Reiner Klingenberg, Kevin Kröninger und •Jonas Lönker — TU Dortmund, Experimentelle Phyisk IV, Deutschland

Im Zuge des HL-LHC-Upgrades ist geplant den Inneren Detektor des ATLAS-Experiments auszutauschen. Hierfür werden neue Streifenmodule gebaut und untersucht. Eine entsprechende Produktionsstrasse und Messplätze entstehen in Dortmund. Erste Untersuchungen werden vorgestellt.

T 10.6 Mo 12:15 VMP8 HS

Tuning of the Silicon microstrip detector (SCT) digitization parameters at ATLAS — •Akanksha Vishwakarma — Humboldt University, Unter den Linden 6, 10099 Berlin, Germany

The increased luminosity of LHC in RUN-2 causes high radiation exposure of the ATLAS detector. This might bring about changes in the detector responses, especially of the pixel and the silicon strip detector. To study this, several digitization parameters are varied in the simulation and are analysed by comparing with data. In particular, the impact on the reconstructed cluster and track is considered. This investigation is used to optimize data-Monte Carlo agreement.

T 11: Top Quark Tagging

Zeit: Montag 11:00–12:15 Raum: VMP8 SR 05

T 11.1 Mo 11:00 VMP8 SR 05

Studien zur Erweiterung des Top-Tagging-Algorithmus zur Anwendung auf W-, Z,- und Higgs-Bosonen — Roman Kogler, Tobias Lapsien und •Eugen Trapp — Universität Hamburg

Die Identifizierung von schweren Teilchen durch deren Zerfallsprodukte, insbesondere von Top-Quarks und den schweren Eichbosonen (W, Z, H), ist von großer Bedeutung am LHC. Die Identifizierung von voll hadronischen Zerfällen bei hohen Impulsen birgt hier eine besondere Schwierigkeit, da alle Teilchen aus dem Zerfall häufig in nur einem Jet rekonstruiert werden. Kürzlich wurde ein neuer Algorithmus vorgestellt, um Top-Quark-Zerfälle zu identifizieren. Dieser Algorithmus basiert auf Jets mit variablem Distanzparameter. Der Vorteil dieses Algorithmus ist die Anwendbarkeit in unterschiedlichen Impulsbereichen, ohne zusätzliche, impulsabhängige Kriterien für die Unterdrückung von Untergrund einzuführen. In diesem Vortrag werden Studien zur Erweiterung des Algorithmus im Hinblick auf die Identifikation von hadronischen W-, Z,- und Higgs-Bosonzerfällen vorgestellt.

T 11.2 Mo 11:15 VMP8 SR 05

Suche nach $t\bar{t}$ Resonanzen im Lepton+Jets-Kanal — •Tobias Heck, Sabrina Groh, Julien Caudron und Lucia Masetti — Johannes-Gutenberg Universität Mainz

In vielen Erweiterungen des Standardmodells zerfallen neue schwere Teilchen (wie Z' oder Kaluza-Klein Gluonen) bevorzugt in Top-Antitop Paare. Das ATLAS Experiment am LHC hat im Jahr 2012 insgesamt 21.3 fb^{-1} an Daten aufgezeichnet, womit eine gesteigerte Sensitivität auf Resonanzen mit einer invarianten Masse von einigen TeV einhergeht. Es wird die Rekonstruktion von Top-Antitop Zerfällen im Lepton+Jets Kanal in voll aufgelösten (klar separierte Zerfallsprodukte) sowie geboosteten (kollimierte Zerfallsprodukte) Topologien sowie Techniken zur Abschätzung und Reduzierung verschiedener Untergrundbeitraege wie u.a. W+Jets vorgestellt. Der Schwerpunkt wird auf die Rekonstrution des hadronisch zerfallenden top quarks in geboosteten Topologien mit verschiedenen TopTagger Algorithmen gelegt und ein Vergleich zwischen dem ATLAS TopTagger und dem HepTopTagger, welcher auf gute Signal-Effizienzen optimiert wird, präsentiert.

T 11.3 Mo 11:30 VMP8 SR 05

Search for Heavy Resonances with the HEPTopTagger in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS Experiment — Christoph Anders, Danilo Ferreira de Lima, Sebastian Schätzel, André Schöning, and •David Sosa — Physikalisches Institut, Universität Heidelberg

A search for heavy resonances where two top quarks decay hadronically is carried out using the full 2015 proton-proton ATLAS dataset. The HEPTopTagger is used to reconstruct the $t\bar{t}$ system and to reduce the large multijet background. Top quark candidates are required to be close to a track jet identified as resulting from a b-hadron. It is shown that track jet b-tagging performs significantly better than the previously used calorimeter jet b-tagging at higher top quark transverse momenta. The dominant contributions, $t\bar{t}$ and multijet production, are validated and estimated using control regions in data. Finally, the measured distributions are compared to expected Standard Model backgrounds and several New Physics models.

T 11.4 Mo 11:45 VMP8 SR 05

Top-tagging in ATLAS for Run-1 and Run-2 — •Julien Caudron, Sabrina Groh, Tobias Heck, and Lucia Masetti — Johannes Gutenberg-Universität Mainz

Studies of the boosted sector in top-quark physics have known a fast-growing development with the arrival of high-energy data at LHC. Different techniques to identify high-p_{T} top quarks based on substructure analyses of large radius jets have been developed for Run-1 and Run-2 data. For Run 1, the ATLAS collaboration have studied the optimization and performance of different techniques (HEPTopTagger, Shower Deconstruction and substructure variables cut-based taggers), using pp collision data and MC simulations at $\sqrt{s} = 8$ TeV. For Run 2, a simple algorithm has been developed, intended to provide strong and reliable performance for early $\sqrt{s} = 13$ TeV analyses. Two working points have been provided, for high efficiency or high rejection. Uncertainties, as well as the performance in different topologies, have also been studied.

T 11.5 Mo 12:00 VMP8 SR 05

Introduction to a new top tagging strategy for LHC Run II — Johannes Haller, Roman Kogler, and •Tobias Lapsien — University of Hamburg

Exciting times are ahead, Run II of the LHC started with an increased centre-of-mass energy. New heavy particles might be discovered in this period. Many theories beyond the standard model predict that possible new heavy particles will most likely decay into the heaviest standard model particle, the top quark. Therefore the identification of these quarks might be the key towards new physics. Identifying hadronically decaying top quarks ($t \to bW \to bq\bar{q}'$), while rejecting light flavor jets is challenging since for high transverse momenta of the top quarks its decay products are collimated within one large jet. In this talk a new strategy for identifying top quarks over a large range of transverse momenta, by using a variable jet conesize approach and an on the fly subjet finding will be introduced and explained. Furthermore the comparison to other existing top tagging algorithms will be presented.

T 12: Experimentelle Methoden I

Zeit: Montag 11:00–12:00 Raum: VMP8 SR 105

T 12.1 Mo 11:00 VMP8 SR 105

DSEA: Data Mining Methoden zur Lösung inverser Probleme — •Tim Ruhe, Mathis Börner, Tomasz Fuchs, Maximilian Meier, Thorben Menne und Alexander Sandrock — Technische Universität Dortmund, Dortmund

Die Lösung inverser Probleme, z.B. zur Bestimmung von Energiespektren, ist eine Herausforderung für die Neutrinoastronomie und andere Teilgebiete der Astroteilchenphysik. Da die Energie der gemessenen Teilchen experimentell nicht direkt zugänglich ist, werden energieabhängige Observablen zur Energierekonstruktion heran gezogen. Diese energieabhängigen Observablen sind über die Fredholm'sche Integralgleichung mit der Response-Funktion des Detektors und der zu messenden Größe verknüpft. Eine limitierte Akzeptanz und eine Verschmierung durch den Detektor selbst erschweren die Lösung zusätzlich. Im Dortmund Spectrum Estimation Algorithm (DSEA) wird das inverse Problem durch Anwendung eines Random Forests gelöst. Die Rückgabe des Forests kann dann als Approximation der Wahrscheinlichkeitsdichte einzelner Ereignisse aufgefasst werden. Eine Summation über alle gemessenen Ereignisse liefert das gesuchte Spektrum. Der Vortrag gibt einen Überblick über den aktuellen Status des Algorithmus.

T 12.2 Mo 11:15 VMP8 SR 105

VISPA: New Applications for Intuitive Data Visualisation and Analysis Creation — Martin Erdmann, Benjamin Fischer, Robert Fischer, Christian Glaser, Fabian Heidemann, Gero Müller, •Thorben Quast, Marcel Rieger, Martin Urban, Daniel van Asseldonk, Ralf Florian von Cube, and Christoph Welling — Physics Institute IIIa, RWTH Aachen University, Germany

The Visual Physics Analysis software is a framework developed at RWTH Aachen providing intuitive access and usage of experiment-specific resources via common web browsers. Through its extension mechanism, VISPA allows for interfacing a wide range of applications to meet the demands for diverse use cases. After a quick review of the internal architecture and basic functionalities, most recent updates to the system are highlighted and various newly released extensions are presented: Our data browsers facilitate the inspection of information in Pierre Auger Observatory and HEP data samples. The JSROOT project has been embedded and enables the visualisation of ROOT files. Modular analysis chains based on our HEP software library (PXL) can be interactively created and modified using the Analysis Designer. VISPA is tested both through its integration in undergraduate and elementary particle physics courses at RWTH and through its use in analysis work for CMS and Auger. Finally, instructions on how to access our cluster or to set up an own server are given.

T 12.3 Mo 11:30 VMP8 SR 105

Development of morphing algorithms for `Histfactory` using information geometry — •Anjishnu Bandyopadhyay[1], Ian Brock[1], and Kyle Cranmer[2] — [1]University of Bonn — [2]New York University

Many statistical analyses are based on likelihood fits. In any likelihood fit we try to incorporate all uncertainties, both systematic and statistical. We generally have distributions for the nominal and $\pm 1\sigma$ variations of a given uncertainty. Using that information, `Histfactory` morphs the distributions for any arbitrary value of the given uncertainties. In this talk, a new morphing algorithm will be presented, which is based on information geometry. The algorithm uses the information about the difference between various probability distributions. Subsequently, we map this information onto geometrical structures and develop the algorithm on the basis of different geometrical properties. Apart from varying all nuisance parameters together, this algorithm can also probe both small ($< 1\sigma$) and large ($> 2\sigma$) variations. It will also be shown how this algorithm can be used for interpolating other forms of probability distributions.

T 12.4 Mo 11:45 VMP8 SR 105

Performance and optimization of support vector machines in high-energy physics classification problems — •Mehmet Özgür Sahin, Dirk Krücker, and Isabell Melzer-Pellmann — DESY, Hamburg, Germany

In this talk, the use of Support Vector Machines (SVM) is promoted for new-physics searches in high-energy physics. We developed an interface, called SVM HEP Interface (SVM-HINT), for a popular SVM library, LibSVM, and introduced a statistical-significance based hyperparameter optimization algorithm for the new-physics searches. As example case study, a search for Supersymmetry at the Large Hadron Collider is given to demonstrate the capabilities of SVM using SVM-HINT.

T 13: Quantenfeldtheorie und Gittereichtheorie (Theorie)

Zeit: Montag 11:00–12:00 Raum: VMP8 SR 106

T 13.1 Mo 11:00 VMP8 SR 106

On the Eigenvalue Spectrum of (Staggered) Domain Wall Fermions — Christian Hoelbling[1] and •Christian Zielinski[2,1] — [1]Department of Physics, University of Wuppertal, Germany — [2]Division of Mathematical Sciences, Nanyang Technological University, Singapore

We explore spectral properties of staggered domain wall lattice fermions, which were recently proposed by Adams [Phys. Lett. B699 (2011) 394–397]. They differ from the usual domain wall fermion construction by replacing the Wilson kernel with the novel staggered Wilson Dirac operator. In both cases one formulates fermions with approximate chiral symmetry in d dimensions by means of massive interacting fermions in $d+1$ dimensions. In the limit of large extents of the extra dimension N_s, the low-energy effective d-dimensional Dirac operator approaches the overlap operator with an exact chiral symmetry. In this work we investigate the eigenvalue spectra of both the d-dimensional effective operators and the $(d+1)$-dimensional bulk operators for $d = 2, 4$. We implement several variations of the original proposal and examine the dependence on N_s, various degrees of gauge link smearing and different topological sectors.

T 13.2 Mo 11:15 VMP8 SR 106

Regularization of ultraviolet divergence for a particle interacting with a scalar quantum field — •Oleg Skoromnik[1], Ilya Feranchuk[2], Dung Lu[2], and Christoph Keitel[1] — [1]Max Planck Institute for Nuclear Physics — [2]Belarusian State University

When a non-relativistic particle interacts with a scalar quantum field, the standard perturbation theory leads to a dependence of the energy of its ground state on an undefined parameter "momentum cut-off" due to the ultraviolet divergence. We show that the use of non-asymptotic states of the system results in a calculation scheme in which all observable quantities remain finite and continuously depend on the coupling constant without any additional parameters. It is furthermore demonstrated that the divergence of traditional perturbation series is caused by the energy being a function with a logarithmic singularity for small values of the coupling constant.

[1] O. D. Skoromnik, I. D. Feranchuk, D. V. Lu and C. H. Keitel, Phys. Rev. D Accepted (2015)

T 13.3 Mo 11:30 VMP8 SR 106

A new sphaleron in SU(3) Yang-Mills-Higgs theory — •Pascal Nagel and Frans Klinkhamer — Karlsruher Institut für Technologie (KIT), Karlsruhe, Deutschland

The sphaleron solution S is known to contribute to baryon-number violation within the electroweak Standard Model. To gain further insight into the nonperturbative dynamics of QCD (and GUTs), we study a new sphaleron solution of SU(3) Yang-Mills-Higgs theory, the solution $\widehat{S}$. Two independent numerical approaches yield solutions of the reduced field equations and a surprising structure of the energy barrier

in configuration space.

T 13.4 Mo 11:45 VMP8 SR 106

Lepton-photon interactions in external background fields — •Ibrahim Akal[1] and Gudrid Moortgat-Pick[2] — [1]Theory Group, Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, D-22607 Hamburg, Germany — [2]II. Institute for Theoretical Physics, University of Hamburg, Luruper Chaussee 149, D-22761 Hamburg, Germany

We investigate lepton-photon interactions in a class of generalized external background fields with periodic plane-wave character. Considering the full interaction with the background, S-matrix elements are calculated exactly. We apply those general expressions to interaction schemes like Compton scattering in specific field configurations, as for instance provided in modern laser facilities, or in high intense regions of future linear colliders. Results are extended to the case of frontal colliding high-energy field photons with leptons such that new insights beyond the usual soft terms become accessible.

T 14: Starke Wechselwirkung (Experiment) I

Zeit: Montag 11:00–12:30 Raum: VMP8 SR 206

T 14.1 Mo 11:00 VMP8 SR 206

Low Pt heavy flavour production at CMS and ZEUS — •Nazar Stefaniuk and Achim Geiser — Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, Hamburg

The beauty and charm quark masses provide perturbative scales which can be exploited for QCD measurements even in the very low Pt range. The techniques which allow us to go to the minimal threshold in Pt are explained.

The main goal of the analysis is to measure the inclusive heavy flavour cross sections. The study of charm meson production helps to understand the low Pt behaviour of the charm cross section. The extension to low Pt beauty production is also reported.

T 14.2 Mo 11:15 VMP8 SR 206

Multiplizität geladener Teilchen in pp Kollisionen für den 100MeV Phasenraum mit dem ATLAS Detektor — •Daniela Börner[1], Heather Gray[2], Alison Lister[3] und Roberta Maria Devesa[4] — [1]Bergische Universität Wuppertal, Wuppertal, Deutschland — [2]CERN, Genf, Schweiz — [3]University of British Columbia, Vancouver BC, Canada — [4]Universidad de Buenos Aires, Argentina

Gemessen werden die Multiplizität geladener Teilchen pro Ereignis, die Abhängigkeit der Anzahl geladener Teilchen zu ihrem transversalen Impuls p_T und ihrer Pseudorapidität η, sowie die Beziehung zwischen dem gemittelten Impuls p_T zur Mulitiplizität geladener Teilchen wird gemessen. Die Daten wurden in Proton-Proton Kollisionen bei einer Schwerpunktsenergie von 13 TeV mit dem Trigger für Minimum Bias am ATLAS-Detektor genommen.

Ereignisse mit mindestens zwei stabilen Teilchen, deren Impuls größer als 100MeV ist und derern Pseudorapidität $|\eta| < 2.5$ erfüllt, werden selektiert und analysiert. Dieser Phasenraum ist von besonderem Interesse, da er sehr schlecht von verschiedenen Modellen der Soft QCD beschrieben wird.

T 14.3 Mo 11:30 VMP8 SR 206

Measurement of pseudorapidity distributions of charged particles in proton-proton collisions at $\sqrt{s} = 13$ TeV by the CMS experiment — •Juan Manuel Grados Luyando, Benoit Roland, and Hannes Jung — DESY, Hamburg, Germay

Pseudorapidity distributions of charged-particles, $N_{ch}/d\eta$, produced in proton-proton collisions at a centre-of-mass energy of 13 TeV are measured in the pseudorapidity range $|\eta| < 2.4$ for charged-particles with a transverse momentum $p_T > 0.5$ GeV. Measurements are presented for three event categories. The most inclusive category corresponds to an inelastic enhanced event sample. The other two categories are disjoint subsets of the inclusive sample that are either enhanced or depleted in single diffractive dissociation events. The measurements are compared to predictions from Monte Carlo event generators which were tuned to describe the underlying event topologies at $\sqrt{s} = 7$ TeV.

T 14.4 Mo 11:45 VMP8 SR 206

Determination of the total cross section in proton-proton collisions at the LHC at $\sqrt{s} = 8$ from elastic scattering using the ALFA sub-detector of ATLAS — •Christian Heinz, Hasko Stenzel, and Michael Düren — 2. Physikalisches Institut, Universität Gießen

The ALFA (Absolute Luminosity for ATLAS) Roman Pot detector system is part of the forward instrumentation of ATLAS located about 240 m away from the interaction point in the LHC tunnel in both directions. ALFA consists of a scintillating fibre tracker housed in vertical Roman Pots which enables the measurement of elastic proton-proton scattering at small scattering angles. In 2012 data were recorded at a centre-of-mass energy of $\sqrt{s} = 8$ TeV during a fill with special beam optics of the LHC with $\beta^* = 90$ m 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. In this talk a preliminary determination of the total cross section and of the slope of the elastic cross section at small |t| obtained from a fit to the differential cross section using the optical theorem is reported. In addition a second run at $\sqrt{s} = 8$ TeV with a special beam optics of $\beta^* = 1$ km, providing access to the Coulomb-nuclear interference region, is being analysed. Preliminary analysis results from this run will be presented as well.

T 14.5 Mo 12:00 VMP8 SR 206

Observation of soft diffraction with rapidity gaps in the CASTOR calorimeter of CMS — •Melike Akbiyik, Colin Baus, Sebastian Baur, Igor Katkov, Ralf Ulrich, and Hauke Woehrmann — Karlsruhe Institute of Technology, Karlsruhe, Germany

Observation of soft diffractive dissociation in pp collisions of LHC Run2 at $\sqrt{s} = 13\,\text{TeV}$ are presented in kinematics regions defined by the masses M_X and M_Y of the two final state hadronic systems separated by the largest rapidity gap in the event. Differential cross sections are obtained as a function of $\xi_X = M_X^2/s$. Two samples are distinguished depending on their masses M_X and M_Y, one dominated by single dissociation (SD), and other one dominated by double dissociation (DD). The CASTOR calorimeter allow us to detect the hadronic system of the mass M_Y when it escapes the central detector. The activity (or lack of it) in CASTOR enables to distinguish a SD event from a DD event. The calibration of CASTOR is done using beam halo muon is introduced. Analysis of the obtained muon spectra provides relative response to a muon for each individual read-out channel.

T 14.6 Mo 12:15 VMP8 SR 206

ρ^0 Photoproduktion im H1-Experiment — •Arthur Bolz — Physikalisches Institut, Universität Heidelberg, Deutschland

Eine Messung des Wirkungsquerschnitts für ρ^0 Potoproduktion ($\gamma p \to \rho^0 p$) wird vorgestellt. Der Messung liegen elastische Streuprozesse $e^+p \to \pi^+\pi^- p$ im Energiebereich 20 GeV $< W_{\gamma p} <$ 90 GeV und bei kleinem Proton-Impulsübertrag $|t| < 3$ GeV^2 zugrunde, die während der Hochenergieperiode 2006/2007 an der HERA vom H1-Experiment aufgezeichnet wurden.

Der vorhandene Datensatz erlaubt eine präzise Messung des doppelt differentiellen Wirkungsquerschnitts in $W_{\gamma p}$ und t, aus der die Pomeron-Trajektorie extrahiert werden kann. Außerdem ermöglicht er eine detaillierte Helizitätsanalyse.

T 15: Top Quark I (Ladungsasymmetrie, Spin)

Zeit: Montag 11:00–12:15 Raum: VMP9 HS

T 15.1 Mo 11:00 VMP9 HS

Messung der Ladungsasymmetrie in $t\bar{t}$-Ereignissen am CMS-Experiment — Thorsten Chwalek, Thomas Müller und •Frank Roscher — Institut für Experimentelle Kernphysik (IEKP), KIT

Die Ladungsasymmetrie in $t\bar{t}$-Ereignissen, im Standardmodell hervorgerufen durch die Interferenz verschiedener Feynman-Diagramme in nächstführender Ordnung, äußert sich am LHC durch unterschiedlich breite Rapiditätsverteilungen von Top-Quarks und Top-Antiquarks. Abweichungen dieses Verhaltens von den Standardmodellvorhersagen könnten erste Hinweise auf neue Physik liefern, und Messungen am Tevatron schienen in der Vergangenheit auf einen eben solchen Effekt hinzudeuten.

Im Vortrag werden Messungen der Ladungsasymmetrie als Funktion von charakteristischen Variablen des Top-Quark-Paarsystems ($m_{t\bar{t}}$, $p_{\mathrm{T}}^{t\bar{t}}$, $y_{t\bar{t}}$) vorgestellt. Zusätzlich zu den Ergebnissen für den gesamten Phasenraum der Top-Quark-Paarproduktion wird auch die Asymmetrie in einem eingeschränkten, "sichtbaren" Phasenraum präsentiert. Der verwendete Datensatz besteht aus vom CMS-Experiment aufgezeichneten $t\bar{t}$-Kandidaten im Lepton+Jets-Zerfallskanal bei einer Schwerpunktsenergie von 8 TeV.

T 15.2 Mo 11:15 VMP9 HS

Messung der $t\bar{t}$-Ladungsasymmetrie im Lepton+Jets Kanal bei $\sqrt{s} = 13$ TeV mit ATLAS — •Sabrina Groh, Julien Caudron, Tobias Heck und Lucia Masetti — Johannes Gutenberg-Universität Mainz

Als das schwerste der bisher entdeckten Elementarteilchen ist das Top-Quark besonders empfindlich bezogen auf Effekte von Physik jenseits des Standardmodells, da seine Masse im Bereich der elektroschwachen Skala zu finden ist. Ein Hinweis darauf wäre eine Abweichung von der im Standardmodell vorausgesagten Ladungsasymmetrie bei der $t\bar{t}$-Produktion.

Die Verteilungen der Rapidität des Top- und Antitop-Quarks weisen eine Asymmetrie auf, die durch vollständige Rekonstruktion der Ereignisse gemessen werden kann. Durch die Erhöhung der Schwerpunktsenergie von 8 auf 13 TeV am LHC können nun kollimierte (geboostete) Top-Zerfälle mit hoher Statistik untersucht werden, für die das Standardmodell einen höheren Wert der Ladungsasymmterie vorhersagt als bei niedrigeren Transversalimpulsen. Die Modellierung des ebenfalls asymmetrischen W+Jets Untergrundes stellt dabei die größte systematische Unsicherheit dar.

In diesem Vortrag wird nun der Status der Messung der $t\bar{t}$-Ladungsasymmetrie in der geboosteten Topologie im Lepton+Jets Kanal bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV mit dem ATLAS-Detektor am LHC vorgestellt. Besonderen Wert wurde dabei auf die auf Daten basierende Abschätzung des dominierenden W+Jets Untergrundes unter Verwendung der W^+/W^--Ladungsasymmetrie gelegt.

T 15.3 Mo 11:30 VMP9 HS

Measurements of the charge asymmetry in top-quark pair production in the dilepton final state at 8 TeV with the ATLAS detector — •Roger Naranjo[1], Cecile Deterre[1], Yvonne Peters[1,2], James Howarth[1], and Ralph Schäfer[1] — [1]DESY, Hamburg, Germany, — [2]University of Manchester, Manchester. UK.

Measurements of the top-antitop quarks charge asymmetry in the dilepton channel are presented using data corresponding to an integrated luminosity of 20.3 fb^{-1} from pp collisions at a center of mass energy of 8 TeV collected by the ATLAS detector at the Large Hadron Collider at CERN. Inclusive and differential measurements as a function of the mass, transverse momentum and boost of the $t\bar{t}$ system are performed both in the full phase-space and also in a fiducial phase-space closely matching the detector acceptance. Two observables are studied: $A_C^{\ell\ell}$ based on the selected leptons and $A_C^{t\bar{t}}$ based on the reconstructed $t\bar{t}$ final state. The measurements are consistent with the Standard Model predictions.

T 15.4 Mo 11:45 VMP9 HS

Measurement of the W Boson Helicity fractions in $t\bar{t}$ Events at $\sqrt{s} = 8$ TeV in the Lepton+Jets Channel with ATLAS — •Mohamamd Kareem, Boris Lemmer, Maria Moreno Llacer, Arnulf Quadt, and Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

A summary of the ongoing measurement of the W boson helicity fractions in $t\bar{t}$ decays is presented. Events produced via pp collisions at a centre-of-mass energy of 8 TeV, collected in 2012 by the ATLAS detector at the LHC, corresponding to an integrated luminosity of 20.3 fb^{-1} have been analysed. The measurement is performed in the lepton+jets channel characterized by one isolated electron or muon, missing transverse momentum and at least four energetic jets of which at least two are tagged as a b-jet.

Using a kinematic likelihood fit for the reconstruction of the top quarks, the angular distribution of the charged lepton (down type quark) in the leptonically (hadronically) decaying W boson rest frame is sensitive to the three possible helicity states. The fractions are obtained by performing a template fit to data. As the polarization of the W bosons in top quark decays is sensitive to the Wtb vertex structure, limits on anomalous Wtb couplings can be set.

T 15.5 Mo 12:00 VMP9 HS

Measurement of Spin Correlations in $t\bar{t}$ Systems in the muon+jets Channel using a Matrix Element Method with the CMS Detector at the LHC — •Kelly Beernaert — Deutsches Elektronen-Synchrotron

The spin correlation strength in top-quark pair production is measured and the consistency of the result with the standard model (SM) prediction is tested. In the data, produced in pp–collisions at a centre-of-mass energy of 8 TeV and collected by the CMS detector corresponding to an integrated luminosity of 19.7 fb^{-1}, top-quark pair events with one muon and jets in the final state are selected. The data are compared with the expectation for the spin correlation predicted by the SM and with the expectation of no correlation. Using a template fit method, the fraction of events that show SM spin correlations is measured to be $0.72 \pm 0.08\,(\mathrm{stat})\,^{+0.15}_{-0.13}\,(\mathrm{syst})$, representing the most precise measurement of this quantity in the lepton+jets final state to date.

T 16: Neutrinoloser Doppelbeta-Zerfall I

Zeit: Montag 11:00–12:35 Raum: VMP9 SR 07

Gruppenbericht T 16.1 Mo 11:00 VMP9 SR 07

The COBRA Experiment - Status and Prospects — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

COBRA is a next-generation experiment dedicated to the search for the existence of neutrinoless double beta-decay ($0\nu\beta\beta$-decay). The aim is to clarify the nature of neutrinos as either Dirac or Majorana particles. Furthermore, the study of $0\nu\beta\beta$-decay could allow for the identification of the neutrino mass hierarchy realized in nature and the determination of the effective Majorana neutrino mass in case of a signal.

Currently a demonstrator setup at the underground facility LNGS (Italy) built of 4×4×4 coplanar grid (CPG) detectors collects high quality low background physics data with FADC pulse shape sampling. The detectors are made of natural abundant CdZnTe, which is a commercially available room temperature semiconductor. It contains several double beta isotopes, the most promising of which is ^{116}Cd with a Q-value of 2813.5 keV – which is well above the highest naturally occurring γ-lines.

In this talk an overview of the experimental status and recent results of the data analysis of the LNGS detector array will be presented. Additionally, newly developed techniques to reduce background via pulse shape analysis and future prospects towards a large-scale setup will be discussed.

The COBRA experiment is funded by the German Research Foundation DFG.

T 16.2 Mo 11:20 VMP9 SR 07

In-situ measurement of the light attenuation in liquid argon in the GERDA cryostat — •Birgit Schneider for the GERDA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

GERDA is an experiment searching for neutrinoless double beta decay in ^{76}Ge. It operates the enriched germanium detectors bare in liquid argon (LAr), which serves both as a coolant and a shield for external radiation. Phase II of GERDA aims for an exposure of 100 kg · yr with a background index (BI) of 10^{-3} cts/(kg · yr · keV). One of the major improvements to further reduce the BI comes from the instrumentation of the LAr to readout its scintillation light. The attenuation of the scintillation light in LAr limits the effective active volume of the LAr veto and is therefore a key parameter to characterize the instrumentation.

In order to measure the light attenuation in LAr, a setup was designed that could be deployed directly into the GERDA cryostat. This setup contains a movable beta source and a PMT to detect the scintillation light at different distances.

The talk will present the acquired data as well as a detailed description of the performed analysis technique and the current results.

This project is partially funded by BMBF.

T 16.3 Mo 11:35 VMP9 SR 07

Results of a search for neutrinoless double-beta decay using the COBRA demonstrator — •Thomas Quante, Claus Gössling, and Kevin Kröninger — TU Dortmund, Exp. Physik IV, Dortmund

COBRA is an experiment aiming to search for neutrinoless double-beta-decay ($0\nu\beta\beta$-decay) using CdZnTe semiconductor detectors. The main focus is on ^{116}Cd, with a Q-value of 2813.5 keV well above the highest dominant naturally occurring gamma lines. By measuring the half-life of the $0\nu\beta\beta$-decay, it is possible to clarify the nature of the neutrino as either Dirac or Majorana particle and furthermore to determine its effective Majorana mass.

The COBRA collaboration operates a demonstrator to search for these decays at the Laboratori Nazionali del Gran Sasso in Italy. The exposure of 234.7 kg d considered in this analysis was collected between September 2011 and February 2015. The analysis focuses on the decay of the nuclides ^{114}Cd, ^{128}Te, ^{70}Zn, ^{130}Te and ^{116}Cd. A Bayesian analysis is performed to estimate the signal strength of $0\nu\beta\beta$-decay.

T 16.4 Mo 11:50 VMP9 SR 07

Study of pulse shapes in Ge detectors with PET — Peter Grabmayr, Alexander Hegai, Josef Jochum, Christopher Schmitt, and •Ann-Kathrin Schütz for the GERDA-Collaboration — Eberhard Karls Univerität Tübingen

The Gerda collaboration aims to determine the half life of the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. For Phase II Gerda wants to reduce the background contribution significantly by active background-suppression techniques. One of such techniques is the pulse shape analysis of signals induced by the interaction of radiation with the detector. The pulse shapes depend not only on the energy of the interacting gamma, the geometry and field configuration but also on the location of interaction in the crystal. The waveform and the location of the interaction in the germanium can be determined by positron-emission-tomography (PET). First results of this novel pulse shape study with the PET will be presented in this talk. This work was partly funded by the BMBF.

T 16.5 Mo 12:05 VMP9 SR 07

Performance of the LAr scintillation veto of Gerda Phase II — •Christoph Wiesinger for the GERDA-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, James-Franck-Straße, 85748 Garching

Gerda is an experiment to search for the neutrinoless double beta decay in ^{76}Ge. Results of Phase I have been published in summer 2013 and Gerda has been upgraded to Phase II. To reach the aspired background index of $\sim 10^{-3}$ cts/(keV·kg·yr) for Phase II active background-suppression techniques are applied, including an active liquid argon (LAr) veto. It has been demonstrated with the LArGe test facility that the detection of argon scintillation light can be used to effectively suppress background events in the germanium detectors, which simultaneously deposit energy in the LAr. The light instrumentation consisting of photomuliplier tubes (PMT) and wavelength-shifting fibers connected to silicon photomultipliers (SiPM) has been installed in Gerda. In this talk the low background design of the LAr veto and its performance during Phase II start-up will be reported.

This work was partly funded by BMBF.

T 16.6 Mo 12:20 VMP9 SR 07

Das Minidex-Experiment zur Vermessung Myonen-induzierter Neutronen — •Raphael Kneissl für die GERDA-Kollaboration — MPI für Physik, München, Deutschland

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 sowie diese zu verstehen. Einer dieser Untergründe sind Myon-induzierte Neutronen, die außerhalb im Gestein oder direkt in den Abschirmungsmaterialien des Experiments erzeugt werden. Des Weiteren können in den Detektoren durch Myon-induzierte Neutronen beim Transport oder der Lagerung radioaktive Isotope entstehen. 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 neutron 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 der Aufbau, die Datenanalyse sowie die Resultate des Minidex-Experiments vorgestellt.

T 17: Neutrinoastronomie I

Zeit: Montag 11:00–12:35 Raum: VMP9 SR 08

Gruppenbericht T 17.1 Mo 11:00 VMP9 SR 08

IceCube Gen2: the next-generation neutrino observatory for the South Pole — •Jakob van Santen for the IceCube-Collaboration — DESY, Zeuthen

The IceCube Neutrino Observatory is a cubic-kilometer Cherenkov telescope buried in the ice sheet at the South Pole that detects neutrinos of all flavors with energies from tens of GeV to several PeV. The instrument provided the first measurement of the flux of high-energy astrophysical neutrinos, opening a new window to the TeV universe. At the other end of its sensitivity range, IceCube has provided precision measurements of neutrino oscillation parameters that are competitive with dedicated accelerator-based experiments.

Here we will present design studies for IceCube Gen2, the next-generation neutrino observatory for the South Pole. Instrumenting a volume of more that 5 km^3 with over 100 new strings, IceCube Gen2 will have substantially greater sensitivity to high-energy neutrinos than current-generation instruments. PINGU, a dense infill array, will lower the energy threshold of the inner detector region to 4 GeV, allowing a determination of the neutrino mass hierarchy. On the surface, a large air shower detector will veto high-energy atmospheric muons and neutrinos from the southern hemisphere, enhancing the reach of astrophysical neutrino searches. With its versatile instrumentation, the IceCube Gen2 facility will allow us to explore the neutrino sky with unprecedented sensitivity, providing new constraints on the sources of the highest-energy cosmic rays, and yield precision data on the mixing and mass ordering of neutrinos.

T 17.2 Mo 11:20 VMP9 SR 08

Search for sterile neutrinos with IceCube DeepCore — •Andrii Terliuk for the IceCube-Collaboration — DESY, Platanenallee 6, 15738 Zeuthen, Germany

The DeepCore detector is a sub-array of the IceCube Neutrino Observatory that lowers the energy threshold for neutrino detection down to approximately 10 GeV. DeepCore is used for a variety of studies including atmospheric neutrino oscillations. The standard three-neutrino oscillation paradigm is tested using the DeepCore detector by searching for an additional light, sterile neutrino with a mass on the order of 1 eV. Sterile neutrinos do not interact with the ordinary matter, however they can be mixed with the three active neutrino states. Such mixture changes the picture of standard neutrino oscillations for atmospheric neutrinos with energies below 100 GeV. The capabilities of DeepCore detector to measure such sterile neutrino mixing will be presented in this talk.

T 17.3 Mo 11:35 VMP9 SR 08

A Readout System for the Wavelength-shifting Optical Module — •Carl-Christian Fösig and Sebastian Böser for the IceCube-Collaboration — Johannes Gutenberg-Universität, Mainz

The success of IceCube and the plans for an IceCube-Gen2 stimulate the development of new photo sensors. The approach of the Wavelength-shifting Optical Module is to provide a device which has a low dark noise rate combined with a high detection efficiency. A small PMT is used to detect red shifted photons guided in a coated PMMA tube, originally emitted by a wavelength shifting coating that absorbs photons in the UV Region. We have studied several PMTs for their usability with the IceCube-Gen2 readout system. Relevant parameters are the pulse widths in relation to the bandwidth of the IceCube-Gen2 readout electronics and the dark noise rates.

T 17.4 Mo 11:50 VMP9 SR 08

Simulation studies of the Wavelength-shifting Optical Module — •Vincenzo Di Lorenzo, Esther Del Pino Rosendo, and Sebastian Böser for the IceCube-Collaboration — Johannes Gutenberg-Universität, Mainz, Germany

The Wavelength-shifting Optical Module (WOM) is a concept for a photon sensor developed for the next generation of the IceCube experiment. The large sensitivity area in combination with the high photon detection efficency, in particular in the UV region, as well as the low dark noise rates are prominent features of this sensor. A prototype of the WOM is being developed and shows promising results, but some questions are still open. We present here results from a Geant4 simulation used to study the light propagation inside the WOM and the principle reasons of light loss during photon propagation. Using this simulation, it is possible to reproduce the dominant physical effects inside the tube and correlate the simulated results with the experimental ones.

T 17.5 Mo 12:05 VMP9 SR 08

Simulation of an extended surface detector IceVeto for IceCube-Gen2 — •Tim Hansmann, Jan Auffenberg, Christian Haack, Bengt Hansmann, Julian Kemp, Richard Konietz, Jakob Leuner, Leif Rädel, Martin Stahlberg, Sebastian Schoenen, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

IceCube is a neutrino observatory located at the geographic South Pole. The main backgrounds for IceCube's primary goal, the easurement of astrophysical neutrinos, are muons and neutrinos from cosmic-ray air showers in the Earth's atmosphere. Strong supression of these backgrounds from the Southern hemisphere has been demonstrated by coincident detection of these air showers with the IceTop surface detector. For an extended instrument, IceCube-Gen2, it is considered to build an enlarged surface array, IceVeto, that will improve the detection capabilities of coincident air showers. We will present simulation studies to estimate the IceVeto capabilities to optimize the IceCube-Gen2 design.

T 17.6 Mo 12:20 VMP9 SR 08

Status and Performance of the Wavelength-shifting Optical Module for In-Ice Neutrino Detectors — •Dustin Hebecker — HU-Berlin / DESY

The Wavelength-shifting Optical Module is a single-photon sensor that employs wavelength-shifting and light-guiding techniques to maximize the collection area while minimizing the dark noise rate. The sensor is tailored towards application in ice-Cherenkov neutrino detectors, such as IceCube-Gen2 or MICA. It is aimed at decreasing the energy threshold as well as increasing the energy resolution and the vetoing capability of the neutrino telescope, when compared to a setup with optical sensors similar to those used in IceCube. The proposed sensor captures photons with wavelengths between 250 nm and 400 nm. These photons are re-emitted with wavelengths above 400 nm by a wavelength shifter coating applied to a 90 mm diameter polymer tube. This tube guides the light towards a small-diameter PMT via total internal reflection. As a core component the wavelength shifting and light guiding inner tubes performance has been investigated with multiple methods that will be presented. Furthermore the status of the whole prototype development and its performance will be discussed.

T 18: Gammaastronomie I

Zeit: Montag 11:00–12:35 Raum: VMP9 SR 27

Gruppenbericht T 18.1 Mo 11:00 VMP9 SR 27

Status and recent results of the MAGIC telescope system — •Christian Fruck for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München, GERMANY

MAGIC is an instrument for pointed ground-based observations of the gamma-ray sky in the 50 GeV to 80 TeV regime. The two 17 m diameter Imaging Air Cherenkov Telescopes are located on 2200 m a.s.l. at the Roque de los Muchachos Observatory on the Canary island La Palma. We will report the status and recent technical developments of the instrument, highlight the most important scientific results obtained with observations of Galactic and extragalactic objects, and will summarize future plans.

T 18.2 Mo 11:20 VMP9 SR 27

Cross Calibration of the H.E.S.S. Telescopes — •David Jankowsky and Ira Jung-Richardt — ECAP, Universität Erlangen-Nürnberg

The H.E.S.S. experiment consists of five imaging atmospheric Cherenkov telescopes. Four smaller, identical ones have a mirror area of 108 m^2 and a larger one that has a mirror area of 614 m^2. To guarantee high quality data and the best possible physical output it is essential that all data are well understood. This talk presents a possible method to check the responses of such mixed telescope systems: the inter and cross calibration. The main idea behind this calibration is to compare the reconstructed image amplitudes (number of measured photo electrons) or energies of the individual telescopes pairwise and to search for differences in the responses. To illustrate the usability of the methods and their implications on data taking without systematical effects from the telescope array, this talk shows results which were obtained with the help of Monte Carlo simulations.

T 18.3 Mo 11:35 VMP9 SR 27

Increasing Data Quality by Predicting Cloud-Movement with Allsky-Cams — •Jan Adam, Jens Buss, and Maximilian Nöthe for the FACT-Collaboration — TU Dortmund, Germany

Clouds and related atmospheric phenomena have a big influence on the quality of astronomical observations. Especially in case of ground-based gamma telescopes such as FACT, bad atmospheric conditions impair the reconstruction of air-shower events.

The **F**irst G-**A**PD **C**herenkov **T**elescope aims for automatic long-term monitoring. Therefore, it benefits greatly from an advanced scheduling algorithm which takes into account the current weather conditions. While there is no way to reduce the occurrence of clouds in the direction of a desired object, it is possible to increase the duty cycle by switching to an uncovered source. Hence, a quantitative rating of the sky cloudiness is needed to differentiate between covered and uncovered areas.

This talk presents a method to calculate the current sky cloudiness by searching stars in 180° allsky camera images. This method can be applied to arbitrary areas, e.g., the whole sky or a few degrees around any certain source. Results and various visualisations will be presented, such as the distribution of the parameters for different weather conditions. Moreover, their developement over time will be shown for multi-

ple sources in a partly clouded night. And a first approach for predicting the cloud's movement by using subsequent images and additional data such as wind profiles will be discussed.

T 18.4 Mo 11:50 VMP9 SR 27

Pulsar Observations with the MAGIC telescopes — •Jezabel R. Garcia[1], S. Bonnefoy[2], D. Carreto-Fidalgo[2], F. Dazzi[1], D. Galindo[3], W. Idec[1], M. Lopez[2], E. Moretti[1], E. de Ona Wilhelmi[4], I. Reichardt[5], T. Saito[6], T. Schweizer[1], and R. Zanin[3] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik, Munich, Germany — [2]Universitad Compultense, Madrid, Spain — [3]Universitat de Barcelona, ICC/IEEC-UB, Barcelona, Spain — [4]Institute for Space Sciences (CSIC/IEEC), Barcelona, Spain — [5]Istituto Nazionale di Fisica Nucleare (INFN), Padova, Italy — [6]Kyoto University, Hakubi center, Japan

MAGIC is a stereoscopic system of two IACTs, located at the ORM (Spain). Since 2008, MAGIC has played a big role in Pulsar physics due to the discovery of the first VHE gamma-ray emission from the Crab pulsar. Such a discovery was possible thanks to a revolutionary trigger technique used in the initial MAGIC mono system, the Sum-Trigger, that provided a 25 GeV energy threshold. The study of the Crab keeps providing numerous important results for the understanding of pulsar physics. The most recent ones are the bridge emission at VHE and the detection of the Crab pulsations at TeV energies. MAGIC has been also searching for new pulsars, providing recently interesting results about the Geminga pulsar and nebula. This talk reviews the essential MAGIC results about VHE pulsars and their implications for pulsar physics.Also we discuss the development of a new stereo trigger system, the Sum-Trigger-II, and the importance of the observation windows that this system opens for the study of VHE pulsars.

T 18.5 Mo 12:05 VMP9 SR 27

FACT - Influence of Night Sky Background Photons and Crosstalk — •Jens Buss[1], Sebastian Müller[2], and Fabian Temme[1] for the FACT-Collaboration — [1]Experimentelle Physik 5b, TU Dortmund, Deutschland — [2]IPP, ETH Zürich, Schweiz

During the last four years, the First G-APD Cherenkov Telescope (FACT) established silicon-based photo detectors as a valid concept for the imaging atmospheric Cherenkov technique. These detectors, namely silicon photo multipliers (SiPMs), are more robust to bright light conditions than conventional photo multiplier tubes (PMTs). At the same time, SiPMs feature a high photon detection efficiency. As a consequence, this technology yields observations at bright light conditions where PMTs would be damaged.

However, dark counts and night sky background light (NSB), in combination with optical crosstalk and after-pulses contribute to the extracted signal from Cherenkov photons. Therefore, they cause a bias on the photon charge extraction and any subsequent analysis steps. Consequently, it is necessary to understand their impact on the data of FACT.

This presentation will show the influence of changing NSB and crosstalk conditions on the performance of FACT. Therefore, the influence on the analysis chain is investigated on basis of data that were taken at different NSB conditions as well as dedicated Monte Carlo simulations.

T 18.6 Mo 12:20 VMP9 SR 27

FACT – Multivariate Extraction of Muon Ring Images — •Maximilian Nöthe, Fabian Temme, and Jens Buss for the FACT-Collaboration — Experimentelle Physik 5b, TU Dortmund, Dortmund

In ground-based gamma-ray astronomy, muon ring images are an important event class for instrument calibration and monitoring of its properties. In this talk, a multivariate approach will be presented, that is well suited for real time extraction of muons from data streams of Imaging Atmospheric Cherenkov Telescopes (IACT).

FACT, the First G-APD Cherenkov Telescope is located on the Canary Island of La Palma and is the first IACT to use Silicon Photomultipliers for detecting the Cherenkov photons of extensive air showers. In case of FACT, the extracted muon events are used to calculate the time resolution of the camera. In addition, the effect of the mirror alignment in May 2014 on properties of detected muons is investigated.

Muon candidates are identified with a random forest classification algorithm. The performance of the classifier is evaluated for different sets of image parameters in order to compare the gain in performance with the computational costs of their calculation.

T 19: Suche nach dunkler Materie I

Zeit: Montag 11:00–12:35 Raum: VMP9 SR 28

Gruppenbericht T 19.1 Mo 11:00 VMP9 SR 28

First Low WIMP Mass Results in EDELWEISS III Experiment. — •Silvia Scorza for the EDELWEISS-Collaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, Karlsruhe

The EDELWEISS-III collaboration is operating an experiment for the direct detection of Weakly Interacting Massive Particle (WIMPs) dark matter in the low radioactivity environment of the Modane Underground Laboratory. It consists of twenty-four advanced high purity germanium detectors operating at 18 mK in a dilution refrigerator in order to identify rare nuclear recoils induced by elastic scattering of WIMPs from our Galactic halo. The current EDELWEISS-III program, including improvements of the background, data-acquisition and the configuration will be detailed. Sources of background along with the rejection techniques will be discussed. Detector performances and a first low WIMP mass analysis of data acquired in a long-term campaign will be presented as well.

T 19.2 Mo 11:20 VMP9 SR 28

The EDELWEISS Dark Matter search programme for 2017 and beyond — •Klaus Eitel for the EDELWEISS-Collaboration — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe

Starting from the achieved sensitivity of EDELWEISS-III with its FID800 Ge detector technology, we present the planning for the next measurement phase. This will concentrate on the usage of Ge bolometers with voltage-assisted amplified heat signals (so-called Neganov-Luke mode) to explore the parameter space for low mass WIMPs (down to m˜1GeV). Significant improvements in sensitivity can be realised with a moderate exposure of 350 kg.d within the next 2 years. Beyond 2017, the already existing cooperation with SuperCDMS should lead to a common experimental infrastructure in SNOLAB.

Current R&D activities, sensitivity projections and the project towards the SNOLAB cryogenic facility will be presented.

T 19.3 Mo 11:35 VMP9 SR 28

Nutzung von TSV-SiPMs für Fluoreszenzteleskope — •Thomas Huber[2], Francesca Bisconti[1], Andreas Ebersoldt[3], Andreas Haungs[1], Michael Karus[1], Max Renschler[2], Sally-Ann Sandkuhl[2], Harald Schieler[1] und Andreas Weindl[1] für die JEM-EUSO-Kollaboration — [1]Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT) — [2]Institut für Experimentelle Kernphysik (IEKP), KIT — [3]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

Um die Exposure, und damit die Statistik detektierter ultrahochenergetischer Teilchen zu erhöhen wird momentan das *Extreme Universe Space Observatory* (EUSO) entwickelt. Die Detektion im Standard-Design erfolgt mit *Multianoden-Photomultipliern* (MAPMT).

Eine weitere Möglichkeit Photonen nachzuweisen bilden *Sillicon Photomultiplier* (SiPMs). Diese besitzen im Vergleich zu klassischen Photomultipliern neben ähnlicher Detektionseffizienz zusätzliche Vorteile: Eine bessere Zeitauflösung, eine kompaktere Bauweise und eine Operationsspannung, die sich nicht im Hochspannungsbereich befindet.

Die neuste Generation, TSV-SiPMs *(Trough Silicon Via)*, verringert die nicht photosensitive Fläche zwischen zwei Kanälen signifikant und sind damit vielversprechende Kandidaten für eine auf SiPM basierte Fokalfläche. Unklar ist das thermische Verhalten unter realen Messbedingungen. Dies wurde am KIT untersucht. Die Ergebnisse werden in diesem Vortrag vorgestellt.

T 19.4 Mo 11:50 VMP9 SR 28

Search for chameleons with an InGrid based X-ray detector

at the CAST experiment — Klaus Desch, Jochen Kaminski, •Christoph Krieger, and Sebastian Schmidt — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

The CERN Axion Solar Telescope (CAST) searches for axions and also other exotic particles emerging from the Sun. Chameleons, for example, are part of Dark Energy theories. Like Axions they can be converted into soft X-ray photons in a high magnetic field and should result in an X-ray spectrum peaking below 1 keV. Because of their low energy and weak coupling, detectors with low energy threshold and low background rates are mandatory.

Both requirements are met by an X-ray detector based on the combination of a Micromegas gas amplification stage with a highly integrated pixel chip which allows to make full use of the Micromegas structure's granularity. It has been demonstrated that these devices can detect even single electrons. Thus, allowing for a topological background suppression as well as for detection of low energy X-ray photons creating only very few primary electrons.

After the detection threshold had been evaluated to be low enough to allow for the detection of the carbon K_α line at 277 eV, the detector was mounted at one of CAST's X-ray telescopes and installed along with its infrastructure in 2014. During data taking until end of 2015 background rates of less than 10^{-4} /keV/cm^2/s have been achieved below 2 keV. First preliminary results of the ongoing chameleon analysis and possibly an improved limit for solar chameleons will be presented.

T 19.5 Mo 12:05 VMP9 SR 28

Upgrade of the InGrid based X-ray detector for the CAST experiment — Klaus Desch, Jochen Kaminski, Christoph Krieger, and •Sebastian Schmidt — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

The CERN Axion Solar Telescope (CAST) is a magnetic helioscope searching for solar axions and chameleons using the inverse Primakoff effect. The produced photons are in the low X-ray regime.

Chameleon search demands high sensitivity to photons with less than 1 keV and a very low background rate. Several improvements to the detector design used in 2014/15 are envisaged for 2016.

The readout system is to be improved by including a flash ADC to read out the analog signal induced on the grid. The pulse shape contains information about the longitudinal shape of the event in addition to the transverse shape given by the pixel read out. Tracks passing through the chip orthogonally resemble photons in transverse shape. A scintillator behind the detector will also allow cross referencing chip and and scintillator signals to further reduce background rates.

Finally, a new X-ray window separating detector and X-ray telescope volume from one another will be installed. Due to the low expected signal rate, a window with very low X-ray opacity is needed. Due to a pressure difference of $\sim$ 1 bar between detector and the vacuum of CAST this is demanding. The usage of silicon nitride windows is being explored.

The current progress of the detector upgrade will be presented.

T 19.6 Mo 12:20 VMP9 SR 28

Preliminary Result and Upgrade from WISPDMX Phase II — •le hoang nguyen[1], dieter horns[1], and andrei lobanov[1,2] — [1]Institut fur Experimentalphysik, Universitat Hamburg, Germany. — [2]Max-Planck-Institut fur Radioastronomie, Bonn, Germany.

The microwave cavity experiment WISPDMX is the first direct WISP (Weakly interactive slim particles) dark matter search experiment probing the particle masses in the 0.8-2.0 *eV range. The first stage of WISPDMX measurements has been completed at nominal resonant frequencies of the cavity. The upgrading of the data acquisition and analysing has been done to increase the sensitivity of the experiment. We report preliminary result from the cavity tuning at second stage of WISPDMX.

T 20: Kosmische Strahlung I

Zeit: Montag 11:00–12:30 Raum: VMP9 SR 29

T 20.1 Mo 11:00 VMP9 SR 29

Galactic Cosmic Ray Spectra during Solar Cycle 23 and 24 - Measurement Capabilities of the Electron Proton Helium Telescope on Board SOHO — •Patrick Kühl, Nina Dresing, Jan Gieseler, Bernd Heber, and Andreas Klassen — Christian-Albrechts Universität zu Kiel

The solar modulation of galactic cosmic rays (GCR) can be studied in detail by long term variations of the GCR energy spectrum (e.g. on the scales of a solar cycle). With almost 20 years of data, the Electron Proton Helium INstrument (EPHIN) aboard SOHO is well suited for these kind of investigations. Although the design of the instrument is optimized to measure proton and helium isotope spectra up to 50 MeV/nucleon the capability exist that allow to determine energy spectra above 1.5 GeV/nucleon. Therefore we developed a sophisticated inversion method to calculate such proton spectra. The method relies on a GEANT4 Monte Carlo simulation of the instrument and a simplified spacecraft model that calculates the energy response function of EPHIN for electrons, protons and heavier ions. As a result we present galactic cosmic ray spectra from 1995 to 2015. For validation, the derived spectra are compared to AMS, BESS and PAMELA data. Furthermore we discuss the spectra with respect to the solar modulation.

T 20.2 Mo 11:15 VMP9 SR 29

Proton energy spectra during ground level enhancements as measured by EPHIN aboard SOHO — •Bernd Heber[1], Patrick Kühl[1], Andreas Klassen[1], Nina Dresing[1], and Rául Goméz-Herrero[2] — [1]Christian-Albrechts-Universität zu Kiel, 24118 Kiel — [2]Universidad de Alcala

Ground Level Enhancements (GLEs) are solar energetic particle (SEP) events that are recorded by ground-based instrumentation. The energy of the particles is so high that they produce secondary particles in the Earth's atmosphere, i.e. protons and neutrons, which are detected as sudden increases in cosmic ray intensities measured by e.g. neutron monitors. Since the launch of SOHO in December 1995 the neutron monitor network recorded 16 GLEs. The Electron Proton Helium INstrument on board SOHO has been designed to measure protons and helium up to 53 MeV/nucleon as well as electrons up to 8.3 MeV. Above these energies, particles penetrate all detector elements and thus, a separation between different particle species becomes more complicated. Recently we developed a method that allows deriving the energy spectrum for penetrating protons up to more than 1 GeV. In this contribution we present the proton energy spectra and time profiles of above mentioned GLEs and compare them to previous measurements. Although there are differences of up to a factor two the overall shape of the energy spectra agree surprisingly well. Thus it has been demonstrated that EPHIN measurements are a valuable tool for understanding GLE.

T 20.3 Mo 11:30 VMP9 SR 29

Features of the galactic magnetic field regarding deflections of ultra-high-energy cosmic rays — •Marcus Wirtz, Martin Erdmann, Gero Müller, and Martin Urban — III. Physikalisches Institut A, RWTH Aachen University, Deutschland

Most recent models of the galatic magnetic field have been derived from Faraday rotation measurements and imply strong deflections even for ultra-high energy cosmic rays. We investigate the characteristics of the different field parametrizations and point out similarities and interesting features. Among them are extragalactic regions which are invisible for an Earth bound observation and the transition from diffuse to ballistic behaviour in the 1EeV energy regime. Applying this knowledge to a directional analysis, there are indications for deflection patterns by the galactic magnetic field in cosmic ray arrival directions measured by the Pierre Auger Observatory.

T 20.4 Mo 11:45 VMP9 SR 29

Sensitivity of a search for cosmic ray sources including magnetic field effects — •Martin Urban, Martin Erdmann, and Gero Müller — III. Physikalisches Institut A, RWTH Aachen University

We analyze the sensitivity of a new method investigating correlations between ultra-high energy cosmic rays and extragalactic sources taking into account deflections in the galactic magnetic field. In comparisons of expected and simulated arrival directions of cosmic rays we evalu-

ate the directional characteristics and magnitude of the field. We show that our method is capable of detecting anisotropy in data sets with a low signal fraction.

T 20.5 Mo 12:00 VMP9 SR 29

Geometrierekonstruktion von niedrigenergetischen Luftschauern mit HEAT* — •Ingolf Jandt für die Pierre-Auger-Kollaboration — Uni Wuppertal

Der Fluoreszenzdetektor (FD) des Pierre Auger Observatoriums misst Lichtsignale von Luftschauern, mit Beiträgen aus Fluoreszenz und Tscherenkovstrahlung. Die High Elevation Auger Telescopes (HEAT) können als Niedrigenergie-Erweiterung des FD steiler in die Atmosphäre blicken. Dabei messen sie höhere Anteile des vorwärtsgerichteten Tscherenkovlichtes, und verkürzte longitudinale Schauerprofile. Aus diesen wenigen Messpunkten die Geometrie des Schauers zu rekonstruieren, gelingt mit den bisherigen Methoden nur begrenzt. Der Profile Constrained Geometry Fit (PCGF) bezieht die longitudinale Schauerentwicklung in die Geometriebestimmung mit ein. Damit kann die Messung des Energiespektrums bis unterhalb 10^{16} eV erweitert werden.

*Gefördert durch die BMBF Verbundforschung Astroteilchenphysik

T 20.6 Mo 12:15 VMP9 SR 29

The solar modulation potential derived by spacecraft measurements modified to describe GCRs also at energies below neutron monitors — •Jan Gieseler[1], Bernd Heber[1], and Konstantin Herbst[2] — [1]IEAP, University of Kiel, Germany — [2]Dept. of Geology, Quaternary Sciences, Lund University, Sweden

Galactic Cosmic Rays (GCRs) are modulated by various effects as they propagate through the heliosphere before they are detected at Earth. This transport can be described by the Parker equation. It 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, Usoskin et al. (2005; 2011) reconstructed ϕ between 1936 and 2010, which by now is commonly used in many fields. However, it has been shown previously (e.g. by Herbst et al. 2010) that ϕ depends not only on the Local Interstellar Spectrum (LIS) but also on the energy range of interest. Using the LIS by Usoskin et al. (2005) together with published proton intensity spectra obtained by PAMELA, heavier nuclei measurements from IMP8 and ACE/CRIS as well as neutron monitors, we have investigated this energy dependence further. We will present the results that show as expected severe limitations at lower energies including a strong dependence on the solar magnetic epoch. Based on these findings, we will outline a 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 21: Theorie und Experiment in Kosmologie und Neutrinophysik

Zeit: Montag 11:00–12:30 Raum: VMP9 SR 30

T 21.1 Mo 11:00 VMP9 SR 30

Electroweak supersymmetric dark matter annihilation in DM@NLO — •Saskia Schmiemann[1], Michael Klasen[1], Karol Kovarik[1], Björn Herrmann[2], Julia Harz[3], and Patrick Steppeler[1] — [1]Institut für theoretische Physik, Universität Münster, Wilhelm-Klemm-Straße 9,D-48149 Münster, Germany — [2]LAPTh, Université Savoie Mont Blanc, CNRS, 9 Chemin de Bellevue, B.P. 110, F-74941 — [3]Sorbonne Universités, Institut Lagrange de Paris (ILP), 98 bis Boulevard Arago, 75014 Paris, France Sorbonne Universités, UPMC Univ Paris 06, UMR 7589, LPTHE, F-75005, Paris, France CNRS, UMR 7589, LPTHE, F-75005, Paris, France

Today there are several pieces of evidence for dark matter. One well-known experiment is the measurement of the Dark Matter relic density by the Planck satellite. The talk introduces the *Dark Matter at next-to-leading order* (DM@NLO) project which provides predictions for the dark matter relic density in the MSSM including higher-order corrections.

After an introduction of the project DM@NLO, I will shortly speak about the calculation of the electroweak processes. The main focus will lie on the effects of the electroweak tree-level processes on the relic density of neutralinos within selected scenarios.

T 21.2 Mo 11:15 VMP9 SR 30

Significant gamma-ray lines from dark matter annihilation — •Michael Duerr[1], Pavel Fileviez Perez[2], and Juri Smirnov[2] — [1]DESY, Notkestraße 85, 22607 Hamburg, Germany — [2]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

Gamma-ray lines from dark matter annihilation are commonly seen as a “smoking gun” for the particle nature of dark matter. However, in many dark matter models the continuum background from tree-level annihilations makes such a line invisible. I present two simple extensions of the Standard Model where the continuum contributions are suppressed and the gamma-ray lines are easily visible over the continuum background.

T 21.3 Mo 11:30 VMP9 SR 30

Strong Washout Approximation to Resonant Leptogenesis — Björn Garbrecht, Florian Gautier, and •Juraj Klaric — Physik Department T70, James-Franck-Straße, Techniche Universität München, 85748 Garching, Germany

We study resonant Leptogenesis with two sterile neutrinos with masses M_1 and M_2, Yukawa couplings Y_1 and Y_2, and a single active flavor. Specifically, we focus on the strong washout regime, where the decay width dominates the mass splitting of the two sterile neutrinos.

We show that one can approximate the effective decay asymmetry by it's late time limit $\varepsilon = X \sin(2\varphi)/(X^2 + \sin^2\varphi)$, where $X = 8\pi\Delta/(|Y_1|^2+|Y_2|^2)$, $\Delta = 4(M_1-M_2)/(M_1+M_2)$, and $\varphi = \arg(Y_2/Y_1)$, and establish criteria for the validity of this approximation. We compare the approximate results with numerical ones, obtained by solving the mixing and oscillations of the sterile neutrinos.

We generalize the formula to the case of several active flavors, and demonstrate how it can be used to calculate the lepton asymmetry in phenomenological scenarios which are in agreement with the neutrino oscillation data. We find that that using the late time limit is an applicable approximation throughout the phenomenologically viable parameter space.

T 21.4 Mo 11:45 VMP9 SR 30

Consequences of a gravitational θ-term in the neutrino sector — •Lena Funcke[1,2] and Gia Dvali[1,2,3] — [1]Arnold Sommerfeld Center for Theoretical Physics, Ludwig Maximilian University, Theresienstr. 37, 80333 Munich, Germany — [2]Max Planck Institute for Physics, Foehringer Ring 6, 80805 Munich, Germany — [3]Center for Cosmology and Particle Physics, Department of Physics, New York University, 4 Washington Place, New York, NY 10003, USA

It is known that non-perturbative effects in QCD break chiral symmetry and give rise to the η' meson. As widely believed, also gravity violates global symmetries, since microscopic black holes or wormholes may take away global charges from our universe. Based on a topological 3-form formulation of gravity, it was recently shown that the consequent gravitational θ-term inevitably leads to a new pseudoscalar degree of freedom in the neutrino sector, analogous to the η'. The appearance of such a "Goldstone" boson due to anomaly is a general feature of the topological 3-form language and not necessarily related to the confining characteristics of QCD.

In the current research project, we investigate the rich theoretical and experimental consequences of this new topological degree of freedom in the neutrino sector.

T 21.5 Mo 12:00 VMP9 SR 30

Corrections to Neutrino Mass Rules — •Julia Gehrlein[1], Alexander Merle[2], and Martin Spinrath[1] — [1]Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology, Engesserstraße 7, D-76131 Karlsruhe, Germany — [2]Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), Föhringer Ring 6, D-80805 München, Germany

Neutrino mass sum rules are a common class of predictions in flavour models relating the Majorana phases to the neutrino masses. This leads, for instance, to strong restrictions on the effective mass probed in

experiments on neutrinoless double beta decay. We will discuss generic corrections to these neutrino mass sum rules which arise for example from renormalization group evolution and present the effect of the corrections on the predictions from all sum rules found in the literature. Most of the predictions are rather robust under renormalization group effects, for example the lower bound on the lightest neutrino mass does not change significantly.

T 21.6 Mo 12:15 VMP9 SR 30

Novel Computational Approaches for the Analysis of Cosmic Magnetic Fields — •Andrey Saveliev — Universität Hamburg, Hamburg, Deutschland — Keldysh Institut, Moskau, Russland

In order to give a consistent picture of cosmic, i.e. galactic and extragalactic, magnetic fields, different approaches are possible and often even necessary. Here we present three of them: First, a semi-analytic analysis of the time evolution of primordial magnetic fields from which their properties and, subsequently, the nature of present-day intergalactic magnetic fields may be deduced. Second, the use of high-performance computing infrastructure by developing powerful algorithms for (magneto-)hydrodynamic simulations and applying them to astrophysical problems. We are currently developing a code which applies kinetic schemes in massive parallel computing on high performance multiprocessor systems in a new way to calculate both hydro- and electrodynamic quantities. Finally, as a third approach, astroparticle physics might be used as magnetic fields leave imprints of their properties on charged particles transversing them. Here we focus on electromagnetic cascades by developing a software based on CRPropa which simulates the propagation of particles from such cascades through the intergalactic medium in three dimensions. This may in particular be used to obtain information about the helicity of extragalactic magnetic fields.

T 22: Trigger und DAQ I

Zeit: Montag 11:00–12:30 Raum: VMP11 HS

T 22.1 Mo 11:00 VMP11 HS

Implementierung und Verifizierung einer Oszilloskop-Auslese für Driftrohre — •Robin Boshuis, Raimund Ströhmer und Stefan Weber — Universität Würzburg

Eine Auslesemethode zur Auswertung von Driftzeitspektren kosmischer Myonen mittels eines Oszilloskops wurde implementiert und eine Analyse-Methode entwickelt.

Die Myonen wurden mit Hilfe einer Driftröhre detektiert, welche baugleich zu den MDTs im ATLAS-Myonenspektrometer ist und sich in einem lokal aufgebauten Höhenstrahlungsteststand der Julius-Maximilians-Universität Würzburg befindet. Die Auslese und Datennahme der Driftzeiten wurde mit Hilfe eines digitalen Speicheroszilloskops durchgeführt. Die daraus resultierenden Spektren wurden statistisch analysiert und Aussagen über Länge der Spektren und deren Ansteigszeiten getroffen. Die Datennahme mit dem Oszilloskop wurde weiterhin gegen eine Ausleselektronik auf Basis eines Time-To-Digital-Converters verifiziert.

T 22.2 Mo 11:15 VMP11 HS

Data Acquisition for the CALICE engineering prototype of the Analog Hadronic Calorimeter for the International Linear Collider. — •Adrian Irles for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg

The engineering prototype of the Analogue Hadronic Calorimeter, developed by the CALICE collaboration for future linear colliders, consists in a set of high granularity layers of scintillator tiles readout by a silicon photo-multiplier (SiPM) and is housed in steel cassettes which can be interleaved with different absorber plates. The readout is done with a dedicated front-end SiPM readout system: the SPIROC ASIC. The current data acquisition (DAQ) framework used for the engineering prototype of the AHCAL is fruit of several years of improvement and exhaustive testing in the laboratory and in different test beams and has been designed to be scalable to the full detector size ($\sim 8 \cdot 10^6$ channels) making use of a new Link Data Aggregator. Current efforts in the DAQ development aims to gain in flexibility to include other subsystems in common test beams. The solution that is presented here is based on the use of the EUDAQ software which is a DAQ framework designed to be modular and portable and that has strong suppport from the ILC community.

T 22.3 Mo 11:30 VMP11 HS

Konzepte zur Datenauslese des ATLAS Inner Tracker (ITk) — •Marius Wensing, Carsten Dülsen, Tobias Flick und Wolfgang Wagner — Bergische Universität Wuppertal, Deutschland

Der ATLAS-Detektor am CERN wird für das HL-LHC-Upgrade (Phase-II) im Jahr 2022 mit einem komplett neuen inneren Detektor (Inner Tracker, ITk) ausgestattet. Bedingt durch die wesentlich höhere Luminosität von $5 \times 10^{34}\,\mathrm{cm^{-2}s^{-1}}$ werden deutlich höhere Auslesebandbreiten als bisher benötigt. Für die innerste Pixel-Lage wird die Datenrate pro Detektormodul im Bereich von etwa 5 Gbit/s liegen. Zur Auslese der Detektormodule müssen daher Konzepte für neuartige FPGA-basierte Auslesekarten entwickelt werden. Ein wesentlicher Aspekt aller Konzepte ist die Integration in das globale ATLAS Auslesesystem (TDAQ). Aufgezeigt werden erste Konzeptentwürfe und Entwicklungen basierend auf diesen Entwürfen.

T 22.4 Mo 11:45 VMP11 HS

Data Acquisition at the Front-End of the Mu3e Pixel Detector — •Ann-Kathrin Perrevoort for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

The Mu3e experiment—searching for the lepton-flavour violating decay of the muon into three electrons at an unprecedented sensitivity of one in 10^{16} decays—is based on a pixel tracking detector. The sensors are High-Voltage Monolithic Active Pixel Sensors, a technology which allows for very fast and thin detectors, and thus is an ideal fit for Mu3e where the trajectories of low-momentum electrons at high rates are to be measured.

The detector will consist of about 275 million pixels and will be operated at up to 10^9 muon stops per second. Therefore, a fast and trigger-less data readout is required. The pixel sensors feature zero-suppressed data output via high-speed serial links. The data is then buffered and sorted by time on a FPGA on the front-end before being processed to the following readout stage.

In this talk, the readout of the Mu3e pixel detector at the front-end will be introduced. Furthermore, a first firmware implementation of this concept in a beam telescope consisting of the current pixel sensor prototype MuPix7 will be presented.

T 22.5 Mo 12:00 VMP11 HS

Fast optical readout for Mu3e experiment — •Qinhua Huang for the Mu3e-Collaboration — Institut für Kernphysik, Universität Mainz, Mainz, Germany

Charged lepton flavour violation is highly suppressed in the Standard Model, which results in a prediction for the branching ratio of $\mu^+ \to e^+e^+e^-$ below $\mathcal{O}(10^{-54})$. The Mu3e experiment will search for this rare decay with a sensitivity of 10^{-16}. An observation would be a clear sign for new physics. A high muon stopping rate of $2 \cdot 10^9$ Hz is required so that sufficient statistics can be accumulated in about one year of data taking. The high event rate and the requirement of a full online track reconstruction demand a fast readout system which should provide a bandwidth above 1 Tbit/s. Reconfigurable devices, namely FPGAs, can easily parallelise the data processing, so it becomes possible to sort, merge, pack and route the data with low latency at high throughput. Optical fibres are the only option for the interconnection between different FPGA-based boards. The fibres also reduce the crosstalk and signal attenuation, especially over long distance links. As part of the readout system prototyping, firmware for synchronous merging of different data streams is being developed. In addition, the optical links have been tested and show a bit error rate below $\mathcal{O}(10^{-16})$ at 6.4 Gbit/s for a single fibre.

T 22.6 Mo 12:15 VMP11 HS

Histogramming in the LATOME-Firmware for the Phase-1 Upgrade of the ATLAS LAr Calorimeter Readout — •Philipp Horn, Rainer Hentges, and Arno Straessner — Institut für Kern- und Teilchenphysik, Dresden, Germany

Due to the increased luminosity and the higher effective event rate after the phase 1 upgrade the ATLAS LAr detector needs new trigger electronics. The so-called LATOME-Board was designed as a LAr Digital Processing Blade (LPDB) to reconstruct the energy deposited by the particles and is an important part of the read out system. A prototype has already been build and the firmware for the on-board FPGA is under development. The insertion of a histogram-builder in this device gives the unique opportunity to look at untriggerd data. This talk provides an insight in the LATOME-firmware and shows the different possibilities to implement the histogramm-builder.

T 23: Postersitzung

Zeit: Montag 13:30–14:30 Raum: VMP4 Foyer

T 23.1 Mo 13:30 VMP4 Foyer

Voruntersuchung zu molekularen Clustern in der KATRIN WGTS — •Robin Grössle und Sebastian Mirz für die KATRIN-Kollaboration — Karlsruher Institut für Technologie, Karlsruhe, Deutschland

Ziel des KATRIN Experiments ist die Messung der Neutrinomasse mit einer Sensitivität besser als 200 meV/c^2 (90% C.L.). Hierfür wird der beta-Zerfall des Tritiums untersucht und - da das Neutrino nicht direkt nachgewiesen werden kann - das Energiespektrum des Elektrons genau vermessen. Da die Neutrinomasse im Vergleich zur Zerfallsenergie von 18,6 keV sehr klein ist, wird die Neutrinomasse nur im Bereich des Endpunktes des Energiespektrums sichtbar. Um die gewünschte Sensitivität erreichen zu können, ist es daher notwendig, einzelne systematische Beiträge in der Größenordnung von 10 meV genau zu kennen.

Eine der Herausforderungen besteht darin, dass nicht atomares, sondern molekulares Tritium verwendet wird. Daher müssen systematische Energiebeiträge der Moleküle, wie Rückstoß und innere Anregung, berücksichtigt werden. Hinzu kommt, dass bei tiefen Temperaturen (unter 30 K), wie sie in der KATRIN-Quelle vorherrschen, die Bildung von molekularen Clustern möglich ist.

In diesem Beitrag wird eine Voruntersuchung mittels IR-Absorptionsspektroskopie bezüglich der einfachsten Form dieser Cluster, der Dimere, vorgestellt. Ziel ist es, diese Methode soweit zu kalibrieren, dass quantitative Aussagen über die Zahl der Dimere unter Bedingungen vergleichbar denen in der KATRIN Quelle möglich sind, und so den systematischen Beitrag abzuschätzen.

T 23.2 Mo 13:30 VMP4 Foyer

Overview of recent and current spectroscopic investigations with hydrogen isotopologues for KATRIN — •Tim Brunst, Sebastian Mirz, Robin Grössle, and Bennet Krasch for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The Karlsruhe Tritium Neutrino Experiment (KATRIN) investigates the energy spectrum of the tritium β decay near its energetic endpoint in order to determine the electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90 % C.L.). Therefore, molecular tritium gas is decaying in a windowless gaseous tritium source (WGTS). The physical properties of the gas in the WGTS, like composition, ortho/para ratio or rotational population, need to be stabilised on a 10^{-3} level due to their direct impact on the initial state distribution of the investigated β decay. In order to obtain a complete model of the molecular processes in the sample various spectroscopic measurements of mixtures with non-radioactive isotopologues (H_2, HD, D_2) have been using IR spectroscopy in the liquid at temperatures < 25 K and Raman spectroscopy in the gaseous phase at room temperature. This poster presents an overview of recent and current investigations with TApIR: The investigation of dimer and cluster formation under KATRIN conditions, as well as the ongoing task to investigate mixtures beyond the thermal equilibrium with highly concentrated HD and the design of a tritium compatible system for temperatures between $(15 - 293)\,K$.

T 23.3 Mo 13:30 VMP4 Foyer

YAP: Yet Another Partial-Wave-Analysis Toolkit — •Paolo Di Giglio, Daniel Greenwald, and Johannes Rauch — TUM, Munich, Germany

We will present a new C++ library: YAP, the Yet Another Partial-wave-analysis toolkit. The library calculates amplitudes for multibody particle decays in several model frameworks. It is intended for the analysis of spin-0 heavy mesons, but is programmed with the flexibility to handle other decays. The library implements isobar decompositions, K-matrix formalism, and model-independent approaches for mass-dependent amplitudes; and both Wigner rotation and Zemach (for 3 particles) formalism for spin amplitudes. We will introduce the software and give example use cases.

T 23.4 Mo 13:30 VMP4 Foyer

Unbinned likelihood maximisation framework for neutrino clustering in Python — •Stefan Coenders — Technische Universität München, Boltzmannstr. 2, 85748 Garching

Albeit having detected an astrophysical neutrino flux with IceCube, sources of astrophysical neutrinos remain hidden up to now. A detection of a neutrino point source is a smoking gun for hadronic processes and acceleration of cosmic rays. The search for neutrino sources has many degrees of freedom, for example steady versus transient, point-like versus extended sources, et cetera. Here, we introduce a Python framework designed for unbinned likelihood maximisations as used in searches for neutrino point sources by IceCube. Implementing source scenarios in a modular way, likelihood searches on various kinds can be implemented in a user-friendly way, without sacrificing speed and memory management.

T 23.5 Mo 13:30 VMP4 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 Vergleich dazu liefert die Higgs-Theorie keine quantitativen Ergebnisse.

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

T 23.6 Mo 13:30 VMP4 Foyer

In-situ Kalibrierung der Tritiumanalytik mithilfe tritiierter Kalibriergase — •Simon Niemes — Karlsruhe Institut für Technology, ITEP-TLK, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

Ziel des Karlsruhe Tritium Neutrino Experiments KATRIN ist die modellunabhängige Messung der Elektron-Antineutrinomasse mit einer Sensitivität von 0,2 eV/c^2 mithilfe hochauflösender Spektroskopie nahe der Endpunktsenergie von β-Elektronen aus dem Tritiumzerfall.

Um die geplante Sensitivität zu erreichen, benötigt KATRIN eine Überwachung der Aktivität und Gaszusammensetzung in der Tritiumquelle mit hoher Richtigkeit und Genauigkeit.

Um dies zu gewährleisten, wird am Tritiumlabor Karlsruhe (TLK) das TRIHYDE-Experiment aufgebaut, mit welchem wohldefinierte Gasmischungen aller Wasserstoffisotopologe im thermischen Gleichgewicht hergestellt werden können. Mithilfe von TRIHYDE sollen verschiedene tritiumtaugliche Detektoren in-situ kalibriert und miteinander verglichen werden können.

Das Poster gibt einen Überblick über das Funktionsprinzip sowie die eingesetzten analytischen Methoden in TRIHYDE.

T 23.7 Mo 13:30 VMP4 Foyer

Search for double beta decay processes of ^{124}Xe with XENON100 & XENON1T — •Alexander Fieguth — IKP, Westfälische-Wilhelms-Universität Münster

Driven by the search for dark matter particles the XENON dark matter project recently installed its next stage multi-ton experiment

XENON1T at the LNGS, which will probe the spin-indpendent-WIMP-Nucleon cross section down to $2x10^{-47}cm^2$. Besides its main purpose different particle physics topics can be addressed by the taken data. One example are the double beta decay processes of natural isotope ^{124}Xe. This isotope is expected to decay via two-neutrino double electron capture (2νECEC) and due to its high Q-value of 2864 keV additionally through $2\nu\beta^+\beta^+$. Since these processes have not been detected so far, there is only a lower limit the respective half-life (e.g.$>4.7x10^{21}$yr for 2νECEC). A detection of the 2νECEC is possible using XENON1T data by looking for its clear signature of secondary X-rays or Auger electrons and at least new lower half-life limits for all other decay channels can be obtained. While these processes are expected from standard model physics, a detection of a decay without neutrinos (e.g 0νECEC) would hint towards beyond the standard model physics and could derive conclusions on the neutrino mass. Until XENON1T is taking data, the search for all processes can be tested in the recorded data of its predecessor XENON100. This work is supported by BMBF under contract number 05A14PM1 and DFG (GRK 2149).

T 23.8 Mo 13:30 VMP4 Foyer

Dark matter analysis of XENON100 data and cut development utilizing the novel PAX raw data processor — •Christian Wittweg — Institut für Kernphysik, Westfälische Wilhelms-Universität, Münster, Germany

The XENON100 experiment located at LNGS is aimed at the direct detection of weakly interacting massive particles (WIMPs). It utilizes an ultra-low background dual-phase xenon TPC which yields two separate scintillation signals that facilitate background discrimination and event selection. Limits on various interaction types have been published by the collaboration (Science 349 (2015) 6250, 851-854).

In the analysis dark matter candidate events have to pass cuts with respect to data quality, consistency and physical features of the interaction. The former ones are implemented with regard to the used data processor's capabilities for noise discrimination and peak-finding. The Processor for Analyzing Xenon (PAX), developed for the XENON1T experiment, enhances these capabilities compared to XENON100. A greater robustness against noise and an increased peak-identification efficiency open up new opportunities for physically motivated cuts while rendering old ones obsolete.

The poster will focus on the implementation of new cuts into the analysis chain. Both PAX and the xenon analysis will be introduced. A planned full-scale dark matter analysis of PAX-processed XENON100 data will be outlined. This work is supported by BMBF under contract number 05A14PM1.

T 23.9 Mo 13:30 VMP4 Foyer

Entwicklung eines Echtzeit-Kontrollsystems zur Herstellung von Fasermatten für das LHCb-Upgrade mithilfe Maschinellen Lernens — •Timon Schmelzer, Robert Ekelhof, Julian Wishahi, Janine Müller und Kevin Heinicke für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Im Zuge des LHCb-Upgrades 2018/2019 werden die derzeitigen downstream Trackingsysteme, welche aus einer Kombination von Silikon-Streifen-Detektor (Inner Tracker) und Drifröhren (Outer Tracker) bestehen, durch Matten aus szintillierenden Fasern ersetzt. Diese werden produziert, indem die Fasern zunächst auf ein mit Rillen versehenes Rad gewickelt und dabei verklebt werden. Um eine konstant hohe Qualität bei dieser Produktion gewährleisten zu können, wird ein Echtzeit-Video-Kontrollsystem entwickelt, das den Wickelvorgang durchgehend überwacht. Konkrete Fehlerquellen wären beispielsweise das Überspringen einer Faser über die dafür vorgesehene Mulde, was durch lokal abweichende Faserdicken verursacht werden kann.

Dieses Poster beschreibt die Funktionsweise des Kontrollsystems, welches auf den Prinzipien eines Maschinellen Lerners, hier eines eigens dafür optimierten Neuronalen Netzes, beruht. Als Trainingsdatensatz dienen Einzelbildaufnahmen von Wickelvorgängen, in denen die Faserpositionen absichtlich manipuliert wurden. Zusätzlich werden die Herausforderungen bei der Entwicklung eines Maschinellen Lerners näher beleuchtet.

T 23.10 Mo 13:30 VMP4 Foyer

Chemical purification of $CaCO_3$ and $CaWO_4$ powders used for $CaWO_4$ crystal production for the CRESST experiment — •H. H. Trinh Thi, X. Defay, A. Erb, R. Hampf, J.-C. Lanfranchi, A. Langenkämper, V. Morgalyuk, A. Münster, E. Mondragon, C. Oppenheimer, W. Potzel, S. Schönert, H. Steiger, A. Ulrich, S. Wawoczny, M. Willers, and A. Zöller — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85748 Garching

CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) uses $CaWO_4$ single crystals as targets for the direct search for dark matter particles. Since several years these $CaWO_4$ crystals are grown at the Technische Universität München. Thereby, commercially available $CaCO_3$ and WO_3 powders are used for the synthesis of $CaWO_4$ powder. For the experiment low intrinsic contaminations of the crystals play a crucial role. In order to improve the radiopurity of the crystals it is necessary to reduce potential sources for radioactive backgrounds such as U and Th. In this poster we will present our studies of the chemical purification of the $CaCO_3$ and $CaWO_4$ powders. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching), by the BMBF.

T 23.11 Mo 13:30 VMP4 Foyer

Characterization of Scintillating Plastic Fibers and Silicon Photomultipliers for their Usage in a Particle Telescope — •Lea Prüfer, Martin Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

The Multi-purpose Active-target Particle Telescope (MAPT) is a newly developed compact charged-particle detector. It can be used for space applications, such as radiation monitoring on spacecraft or for stratospheric research balloons.

Its core consists of scintillating plastic fibers coupled to silicon photomultiplier (SiPMs). The energy reconstruction of the incoming particles is based on an extended Bragg curve spectroscopy technique, requiring a good measurement of the energy deposition. Therefore, non-linearities of the measured light output -such as quenching effects of the scintillating material or saturation of the SiPMs at high light yields- have to be known quantitatively.

To investigate these effects, two scaled-down prototypes were built, consisting of 128 and 16 channels. The first one was tested at a stationary proton beam at Paul Scherrer Institute.

We determine Birk's coefficient describing the ionization quenching of the scintillator and calculate the characteristic photon detection efficiency of the SiPMs. We will explain the results of the first prototype tests and the characterization of the SiPMs. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 23.12 Mo 13:30 VMP4 Foyer

Characterization of scintillating $CaWO_4$ crystals for the CRESST experiment using two-photon excitation — •Raphael Hampf, Thomas Dandl, Andrea Münster, Lothar Oberauer, Sabine Roth, Stefan Schönert, and Andreas Ulrich — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

In the CRESST experiment for direct dark matter search, phonon and photon signals from cryogenic $CaWO_4$ crystals are used to search for WIMP-induced nuclear recoil events. We present a novel table-top setup in which the scintillation of $CaWO_4$ is induced by 0.7ns laser pulses of 355nm wavelength. The excitation occurs via two-photon absorption in the bulk material. The scintillation light is observed by time resolved optical spectroscopy. By varying the focusing of the laser-beam the excitation density can be made high enough to study quenching effects due to exciton-exciton annihilation. This allows to perform experiments to test models for the quenching factors of different ionizing projectiles in $CaWO_4$ which are used to identify these projectiles on an event by event basis.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 23.13 Mo 13:30 VMP4 Foyer

Raman spectroscopic determination of the molecular constants of the hydrogen isotopologues with high accuracy — •Bennet Krasch, Sebastian Mirz, and Robin Grössle for the KATRIN-Collaboration — Karlsruhe Institute for Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The interest in the thermodynamic properties of gases as the chemical equilibrium is faced by the challenge of time-consuming and technical

extensive experimental setups. One possible solution is the derivation of these properties from the molecular constants. The rotational and vibrational movement of diatomic molecules, as the hydrogen isotopologues, is described by the concept of the rotational anharmonic oscillator. The molecular constants are the free parameters of this concept. Molecular constants themselves can be determined by measuring the line position of rotational and/or rotational transitions e.g. with Raman spectroscopy for hydrogen as it has been done since several years. In this contribution a Raman method was development to measure the molecular constant of the hydrogen isotopologues with high accuracy to obtain reliable results. But not only the method was development but also a complete measurement uncertainty budget was set up. The uncertainty budget contains all possible sources for uncertainties from the measurement period or the analysis process as well the contribution of each single uncertainty. The method and the uncertainty budget were exemplary tested on Deuterium.

T 23.14 Mo 13:30 VMP4 Foyer

The OPERA Experiment - $\nu_\mu \to \nu_\tau$ oscillation discovered in appearance mode — •Benjamin Büttner for the OPERA-Hamburg-Collaboration — Universität Hamburg, Institut für Experimentalphysik

The primary goal of the OPERA long-baseline neutrino oscillation experiment is the first direct detection of $\nu_\mu \to \nu_\tau$ oscillations.

The hybrid OPERA detector consists of a large-mass target made from lead and photo emulsions - providing micrometric resolution - and electronic detector parts for online readout. It is located in the LNGS underground laboratory, at a distance of 730km from the SPS at CERN, where the CNGS ν_μ beam is produced.

The measurement of ν_τ appearance relies on the detection of the decay of τ leptons which are created in ν_τ charged current reactions. Data acquisition lasted from 2008 to 2012. With the collected data the OPERA experiment discovered ν_τ appearance in the CNGS neutrino beam with a significance of 5.1 σ .

This poster will give an overview about the OPERA experiment and the discovery of τ neutrino appearance in the CNGS neutrino beam.

T 23.15 Mo 13:30 VMP4 Foyer

VUV-sensitive Silicon-Photomultipliers for the nEXO-Experiment — •Gerrit Wrede, Reimund Bayerlein, Patrick Hufschmidt, Ako Jamil, Judith Schneider, Michael Wagenpfeil, Tobias Ziegler, Jürgen Hössl, Gisela Anton, and Thilo Michel — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

The nEXO (next Enriched Xenon Observatory) experiment will search for the neutrinoless double beta decay of Xe-136 with a liquid xenon TPC (Time ProjectionChamber). The sensitivity of the experiment is related to the energy resolution, which itself depends on the accuracies of the measurements of the amount of drifting electrons and the number of scintillation photons with their wavelength being in the vacuum ultraviolet band. Silicon Photomultipliers (SiPM) shall be used for the detection of the scintillation light, since they can be produced extremely radiopure. Commercially available SiPM do not fulfill all requirements of the nEXO experiment, thus a dedicated development is necessary. To characterize the silicon photomultipliers, we have built a test apparatus for xenon liquefaction, in which a VUV-sensitive photomultiplier tube can be operated together with the SiPM.

In this contribution we present our apparatus for the SiPM characterization measurements and our latest results on the test of the silicon photomultipliers for the detection of xenon scintillation light.

T 23.16 Mo 13:30 VMP4 Foyer

Characterization of Silicon Photomultiplier — •Judith Schneider, Ako Jamil, Reimund Bayerlein, Jürgen Hössl, Patrick Hufschmidt, Michael Wagenpfeil, Gerrit Wrede, Tobias Ziegler, Gisela Anton, and Thilo Michel — Erlangen Centre for Astroparticle Physics, 91058 Erlangen

Silicon Photomultipliers (SiPMs) typically offer excellent photon number resolution. Thus they can be an excellent choice for photo detection in experiments for which energy resolution of a signal - derived from scintillation light detection - is crucial. In addition to that they offer a large ratio of sensitive surface to total mass and high radio purity which makes them a good choice for photosensors of the nEXO experiment (next Enriched Xenon Observatory) to search for the neutrino less double beta decay of 136Xe. We measured internal gain, dark current, dark count rate and crosstalk probability of a SiPM with a special view on their dependence on temperature and bias voltage. This contribution explains the working principle of a SiPM and their basic characteristics. Futhermore, characterization results are presented.

T 24: Higgs-Boson (Zerfall in Tau-Leptonen) II

Zeit: Montag 16:45–19:00 Raum: VMP5 HS A

T 24.1 Mo 16:45 VMP5 HS A

Tau Embedding in CMS — •Artur Akhmetshin, Günter Quast, Roger Wolf und Stefan Wayand — Karlsruhe Institute of Technology, Karlsruhe, Germany

Eine der wichtigsten Aufgaben des LHC im Run-2 besteht in der Untersuchung der Eigenschaften des neu entdeckten Higgs Bosons, diesmal bei 13 TeV Schwerpunktsenergie. Zur Untersuchung der Kopplung an Fermionen eignet sich der Zerfall $H \to \tau\tau$. Einer der wichtigsten, irreduziblen Untergründe ist der Zerfall des Z-Bosons im gleichen Endzustand, $Z \to \tau\tau$. Eine zum großen Teil auf Daten basierende Methode, um diesen Untergrund abzuschätzen besteht in der Embedding Technik. Hierbei werden $Z \to \mu\mu$ Zerfälle in Daten selektiert und die Muonen durch simulierte Tauonen ersetzt. Der Hauptvorteil dieser Methode besteht darin, dass man auf eine volle Simulation verzichten und damit zusammenhängende systematische Unsicherheiten reduzieren kann. In meinem Vortrag werde ich näher auf die Methode selbst, ihre Vorteile und den Stand der derzeitigen Implementierung für die Datennahme des LHC Run-2 eingehen.

T 24.2 Mo 17:00 VMP5 HS A

Studien zur Umgewichtung von Monte Carlo Datensätzen von LO auf NLO für zukünftige MSSM $H \to \tau\tau$ Analysen mit dem CMS Detektor — •René Caspart, Andrew Gilbert, Günter Quast und Roger Wolf — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie (KIT)

Eine der ersten erwarteten Analysen im Bereich der Higgs-Physik im Zerfallskanal in τ-Leptonen mit den Daten des LHC Run-2 besteht in der Analyse im Kontext des Minimal-Supersymetrischen Standard Modells (MSSM).

Ein wichtiger Aspekt zur Optimierung der Signifikanz dieser Analyse ist neben der Verringerung bestehender systematischer Unsicherheiten die Möglichkeit mehr Information des Signals in die Analyse mit einzubeziehen, verbunden mit der Notwendigkeit einer möglichst genauen Beschreibung der entsprechenden Variablen.

In dieser Präsentation werden Studien zur Anwendung einer Umgewichtungs-Methode der simulierten Datensätze zur Signalbeschreibung von führender auf nächst-führende Ordnung der Störungsrechnung gezeigt. Ziel dieser Methode ist es in zukünftigen MSSM $H \to \tau\tau$ Analysen zum Beispiel den Transversalimpuls des Higgs Bosons in die Diskriminierung zwischen Signal und Untergrund mit einbeziehen zu können.

T 24.3 Mo 17:15 VMP5 HS A

Missing Mass Calculator as a technique to reconstruct the mass of resonances decaying into tau pairs — Blumenschein Ulla, •De Maria Antonio, Quadt Arnulf, and Zinonos Zinonas — II. Physikalisches Institut, Georg-August-Universität Göttingen

An accurate reconstruction of a resonance mass decaying into a pair of tau leptons is a difficult task because of the presence of multiple undetected neutrinos from the tau decays. The Missing Mass Calculator (MMC) is a sophisticated method to optimise the reconstruction of this events. It is based on the requirement that mutual orientations of the neutrinos and other decay products are consistent with the mass and decay kinematics of a tau lepton. This is achieved by minimizing a likelihood function defined in the kinematically allowed phase space region. MMC was one of the most powerful tools used in SM-Higgs to tau tau searches in Run1 at LHC. Now, in Run2, LHC collides proton-proton at center of mass energy $\sqrt{s} = 13$ TeV and at higher luminosity. Therefore, many efforts need to be done to optimise the analysis tools

to the new experimental conditions. Amongst these tools, MMC requires to be retuned in order to play a key role again in the searches of the Higgs boson in di-tau final states. This talk will outline the main aspects of the MMC retuning and the impact on its performance.

T 24.4 Mo 17:30 VMP5 HS A

Fehlender Transversalimpuls in der Higgs-Rekonstruktion — •Lucas Schneider, Daniel Tröndle, Benedikt Vormwald, Adrian Perieanu, Annika Vanhoefer, Malte Hoffmann, Jan-Oliver Rieger und Peter Schleper — Institut für Experimentalphysik, Universität Hamburg

Theorien mit zwei Higgs-Doublets sind eine viel diskutierte Erweiterung des Standardmodells, die weitere Higgs-Bosonen vorhersagen. Am CMS-Experiment wird unter anderem nach schweren Higgs-Bosonen H gesucht. Ein untersuchter Zerfallskanal ist dabei der eines schweren Higgs H in zwei Standardmodell-artige Higgs-Bosonen h, die wiederum in $\tau^+\tau^-$- und $b\bar{b}$-Paare zerfallen. Zur Rekonstruktion solcher Ereignisse wird ein kinematischer Fit verwendet: Die χ^2-Funktion des Fits wird dabei unter verschiedenen Zwangsbedingungen, z.B. der bekannten Standardmodell-Higgs-Masse m_h, minimiert. Für die Anwendung des kinematischen Fits ist die genaue Kenntnis der Messunsicherheiten der verwendeten Messgrößen sehr wichtig. In diesem Vortrag wird die Methode zur Bestimmung der Kovarianzmatrix des soften Rückstoßanteils in $Z + Jet$ und $H \to hh \to \tau^+\tau^- b\bar{b}$ - Ereignisse präsentiert.

T 24.5 Mo 17:45 VMP5 HS A

Trennung von Signal und Untergrund bei Zerfällen von Higgs Bosonen in Tauonen — •Marcus Schmitt, Raphael Friese, Roger Wolf und Günter Quast — KIT Institut für Experimentelle Kernphysik Arbeitsgruppe Quast

Der Zerfall von Higgs Bosonen in Tauonen stellt hohe Ansprüche an die Genauigkeit und Methodik der Analyse. Die Trennung von Signal und Untergrund ist dabei ein wichtiger Schritt auf dem Weg zu physikalisch interessanten Ergebnissen. Für diesen Zweck wird die Möglichkeit der Trennung von Signal und Untergrund mit Hilfe von multivariaten Analysemethoden (MVA) untersucht. Dabei wird versucht die klassische Kategorisierung nach Anzahl von Jets und Teilchenimpuls durch eine auf multivariate Methoden gestützte Einteilung zu ergänzen oder zu ersetzen.

T 24.6 Mo 18:00 VMP5 HS A

Improving the performance of the H→ $\tau\tau$ analysis by enhancing reconstruction and identification of neutral pions in tau lepton decays with the CMS experiment — Vladimir Cherepanov, Günter Flügge, Bastian Kargoll, Wolfgang Lohmann, •Alexander Nehrkorn, Ian M. Nugent, Claudia Pistone, Achim Stahl, and Alexander Zotz — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

The most promising channel to measure the fermionic couplings of the recently discovered Higgs boson is the decay into two tau leptons. While the decay rate into taus is much smaller than that into b quarks, considerably less background is expected. The largest reducible backgrounds in a search for a Higgs boson decaying into tau leptons originate from multijet and W+jets production where hadronic jets are misidentified as tau leptons. Improving the reconstruction and identification of neutral pions would not only increase the purity of reconstructed decay modes of the tau and reduce migration effects but might also help to distinguish tau jets from hadronic jets, thereby suppressing background.

T 24.7 Mo 18:15 VMP5 HS A

Suche nach dem SM Higgs-Boson in $H \to \tau_{had}\tau_{had}$ Zerfällen bei $\sqrt{s} = 13$ TeV pp Kollisionen mit ATLAS — Ulla Blumenschein, •Eric Drechsler, Arnulf Quadt und Zinonas Zinonos — II. Physikalisches Institut, Georg-August-Universität Göttingen

Im Jahr 2015 wurde der LHC nach einer Upgradepause mit einer erhöhten Schwerpunktsenergie von $\sqrt{s} =$ 13 TeV zum zweiten Mal in Betrieb genommen. Der ATLAS-Kollaboration gelang es eine Datenmenge von 3.3 fb^{-1} pp-Kollisionen aufzuzeichnen.

Eines der ersten experimentellen Ziele des ATLAS-Experiments im zweiten LHC-Lauf ist die Entdeckung des Higgs Bosons im Zerfall in zwei τ-Leptonen. Nach der Entdeckung in bosonischen Prozessen ist der Zerfall in Fermionen ein wichtiger Schlüssel zum Verständnis der Natur des Higgs Teilchens.

Die Etablierung einer solchen, statistisch signifikanten Abweichung setzt eine korrekte Identifizierung und Rekonstruktion von τ-Leptonen vorraus. Die experimentellen Neuerungen am ATLAS Detektor, sowie veränderten Strahlbedingungen im zweiten LHC-Lauf erfordern neben der Optimierung der Identifikationsalgorithmen auch analysespezifische Änderungen.

Dieser Vortrag stellt einen Zusammenfassung dieser Änderungen zur Suche nach dem Prozess $H \to \tau_{had}\tau_{had}$ in $\sqrt{s} =$ 13 TeV dar. Es wird eine Übersicht über die Strategie, den aktuellen Stand der Analyse, sowie die mittelfristigen Zielsetzungen geboten.

T 24.8 Mo 18:30 VMP5 HS A

Untersuchung des Higgs-Bosons im Zerfall $H \to \tau_{lep}\tau_{had}$ mit dem ATLAS-Detektor bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ GeV — Elias Coniavitis, •Dirk Sammel und Markus Schumacher — Albert-Ludwigs-Universität Freiburg

Am 03. Juni 2015 begann die Datennahme im Run 2 des LHC bei einer neuen Schwerpunktsenergie von $\sqrt{s} = 13$ GeV. Während der ersten Datennahmeperiode Run 1 konnte in den beiden Experimenten ATLAS und CMS getrennt Evidenz für den Zerfall $H \to \tau\tau$ erzielt werden und in der Kombination wurde die Beobachtung erreicht.
Mit dem neuen Datensatz wird es möglich sein, die Yukawa-Kopplung des Tau-Leptons an das Higgs-Boson präziser zu bestimmen und weitere Untersuchungen in diesem Zerfallskanal durchzuführen.
In diesem Vortrag werden erste Ergebnisse basierend auf den Daten des Jahres 2015 mit einer integrierten Luminosität von $\int \mathcal{L}dt = 3.3$ fb^{-1} im Endzustand mit einem leptonisch und einem hadronisch zerfallenen Tau-Lepton vorgestellt.
Der Prozess $Z \to \tau\tau$ ist ein wichtiger Untergrund dieser Analyse. Dessen Abschätzung erfolgt datenbasiert durch die sogenannte "Embedding"-Methode, welche im Vortrag erläutert wird.

T 24.9 Mo 18:45 VMP5 HS A

Optimization studies for the $H \to \tau_{lep}\tau_{had}$ decay channel with the ATLAS detector — •Jessica Liebal, Thomas Schwindt, Jana Kraus, Jürgen Kroseberg, and Norbert Wermes — Universität Bonn

At the beginning of 2015 the ATLAS collaboration published an evidence for the Higgs boson decay into a pair of τ leptons consistent with the Standard Model expectation. The observed excess at $m_H = 125$ GeV corresponds to 4.5 standard deviations. The analysis was based on a combination of data samples collected in 2011 and 2012 with ATLAS at $\sqrt{s} = 7$ TeV and $\sqrt{s} = 8$ TeV corresponding to an overall integrated luminosity of 24.9 fb^{-1}. A preliminary combination of ATLAS and CMS Run1 results yielded an observation with a measured (observed) significance of 5.5. This talk highlights selected aspects of the Run1 ATLAS $H \to \tau\tau$ analysis focussing on the $H \to \tau_{lep}\tau_{had}$ decay process in which one tau decays leptonically and the other one hadronically. Options to improve the analysis as well as channel-specific challenges for Run2 are discussed.

T 25: Higgs-Boson (assoziierte Produktion) II

Zeit: Montag 16:45–19:00 Raum: VMP5 HS B1

T 25.1 Mo 16:45 VMP5 HS B1

ttH Coupling Measurements in ATLAS and Combined Results of 8 TeV Data — •Andre Sopczak[1], Babar Ali[1], Simonetta Gentile[2], Marine Kuna[2], Simone Monzani[2], and Frank Seifert[1] — [1]IEAP CTU in Prague — [2]Universita di Roma, La Sapienza, INFN

After the discovery of a Higgs boson, the measurements of its properties are now at the forefront of research. The measurement 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.

For the first time 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 $\to 2\ell + 1\tau_{\text{had}}$. The analysis was based

on data taken by the ATLAS experiment recorded from 8 TeV proton-proton collisions. It contributed significantly to the combined ATLAS results of the five multi-lepton final states. These results were further combined with other ATLAS ttH analyses where H → γγ and H → bb̄. The combined results are consistent with the Standard Model (SM) expectation allowing models beyond the SM to be constrained.

T 25.2 Mo 17:00 VMP5 HS B1

Search for the production of the Higgs boson in association with a pair of top quarks in the 3 leptons final state at 13 TeV in ATLAS — •Nello Bruscino, Markus Cristinziani, Mazuza Ghneimat, Sebastian Heer, Vadim Kostyukhin, Liza Mijović, Andrea Sciandra, and Kaven Yau Wong — Physikalisches Institut, Universität Bonn

The observation of the Higgs boson in association with a top-quark pair will open a window to the direct study of the Yukawa couplings of the top quark, which is the fermion expected to couple most strongly to the Higgs boson. Thanks to the LHC upgrade to 13 TeV $t\bar{t}H$ events are produced with a significantly higher cross section than at 8 TeV. Final states with high light leptons multiplicity, targeting the $H \to WW^*/\tau\tau/ZZ^*$ decay channels, can consequently be exploited to research the presence of a Standard Model (SM) Higgs boson.
The 3 leptons analysis includes exactly 3 light leptons with total charge equal to ±1. To suppress the $t\bar{t}$ + jets and $t\bar{t}V$ backgrounds, selected events are required to include either at least 4 jets of which at least one must be b-tagged, or exactly 3 jets of which at least 2 b-tagged. The $t\bar{t}H$ to 3 light leptons final state is dominated by the $H \to WW^*$ decay: either 2 leptons originate from the Higgs decay and an additional one from top, or 1 lepton from Higgs and 2 leptons from tops. Further 3 leptons configurations are thinkable, making it harder to pursue this final state. A Pseudo Matrix Element (P.M.E.) approach is developed and used in order to identify signal-like events by partially reconstructing resonances and recognizing peculiar kinematic variables.

T 25.3 Mo 17:15 VMP5 HS B1

Background Estimation in the Associated Higgs Boson Top-Quark Production Channel ttH → $2\ell + 1\tau_{\mathrm{had}}$ at $\sqrt{s} = 13$ TeV with ATLAS — •Babar Ali[1], Simonetta Gentile[2], Marine Kuna[2], Simone Monzani[2], Frank Seifert[2], and Andre Sopczak[1] — [1]IEAP CTU in Prague — [2]Universita di Roma, La Sapienza, INFN

The measurement of the associated production of a Higgs boson with a pair of top quarks is a direct determination of the top-Yukawa coupling at tree-level, which can be compared with the indirect determination in the loop-production via gluon-gluon fusion. The decay channel of the system with several leptons (multi-lepton channel) and jets gives high sensitivity. The focus of the analysis is the sub-channel with two same-sign light leptons (electrons or muons) and a hadronically decaying tau lepton: ttH → $2\ell + 1\tau_{\mathrm{had}}$. In particular the background estimate from top-antitop reactions is discussed. The analysis uses the data set recorded by ATLAS in 2015 from the first LHC Run-II 13 TeV proton-proton collisions.

T 25.4 Mo 17:30 VMP5 HS B1

Higgs production in association with top quarks in the final state with $2\ell 1\tau_{\mathrm{had}}$ at ATLAS — •David Hohn, Jürgen Kroseberg, Thomas Schwindt, Birgit Stapf, and Norbert Wermes — Physikalisches Institut, Universität Bonn

The coupling between the Higgs boson and fermions can be studied in its decay e.g. $H \to \tau\tau$ and in its production e.g. in association with top quarks. Both methods can be combined by looking at events with two leptons, one hadronic tau and many jets which is sensitive to the process $t\bar{t}H \to \tau\tau$ and thus allows the measurement of Higgs fermion couplings entirely at tree level.

For the analysis of the new 13 TeV data taken with the ATLAS detector at LHC new methods have been developed to improve the sensitivity that was reached in Run 1. Further improvements can be achieved by the addition of a new event category.

It will be shown how the dominant $t\bar{t}$ background can be effectively suppressed using multivariate techniques and event reconstruction with kinematic likelihood functions.

T 25.5 Mo 17:45 VMP5 HS B1

Techniken und Methoden für die Suche nach dem Higgs-Boson in assoziierter Produktion mit einem Top-Quark-Antiquark-Paar am CMS-Experiment — Karim El Morabit, Marco A. Harrendorf, Ulrich Husemann, Hannes Mildner, Andrej Saibel, Matthias Schröder, •Korbinian Schweiger und Shawn Williamson — Institut für Experimentelle Kernphysik (IEKP), KIT

Durch die Untersuchung der Higgs-Boson-Produktion in Assoziation mit einem Top-Quark-Antiquark-Paar (tt̄H) ist eine modellunabhängige Messung der Top-Higgs-Yukawa-Kopplung möglich. Mit Hilfe der Daten, welche der CMS-Detektor während des LHC-Run 2 aufnimmt, soll dieser Produktionsprozess weiter untersucht werden, da eine Verbesserung der Sensitivität erwartet wird.

In diesem Vortrag wird der Zerfall des Higgs-Bosons in ein bb̄-Paar sowie des tt̄-Paares in ein geladenes Lepton, ein Neutrino und mehrere Teilchenjets betrachtet. Da die tt̄H-Produktion einen kleinen Wirkungsquerschnitt hat und der betrachtete Zerfallskanal einen großen tt̄-Untergrund aufweist, stellt die Suche nach diesem Produktionskanal eine große Herausforderung dar. Deshalb sind spezialisierte Methoden nötig, um tt̄-Paare und Higgs-Bosonen sowie deren Zerfallsprodukte zu identifizieren und analysieren. In diesem Vortrag werden Techniken und Methoden vorgestellt, die in der Analyse verwendet werden.

T 25.6 Mo 18:00 VMP5 HS B1

Search for the ttH (H->bb) Process Using the ATLAS detector — •Nedaa Asbah, Judith Katzy, and John Keller — Deutsches Elektronen-Synchrotron (DESY)

The measurement of the Higgs boson production in association with top quarks (ttH) is an important goal of the LHC Run-II physics program as it allows a direct measurement of the top quark Yukawa coupling. In Run1, this measurement suffered from a relatively low cross section at $\sqrt{s} = 8$ TeV and will benefit greatly from the higher luminosity and energy of Run II at $\sqrt{s} = 13$ TeV. A search for ttH production with the ATLAS detector at $\sqrt{s} = 13$ TeV will be presented. This study focuses on the search channel with the Higgs boson decaying to bb^- and the tt^- pair decaying semi-leptonically. A data-driven method for determining the background from events with mis-identified leptons has been developed.

T 25.7 Mo 18:15 VMP5 HS B1

Uncertainties related to Higgs production in association with a pair of top quarks — •Tim Michael Heinz Wolf — Nikhef, Amsterdam, Netherlands

The production of a Higgs boson in association with a pair of top quarks ($t\bar{t}H$) is one of the processes which raises the most interest for LHC run-2. The process is very interesting since the Higgs boson couples directly to the top quark so an extraction of the top-Yukawa coupling is feasible. The top-Yukawa coupling is an important quantity in the discussion of the validity of the standard model (SM) it self since it drives the Higgs self-coupling to negative values rendering the SM incomplete. The exact value of the top-Yukawa coupling determines whether the universe is in a stable, meta-stable or unstable phase.

Especially the $H \to b\bar{b}$ final state is interesting since it yields the highest branching ratio among all final states. The QCD uncertainties related to the background of the $t\bar{t}H(b\bar{b})$ final state are large which makes precise assessment of the uncertainties important. I am going to present and quantify the uncertainties coming from gluon splitting in the parton shower as well as the uncertainties coming from different renormalisation and factorisation choice. These findings might provide a more accurate assessment of the uncertainties for the search of $t\bar{t}H(b\bar{b})$ in LHC run-2 with the Atlas detector.

T 25.8 Mo 18:30 VMP5 HS B1

Monte-Carlo-Simulation des tt̄H- und des tt̄-Prozesses in nächstführender Ordnung am LHC — Karim El Morabit, Marco A. Harrendorf, Ulrich Husemann, Hannes Mildner, •Andrej Saibel, Matthias Schröder, Korbinian Schweiger und Shawn Williamson — Institut für Experimentelle Kernphysik (IEKP), KIT

Anhand des tt̄H-Prozesses kann die Top-Higgs-Yukawakopplung direkt gemessen werden. Dazu ist es wichtig, den Prozess selbst sowie den wichtigsten Untergrundprozess tt̄ möglichst genau simulieren zu können. Dabei kommen verstärkt Ereignisgeneratoren in nächstführender Ordnung (next-to-leading order, NLO) zum Einsatz, die genauere Vorhersagen über die Prozesse ermöglichen.

In diesem Vortrag wird auf die Generierung von Ereignissen mit einem Higgs-Boson in Assoziation mit einem Top-Quark-Antiquark-Paar (tt̄H) und dem dazu wichtigsten Untergrundprozess mit einem Top-Quark-Antiquark-Paar (tt̄) mit Hilfe von NLO-Generatoren eingegangen. Dazu werden verschiedene Studien vorgestellt, die die modernen NLO-Generatoren und deren Konfigurationen vergleichen.

T 25.9 Mo 18:45 VMP5 HS B1

Multivariate Analyse für die Suche nach dem Higgs-Boson in assoziierter Produktion mit einem Top-Quark-Antiquark-Paar am CMS-Experiment — •Karim El Morabit, Marco A. Harrendorf, Ulrich Husemann, Hannes Mildner, Andrej Saibel, Matthias Schröder, Korbinian Schweiger und Shawn Williamson — Institut für Experimentelle Kernphysik (IEKP), KIT

Eine Analyse des Wirkungsquerschnittes für die Higgs-Boson-Produktion in Assoziation mit einem Top-Quark-Antiquark-Paar ($t\bar{t}H$) ermöglicht eine direkte Messung der Top-Higgs-Yukawa-Kopplung. Für die erhöhte Schwerpunktsenergie des LHC-Run-2 wird ein deutlicher Anstieg der Produktionsrate dieses Prozesses und somit eine höhere Präzision der Messung erwartet.

In der vorgestellten Analyse werden Ereignisse mit einem semileptonisch zerfallenden $t\bar{t}$-Paar und einem in ein $b\bar{b}$-Paar zerfallenden Higgs-Boson aus den vom CMS-Experiment aufgenommenen Daten selektiert. In Ereignissen, in denen Top-Quarks und Higgs-Bosonen mit hohen Transversalimpulsen auftreten, werden spezielle *Fat-Jet*- und Substruktur-Algorithmen zur Rekonstruktion und Identifikation der Higgs-Bosonen und hadronisch zerfallenden Top-Quarks verwendet. Den größten Untergrund nach der Selektion stellen $t\bar{t}$-Ereignisse mit zusätzlichen Jets dar. Zur Identifikation dieser Untergrundereignisse werden multivariate Methoden verwendet.

Dieser Vortrag stellt eine multivariate Analyse mit *Boosted Decision Trees* zur Klassifikation von Ereignissen als Untergrund- oder Higgs-Boson-Ereignisse vor.

T 26: Suche nach Supersymmetrie II (Leptonische Endzustände)

Zeit: Montag 16:45–19:00 Raum: VMP5 HS B2

T 26.1 Mo 16:45 VMP5 HS B2

Suche nach Supersymmetrie in Ereignissen mit einem Lepton, Jets und fehlender transversaler Energie am ATLAS-Experiment — •Nikolai Hartmann und Jeanette Lorenz — Ludwig-Maximilians-Universität München

Durch die höhere Schwerpunktsenergie von $\sqrt{s} = 13$ TeV in Run 2 am LHC können mit den aus 2015 vorliegenden Daten neue Massenbereiche jenseits des Standardmodells erkundet werden. Die Suche nach Gluinos in Ereignissen mit einem Lepton, Jets und fehlender transversaler Energie ist hierbei besonders sensitiv.
In diesem Vortrag wird die Methode zur Optimierung der Signalselektion vorgestellt, welche erfolgreich für die aktuellen Ergebnisse im Kontext dieser Suche angewandt wurde. Des weiteren wird eine Erweiterung der Suche um Signalregionen mit einer höheren Jet-Multiplizität vorgestellt, die die Sensitivität der Analyse auch auf andere Modelle im Parameterraum des minimalen supersymmetrischen Standardmodells (MSSM) ausdehnt, wie z.B. dem phänomenologischen MSSM und auf R-Parität-verletzende Szenarien.

T 26.2 Mo 17:00 VMP5 HS B2

Suche nach Supersymmetrie in Endzuständen mit einem Lepton, Jets und fehlender Transversalenergie — Katharina Bierwagen, Volker Büscher, Katharina Jakobi, •Manuel Lornatus, Andreas Reiss, Jan Schäffer und Pedro Urrejola — Uni Mainz

Ein Fokus der Datenauswertung des ATLAS-Experiments ist die Suche nach supersymmetrischen Teilchen (SUSY), deren Existenz bisher noch nicht nachgewiesen werden konnte. Am Large Hadron Collider (LHC) am CERN werden diese dominant über die starke Wechselwirkung produziert. Die erzeugten Squarks und Gluinos zerfallen dann über Kaskaden weiter in leichtere SUSY-Teilchen und Teilchen des Standardmodells. Dabei wird häufig der in dieser Analyse betrachtete Endzustand mit einem Lepton, Jets und fehlender Transversalenergie gebildet.

Im Jahr 2015 wurde eine Datennahme mit einer erhöhten Schwerpunktsenergie von 13 TeV durchgeführt. Aufgrund der höheren Massen von Squarks und Gluinos profitieren die Wirkunsquerschnitte der Signalprozesse von diesem Vordringen in höhere Energiebereiche weit mehr als die der relevanten Untergrundprozesse. Daher liegt die Entdeckungssensitivität dieser Analyse bereits mit 3 fb^{-1} jenseits aktueller Ausschlussgrenzen.

Es werden die aktuellsten ATLAS-Ergebnisse mit dem vollen Datensatz der Datennahme in 2015 (3,2 fb^{-1}) präsentiert.

T 26.3 Mo 17:15 VMP5 HS B2

Data-driven background predictions for a search of direct gluino pair production in the single-lepton final state using 13 TeV pp-collisions at the CMS experiment. — •Artur Lobanov, Claudia Seitz, and Isabell Melzer-Pellmann — DESY, Hamburg

We present a search for direct gluino-pair production in events with a single lepton using 13 TeV pp-collisions at the CMS experiment. This final state is characterised by high multiplicities of jets and b-quark jets, as well as a large scalar sum of all jet transverse momenta, and a large scalar sum of the transverse missing momentum and the lepton transverse momentum, called L_T. The dominating Standard Model backgrounds in this phase-space are tt+jets and W+jets production. A data-driven method is used to estimate the background in the search regions. All backgrounds except for QCD in the (high $\Delta\Phi(W,l)$) signal regions are predicted by from the number of events in the low $\Delta\Phi(W,l)$ region, with transfer factors determined also from data, while for the multi-jet events a fake-lepton enriched side-band is used. We conclude by showing predictions and final results from data corresponding to 2.1fb^{-1} integrated luminosity recorded with the CMS detector during the LHC Run2 in 2015.

T 26.4 Mo 17:30 VMP5 HS B2

A Supersymmetry search strategy with single-lepton events at 13 TeV by the CMS experiment — Artur Lobanov, Claudia Seitz, Isabell Melzer-Pellmann, and •Akshansh Singh — DESY, Hamburg, Germany

We present an inclusive search for supersymmetry in the single-lepton channel with 13 TeV. To optimise the sensitivity to various new-physics topologies, we search in several exclusive categories which differ in the number of jets and b-tagged jets. We determine the background from data, exploiting the fact that the main background is located at small values of the azimuthal angle between the W-boson candidate and the charged lepton. To be less dependent on the new-physics scale, we also introduce separate search categories based on the scalar sum of the jet transverse momenta and on the scalar sum of the transverse missing momentum and the transverse momentum of the lepton. Depending on the signal model, the signals regions have varying sensitivity. Here we concentrate on gluino-gluino production, where the pair-produced gluinos decay to a top-antitop pair and the lightest neutralino

T 26.5 Mo 17:45 VMP5 HS B2

Latest analysis results and statistical interpretations for SUSY searches at $\sqrt{s} = 13$ TeV with two same-sign leptons, jets and E_T^{miss} at the ATLAS detector — •Fabio Cardillo and Peter Tornambé — Albert-Ludwigs Universität Freiburg

A search for supersymmetric phenomena in final states with two leptons with the same electric charge, jets and missing transverse energy E_T^{miss} is presented. The production of same-sign lepton pairs or three leptons is only induced by rare Standard Model processes with very small cross-sections. The search thus benefits from little background and has a good exclusion potential in compressed SUSY spectra. This analysis has been performed already in Run-I of the LHC and provided powerful exclusion limits for various SUSY scenarios.

In the ongoing Run-II, the search was conducted with the full dataset of pp collisions at $\sqrt{s} = 13$ TeV recorded with the ATLAS detector in 2015 corresponding to a total integrated luminosity of 3.3 fb^{-1}. The sensitivity to a big variety of supersymmetric models is illustrated by the interpretation of the results in the context of four different SUSY benchmark scenarios producing same-sign leptons signatures. The results can be used to set model-independent limits to new physics signals as well as increasing the existing limits on different supersymmetric scenarios with respect to the previous Run-I results.

This talk will present the latest results of the same-sign/3L analysis published at the end of 2015. Furthermore, analysis details will be addressed and the prospects for the progressive data-taking during Run-II will be shown.

T 26.6 Mo 18:00 VMP5 HS B2

Data-driven background estimates in searches for supersymmetry in final states with two same-sign leptons, jets and E_T^{miss} with the ATLAS detector — •Peter Tornambè and Fabio Cardillo — Albert-Ludwigs Universität Freiburg

Supersymmetry is one of the most studied theories to extend the Standard Model. If R-parity is conserved, SUSY particles are produced in pairs and the lightest supersymmetric particle which is typically the lightest neutralino $\tilde{\chi}_0^1$ is stable. In many models the LSP can be a suitable candidate for dark matter.

This talk presents a search for supersymmetric phenomena in final states with two leptons of the same electric charge, jets and missing transverse energy E_T^{miss}. While the same-sign leptons signature is present in many supersymmetric scenarios, SM processes leading to such events have very small cross-sections. Therefore, this analysis benefits from a small SM background in the signal regions leading to a good sensitivity especially in compressed regions of the SUSY phase-space. The other main sources for SM processes contaminating the signal regions are fake-leptons and leptons with a charge mis-identification. While background originating from prompt same-sign lepton sources is estimated with simulated Monte Carlo events, the non-prompt sources are addressed with data-driven techniques.

Within this talk, the current analysis strategy in Run-II will be presented focussing on the methods used for the background estimation and sensitivity optimization. But also the latest results obtained during the 2015 data-taking will be shown.

T 26.7 Mo 18:15 VMP5 HS B2

Search for Supersymmetry in final states with two opposite-sign same-flavor leptons, jets, and $\mathbf{E_T^{miss}}$ in pp collisions at $\sqrt{s} = 13$ TeV with the CMS experiment — Christian Autermann, Lutz Feld, •Christian Schomakers, and Jan-Frederik Schulte — 1. Physikalisches Institut B, RWTH Aachen University

One of the main purposes of the LHC is the search for new physics which is predicted by theories such as Supersymmetry (SUSY) and is necessary to solve several problems of the standard model. Cascade decays of SUSY particles often yield final states with hadronic activity and missing transverse energy. Signatures including leptons are of particular interest since standard model background processes are suppressed by this selection and can be predicted with good accuracy.

The invariant dilepton mass distribution can provide further information on possible decays of SUSY particles. At 8 TeV, CMS observed an excess of 2.6 σ at a low dilepton mass. ATLAS did not confirm this deviation but reported an excess of 3.0 σ in a nearby signal region on the Z-peak.

The CMS SUSY dilepton search was repeated at 13 TeV and the results are presented.

T 26.8 Mo 18:30 VMP5 HS B2

Verwendung von b-Jets in der Suche nach Gluinos am ATLAS Detektor in Endzuständen mit einem Lepton, Jets und fehlender Transversalenergie — •Daniela Köck und Jeanette Lorenz — Ludwig-Maximilians-Universität München

Die Sensitivität auf die Paar-Produktion von Gluinos wird durch die neue Schwerpunktsenergie von 13 TeV in Run 2 des LHC erheblich gesteigert. Die Standardsuche nach Gluinos in Endzuständen mit einem Lepton, Jets und fehlender Transversalenergie konzentriert sich hierbei auf wenige Endzustände in vereinfachten Modellen, um Signaturen für eine Entdeckung zu definieren. Eine Erweiterung der obigen Analyse und die Optimierung der Signalregionen auf physikalisch inspirierte Modelle wäre wünschenswert. Solche Modelle enthalten sowohl Parameterräume, die eine Anreicherung obiger Endzustände von Jets mit b-Quarks vorhersagen, als auch andere in denen ein Veto hierauf vorteilhaft ist. Der Vortrag untersucht diesen Sachverhalt im Rahmen verschiedener supersymmetrischer Modelle.

T 26.9 Mo 18:45 VMP5 HS B2

Suche nach Supersymmetrie in multileptonischen Endzuständen mit dem ATLAS-Experiment — •Johannes Junggeburth, Michael Flowerdew und Hubert Kroha — Max-Planck Institut für Physik, München

Supersymmetre is die am mesiten studierte Erweiterung des Standardmodells der Teilchenphysik. Sie sagt für jedes Elementarteilchen des Standardmodell einen supersyemmtrischen Partner voraus, dessen Masse allerdings unbekannt ist. Bisher wurde noch kein solches Teilchen in Kollisionsexperimenten nachgewiesen. Im Jahr 2015 begann der Run-II des Large Hadron Collider bei einer erhöhter Schwerpunktsenergie von 13 TeV mit dem die Suche nach neuen supersymmetrischen Teilchen fortgesetzt wird.

Multileptonische Endzustände bieten mit ihrer klaren Signatur und niedrigem Untergrund eine idealen Kanal zur Suche nach Supersymmetrie. In diesem Vortrag werden datenbasierte Methoden zur Bestimmung der Untergrundbeiträge vorgestellt.

T 27: BSM Suchen III (Vektorartige Quarks)

Zeit: Montag 16:45–19:00 Raum: VMP6 HS B

T 27.1 Mo 16:45 VMP6 HS B

Studien zur Suche nach vektorartigen Top-Quarks mit einem einzelnen Lepton im Endzustand bei $\sqrt{s} = 13$ TeV mit dem ATLAS-Detektor — Johannes Erdmann, Claus Gössling, Kevin Kröninger und •Tobias Kupfer — TU Dortmund, Experimentelle Physik IV

Vektorartige Quarks (VLQ), die überwiegend an die dritte Quark-Generation koppeln, sind die einfachste Ergänzung von farbgeladenen Fermionen zum Standardmodell (SM), welche noch nicht experimentell ausgeschlossenen ist. Diese VLQ erhalten ihre Masse nicht über die Yukawa-Kopplung, und ihre rechts- und links-händigen Komponenten transformieren gleich unter der SU(2). Durch die Mischung mit SM-Quarks können VLQ deren Kopplung an massive Eichbosonen verändern und verschiedenen neue hypothetische Erweiterungen zum Standardmodell, wie Composite-Higgs-Modelle, implizieren die Existenz von VLQ.
Einzeln produzierte VLQ ermöglichen bei einer Schwerpunksenergie von $\sqrt{s} = 13$ TeV, im Vergleich zur VLQ-Paarproduktion, Suchen bis hin zu besonders hohen Massen. Für einzeln produzierte vektorartige Top-Quarks T, welche durch den Zerfall $T \to Wb$ in einem Endzustand mit einem einzelnen Lepton und starkem Lorentz-Boost der Zerfallsprodukte resultieren, werden Monte-Carlo-basierte Studien präsentiert. Es wird der Einfluss von verschiedenen Parametern in der Monte-Carlo-Produktion auf die Kinematik der Endzustandsteilchen untersucht.

T 27.2 Mo 17:00 VMP6 HS B

Suche nach Paarproduktion von vektorartigen Quarks im Zerfallskanal $T/B \to Zt/b$ bei $\sqrt{s} = 13$ TeV am ATLAS-Experiment — Johannes Erdmann, •Elena Freundlich, Claus Gössling und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Bei der Suche nach Physik jenseits des Standardmodells spielen Composite-Higgs-Modelle als Erweiterung 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 Analysestrategie zur Suche nach VLQ bei $\sqrt{s} = 13$ TeV am ATLAS-Experiment vorgestellt. Im Vergleich zu $\sqrt{s} = 8$ TeV ergibt sich für die höhere Schwerpunktsenergie ein um ein Vielfaches größerer Wirkungsquerschnitt. Dabei werden die VLQ in Paaren durch die starke Wechselwirkung erzeugt. 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, und eine bestimmte Anzahl an b-Jets.

T 27.3 Mo 17:15 VMP6 HS B

Search for singly-produced vector-like quarks in lepton and jets final state with the ATLAS detector in run-II — •Dustin Biedermann, Janet Dietrich, Sergio Grancagnolo, Heiko Lacker, and Dennis Sperlich — Humboldt-Universität zu Berlin

Vector-like quarks are predicted by many extensions of the Standard Model of particle physics. They provide the possiblity to solve some long-standing problems such as the hierarchy problem and also might

help to explain the b-quark forward-backward asymmetry in e^+e^- collisions measured at LEP. Candidates for these vector-like quarks are the top-like T and the Y quark. The Y quarks decay exclusively into a W-boson and a b-quark, which appears also to be the dominant decay channel of the T quarks.

We present the search strategy for singly-produced T/Y quarks and the expected sensitivity using the first LHC run-II data recorded by the ATLAS detector in 2015.

T 27.4 Mo 17:30 VMP6 HS B

Suche nach vektorartigen Quarks im Zerfallkanal tW mit dem CMS-Detektor — •Daniel Gonzalez, Johannes Haller, Ivan Marchesini, Dominik Nowatschin, Alexander Schmidt und Heiner Tholen — Universität Hamburg, Institut für Experimentalphysik

Vektorartige Quarks sind schwere Teilchen, die von einer Vielzahl von möglichen Erweiterungen des Standard-Modells der Teilchenphysik vorhergesagt werden. Anders als eine chirale vierte Generation von Quarks werden diese nicht durch das Higgs-Boson bei 125 GeV ausgeschlossen. Bei der Schwerpunktsenergie von 8 TeV wurden vektorartige Quarks bei CMS in Paarproduktion gesucht und bis zu einer Masse von circa 800 GeV ausgeschlossen. In diesem Vortrag wird die Suche nach solchen Quarks in Einzelproduktion, die in ein Top-Quark und W-Boson zerfallen, bei einer Schwerpunktsenergie von 13 TeV vorgestellt. Die Einzelproduktion ist besonders interessant, da sie deutlich größere Wirkungsquerschnitte als die Paarproduktion bei der höheren Schwerpunktsenergie besitzen kann. Durch die schwere Masse der vektorartigen Quarks jenseits von 800 GeV ist die geboostete Topologie für diese Suche besonders wichtig. Deshalb werden verschiedene Jetsubstruktur-Algorithmen angewendet.

T 27.5 Mo 17:45 VMP6 HS B

Search for pair-produced Vector-like Quarks in boosted Topologies in pp-collisions at 13 TeV — Daniel Gonzalez, Johannes Haller, Ivan Marchesini, •Dominik Nowatschin, Alexander Schmidt, and Heiner Tholen — Universität Hamburg, Institut für Experimentalphysik

While a fourth generation of chiral quarks has been excluded by the discovery of the Higgs boson, vector-like quarks are still allowed by the present experimental data and are in fact a feature of many BSM models.

We present a search for pair-produced vector-like top partners (T') with 13 TeV data at the CMS detector. The search is carried out in the lepton+jets channel and is most sensitive for final states where at least one T' decays to a top quark and a Higgs boson.

If vector-like quarks exist, they are expected to have masses above ∼800 GeV since lighter particles have already been excluded by both ATLAS and CMS in LHC Run I. As a consequence, final states with large transverse momenta become more likely and the decay products of intermediate particles (like top quarks and Higgs bosons) tend to be very collimated. In order to resolve these boosted final states, jet-substructure techniques such as Higgs-tagging are employed in this analysis.

T 27.6 Mo 18:00 VMP6 HS B

Search for single production of a vector-like T quark decaying into a top quark and a Higgs boson — Daniel Gonzales, Ivan Marchesini, Dominik Nowatschin, Alexander Schmidt, Svenja Schumann, •Heiner Tholen, and Emanuele Usai — Universität Hamburg, Institut für Experimentalphysik

We search for singly produced vector-like top quark partners (T) in pp-collisions at $\sqrt{s} = 13\,\text{TeV}$ with the CMS experiment. Several BSM models, such as composite Higgs and extra dimensions, predict vector-like quarks to be accessible at the LHC. At 13 TeV, single production of vector-like quarks might be enhanced over pair production, depending on the coupling parameters for the individual interactions. In this analysis, we target the decay of the vector-like heavy T quark into a Higgs boson and a top quark, where the top quark decay includes a lepton.

Higgs-boson candidates are reconstructed using new methods to resolve the substructure of boosted jets and top-quark candidates are formed by combining leptons, missing transverse energy and jets. With the top-quark and Higgs-boson candidates, we aim for the complete reconstruction of the four-vector of the new particle in question. The largest fraction of the background is contributed through the top-quark pair production process. First results on the search for single vector-like top partners at 13 TeV are presented.

T 27.7 Mo 18:15 VMP6 HS B

Suche nach Single Vectorlike Quarks in $T \to Z_{\mathbf{inv}} t_{\mathbf{had}}$ — •Sonja Bartkowski, Johannes Erdmann, Claus Gössling und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Vectorlike Quarks (VLQ) sind farbgeladene Fermionen, die wie Vektoren unter der SU(2) transformieren. Sie kommen in vielen Erweiterungen des Standard Modells vor. Immer höhere Massenlimits machen die Suche nach Single VLQ am LHC attraktiv, da für große VLQ-Massen in pp-Kollisionen bei $\sqrt{s} = 13\,\text{TeV}$ die Einzelproduktion gegenüber der Paarproduktion bevorzugt ist.

VLQ können über Flavor Changing Neutral Currents zerfallen. Mit einer Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ eröffnen sich über geboostete Zerfallstopologien Zugänge zu bisher kaum nutzbaren Zerfallskanälen. Im Rahmen dieses Vortrags wird daher eine Studie zur Perspektive der Suche nach Single VLQ in $T \to Zt$ mit hadronischem Topzerfall und $Z \to \nu\overline{\nu}$ am ATLAS-Experiment vorgestellt. Außerdem wird die Sensitivität einer solchen Analyse auf Monotop-Signaturen untersucht.

T 27.8 Mo 18:30 VMP6 HS B

Search for Singly Produced Vector-Like Down-Type Quarks with ATLAS — •Laura Rehnisch, Janet Dietrich, and Heiko Lacker — Humboldt-Universität zu Berlin

Vector-like quarks are predicted in several models, e.g. composite Higgs models. Due to relatively high mass limits from previous searches and the limited phase space for pair-produced heavy quarks, it is indicated to investigate single production of these particles. A search for down-type vector-like quarks decaying to a W boson and a top quark, conducted on the 8 TeV dataset recorded in 2012 with the ATLAS detector, will be presented. Two models, a vector-like quark, B, and an excited quark with vector-like couplings, b^*, have been investigated. The presented and recently published results were obtained using single-lepton and dilepton final states, while the presentation will focus on single-lepton events in which boosted decay topologies of the heavy quarks are used. This increases the sensitivity, as jets from hadronically decaying W's and tops are likely to be merged. In the absence of a significant excess of the data over the expected background, cross-section limits were set. Excited vector-like quarks with masses below 1.5 TeV are excluded.

T 27.9 Mo 18:45 VMP6 HS B

Search for exotic light-flavor quark partners in pp collisions at a center of mass energy of 8 TeV with the CMS detector — •Gerrit Van Onsem — Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, D-22607 Hamburg

Vector-like quarks appear in many new-physics models extending the standard model. We search for vector-like quarks coupling to first-generation quarks using 8 TeV pp collision data collected by the CMS detector at the CERN Large Hadron Collider. The exotic quarks are assumed to be produced both singly and in pairs, and to decay via a W, Z or Higgs boson. We have defined various sets of selections on the reconstructed physics objects, subdividing the data set in different event categories, considering final states with at least one muon or electron. No significant excess over standard model expectations has been found, and exclusion limits on the mass of the exotic quarks are set.

T 28: Myondetektoren II

Zeit: Montag 16:45–19:00 Raum: VMP6 HS E

T 28.1 Mo 16:45 VMP6 HS E

Messung der Nachweiseffizienz von Myonen am ATLAS-Detektor im LHC-Run-2 — •Nicolas Köhler, Maximilian Goblirsch-Kolb, Oliver Kortner und Hubert Kroha — Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München

Das Myonspektrometer des ATLAS-Detektors dient dem effizienten Nachweis von Myonen und der präzisen Impulsmessung über einen großen Raumwinkel- und Energiebereich. Für viele Messungen beim ATLAS-Experiment ist eine genaue Bestimmung der Myonnachweiseffizienz notwendig.

Dazu wird die sogenannte Tag-and-Probe-Methode unter Verwendung von gemessenen $J/\psi \to \mu^+\mu^-$ und $Z \to \mu^+\mu^-$-Zerfällen herangezogen. Die Methode und die Ergebnisse für die 2015 bei einer Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ aufgezeichneten Daten werden vorgestellt. Die Nachweiseffizienz für Myonen mit Transversalimpulsen zwischen 4 und einigen hundert GeV wurde mit einer Genauigkeit im Promillbereich bestimmt.

T 28.2 Mo 17:00 VMP6 HS E

Untersuchungen zu MicroMegas für das Atlas New Small Wheel Upgrade — •Thorwald Klapdor-Kleingrothaus, Ulrich Landgraf und Stephanie Zimmermann — Institut für Physik, Freiburg, Deutschland

Die Micro Mesh Gasous Detectors (MicroMegas, MM) sind flache und hochratenfeste Detektoren.Die MM Technologie wurde in den vergangenen Jahren intensiv von der New Small Wheel Group (ATLAS) untersucht und verbessert, um das aktuelle Small Wheel des ATLAS Detektors mit großflächigen MicroMegas, zusammen mit sTGC's, während des Long Shutdowns (LS2) zu ersetzen. In diesem Zusammenhang wurden kleinere MicroMegas-Prototypen (10x10cm) hergestellt, deren genauere Untersuchung Einfluss auf die Betriebsparameter der großen, endgültigen Detektoren hat. In diesem Vortrag sollen die bisherigen Studien zusammengefaßt werden und ein Ausblick auf die Messungen mit dem neu entwickelten Aufbau in Freiburg gegeben werden. Des Weiteren wird die Auslese mittels Zebra Connectors (Elastomeric Connectors) vorgestellt und deren Kontaktivität untersucht.

T 28.3 Mo 17:15 VMP6 HS E

Production facility for ATLAS New Small Wheel Drift Panels at JGU Mainz — •Andreas Düdder, Tai-Hua Lin, and Matthias Schott — Johannes Gutenberg-Universität Mainz

The ATLAS Phase-I Upgrade in 2018 includes the replacement of the ATLAS Muon Small Wheel by the so-called New Small Wheel (NSW). Large-scale Micromegas detectors will serve as tracking detectors in the NSW. Parts of these detectors will be constructed at the Johannes Gutenberg University Mainz (JGU).

In order to fulfill the requirements of the envisioned detector performance, a high precision detector construction is crucial. Especially the surface planarity of the produced detector panels has to better than 30 μm over an area of 2 m^2.

Methods for the quality control of the raw material and the constructed parts have been developed and implemented. This talk gives an overview of the production facility at JGU Mainz which is used during the mass production of NSW components in coming years.

T 28.4 Mo 17:30 VMP6 HS E

Construction and Test of sMDT Chambers for the ATLAS Muon Spectrometer — •Eric Takasugi, Korbinian Schmidt-Sommerfeld, Oliver Kortner, and Hubert Kroha — Max-Planck-Institut für Physik, München

In the ATLAS muon spectrometer, Monitored Drift Tube chambers (MDTs) are used for precise tracking measurements. In order to increase the geometric acceptance and rate capability, new chambers have been designed and are under construction to be installed in ATLAS during the winter shutdown of 2016/17 of the LHC. The new chambers have a drift tube diameter of 15 mm (compared to 30 mm of the other MDTs) and are therefore called sMDT chambers. This presentation reports on the progress of chamber construction and on the results of quality assurance tests.

T 28.5 Mo 17:45 VMP6 HS E

Grossflaechige Mikrogitter für ATLAS Micromegas Detektoren — •Andre Zibell, Raimund Ströhmer und Giovanni Siragusa — Julius-Maximilians-Universität Würzburg

Im Zuge der zweiten langen Wartungspause des LHC Beschleunigers 2019/2020 werden die 'Small Wheel' Myonkammern des ATLAS Detektors unter anderem gegen grossflächige und hochratenfeste Micromegas Detektoren ausgetauscht. Die Gesamtmenge dieser Detektoren ist in vier unterschiedliche Modultypen aufgeteilt, deren Serienproduktion 2016 beginnt.

Eine der Schlüsselkomponenten dieser Detektortechnologie sind vollflächige Edelstahl-Mikrogitter. Am Standort Würzburg werden für einen der vier Modultypen die 128 nötigen, je etwa 3 Quadratmeter grossen Mikrogitter auf Transferrahmen gespannt, und im Anschluss auf die Detektormodule umgeklebt.

Es werden die Entwicklung und der Aufbau der nötigen Infrastruktur vorgestellt, sowie die Ergebnisse der Modul0- und frühen Serienproduktion hinsichtlich Homogenität der mechanischen Spannung, Stabilität, Verfahren und Ausbeute präsentiert. Die von ATLAS vorgegebenen Anforderungen wurden bereits bei den ersten Testgittern erfüllt.

T 28.6 Mo 18:00 VMP6 HS E

Quality Control of a 2 m^2 Micromegas Detector for the ATLAS Muon Spectrometer Upgrade Project Using Contact CCDs — Otmar Biebel[1], Ralf Hertenberger[1], •Jeannine Wagner-Kuhr[1], and Hermann Wellenstein[2] — [1]LMU, Munich, Germany — [2]Brandeis University, Waltham, USA

The inner endcap region of the ATLAS muon spectrometer, the Small Wheel, will be upgraded in 2019 using Micromegas detectors to retain the tracking performance after the LHC luminosity upgrade. In the new Small Wheel Micromegas detectors will be arranged in trapezoidal quadruplets of four active layers each and 2-3 m^2 in size. Guaranteeing the design spatial resolution of 100 μm poses a huge challenge for the mechanical precision of each readout plane and the alignment between the 4 planes. We report about a novel optical alignment tool based on Contact CCDs and coded masks which will be used for the quality control during the construction of the Micromegas detectors. Using pictures of an arbitrary cutout of a coded mask on a readout board taken by a Contact CCD the relative position of the mask with respect to the center of the Contact-CCD can be determined on sub μm accuracy. Together with a calibrated reference device the position of masks within a single plane but also within a quadruplet can be measured with high precision allowing to monitor the relative position of the 3 PowerCircuitBoards within a single plane and the relative alignment between the different planes in a quadruplet. In this presentation the ideas of this new optical alignment tool are shown as well as first quality control studies using a Contact-CCD.

T 28.7 Mo 18:15 VMP6 HS E

Calibration of Large Area Micromegas Using Cosmic Rays — •Philipp Lösel[1], Otmar Biebel[1], Jonathan Bortfeldt[1], Bernhard Flierl[1], Ralf Hertenberger[1], Ralph Müller[1], and Andre Zibell[2] — [1]LMU München, Germany — [2]JMU Würzburg, Germany

The high luminosity upgrade of the LHC storage ring implies an upgrade of the Muon Spectrometer of the ATLAS experiment. The presently installed detectors of the inner end-cap region cannot cope with the increased background situation and will be replaced by Micromegas and sTGC detectors. Before installation at CERN, the 2 m^2 sized Micromegas quadruplets (SM2) built in Germany will be calibrated.

The LMU Cosmic Ray Measurement Facility (CRF) consists of two Monitored Drift Tube chambers (MDT) with an active area of about 9 m^2 for muon tracking and two trigger hodoscopes with sub-ns time-resolution and with additional position information along the wires of the MDTs. With an angular acceptance of -30° to +30° the CRF allows for centroidal or μTPC position determination and thus for calibration in three dimensions. Of particular interest are potential deviations in the micro pattern readout structures or potential deformations of the whole detector.

The Performance of the CRF is presently investigated using a telescope of a 1 m^2 and three 100 cm^2 resistive strip Micromegas. We report on the differences in performance between large and small detectors, report on homogeneity of efficiency and pulse height, and present results on deformation and performance of the 1 m^2 Micromegas.

T 28.8 Mo 18:30 VMP6 HS E

A TPC-like Readout Method for High Precision Muon-Tracking using GEM-Detectors — •Bernhard Flierl[1], Otmar Biebel[1], Jonathan Bortfeldt[1], Ralf Hertenberger[1], Felix Klitzner[1], Phillipp Loesel[1], Ralph Mueller[1], and Andre Zibell[2] — [1]Ludwig-Maximilians-Universität München — [2]Julius-Maximilians-Universität Würzburg

Gaseous electron multiplier (GEM) detectors are well suited for tracking of charged particles. Three dimensional tracking in a single layer can be achieved by application of a time-projection-chamber like readout mode (/*mu*TPC), if the drift time of the electrons is measured and the position dependence of the arrival time is used to calculate the inclination angle of the track. To optimize the tracking capabilities for ion tracks drift gas mixtures with low drift velocity have been investigated by measuring tracks of cosmic muons in a compact setup of four GEM-detectors of 100×100×6 mm^3 active volume each and an angular acceptance of -25 to 25°. The setup consists of three detectors with two-dimensional strip readout layers of 0.4 mm pitch and one detector with a single strip readout layer of 0.25 mm pitch. All strips are readout by APV25 frontend boards and the amplification stage in the detectors consists of three GEM-foils. Tracks are reconstructed by the μTPC-method in one of the detectors and are then compared to the prediction from the other three detectors defined by the center of charge in every detector. We report our study of Argon and Helium based noble gas mixtures with carbon-dioxide as quencher.

T 28.9 Mo 18:45 VMP6 HS E

Optimization of the ATLAS (s)MDT readout electronics for high counting rates — 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. The standard MDT readout electronics uses bipolar shaping which causes a deterioration of signal pulses by preceding background hits, leading to losses in muon efficiency and drift tube spatial resolution. In order to mitigate these so-called signal pile-up effects, new readout electronics with active baseline restoration (BLR) is under development. Discrete prototype electronics with BLR functionality has been tested in laboratory measurements and in the Gamma Irradiation Facility at CERN under high γ-irradiation rates. Results of the measurements will be presented.

T 29: B-Meson Zerfälle

Zeit: Montag 16:45–19:00 Raum: VMP6 HS F

T 29.1 Mo 16:45 VMP6 HS F

Bestimmung der Zerfallsbreite von $B_s^0 \to D_s^- D^+$ mit dem LHCb-Experiment — •Philipp Ibis, Frank Meier, Magarete Schellenberg und Julian Wishahi — Experimentelle Physik 5, TU Dortmund

Im Zerfall $B_s^0 \to D_s^- D^+$ tritt ein $b \to c\bar{c}d$ Übergang auf, zu dem Baum- und Pinguindiagramme beitragen. Seine Zerfallsbreite ist bislang nur mit relativ großer Unsicherheit bekannt und soll durch eine Analyse des LHCb-Datensatzes genauer bestimmt werden. Zur Reduzierung systematischer Unsicherheiten wird die Zerfallsbreite nicht direkt, sondern das Verhältnis der Zerfallsbreiten $\Gamma(B_s^0 \to D_s^- D^+)/\Gamma(B^0 \to D^- D_s^+)$ gemessen. Außerdem handelt es sich bei dem Kanal $B_s^0 \to D_s^- D^+$ um einen flavourspezifischen Zerfall und in einem weiteren Schrit ist es möglicht direkte *CP*-Verletzung zu untersuchen.

In diesem Vortrag wird der aktuelle Stand der Analyse vorgestellt. Sie beruht auf dem Run I Datensatz des LHCb-Experimentes.

T 29.2 Mo 17:00 VMP6 HS F

Messung des Bottom-Quark Produktionswirkungsquerschnitts bei pp Kollisionen bei 7 und 13 TeV mit semileptonischen Zerfällen — Mika Vesterinen, Michel De Cian und •Max Neuner für die LHCb-Kollaboration — Physikalisches Institut, Heidelberg, Baden-Württemberg

Der Bottom-Quark Produktionswirkungsquerschnitt bei pp Kollisionen am LHC bei einer Schwerpunktsenergie von 13 TeV wird mit semileptonischen Zerfällen von B^+, B^0, B_s^0 und Λ_b^0 Teilchen mit dem LHCb Detektor bestimmt und mit dem bei 7 TeV verglichen. Dabei werden die Zerfallshadronen D^0, D^+, D_s^+ und Λ_c^+ sowie ein Myon rekontruiert und der Wirkungsquerschnitt als Funktion der Pseudorapidität η der B Hadronen gemessen. Da die Resultate der Wirkungsqeurschnitte bei den beiden Energien den nahezu gleichen systematischen Fehlern unterliegen, kürzen sich diese bei Bildung des Verhältnisses, was eine präzise Gegenüberstellung mit der theoretischen Verteilung ermöglicht. Ich werde in meinem Vortrag auf die Extraktion der Anzahl der Signalereignisse, die dabei anfallenden Rekonstruktions- und Selektionseffizienzen und die Kontamination durch Untergrundzerfälle eingehen.

T 29.3 Mo 17:15 VMP6 HS F

Messung des Verzweigungsverhältnisses von $\Lambda_b^0 \to \psi(2S)\Lambda^0$ mit dem LHCb-Experiment — •Patrick Mackowiak, Vanessa Müller, Ramon Niet und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Eine kürzlich veröffentlichte Messung der ATLAS-Kollaboration zum relativen Verzweigungsverhältnis $\Gamma(\Lambda_b^0 \to \psi(2S)\Lambda^0)/\Gamma(\Lambda_b^0 \to J/\psi\Lambda^0)$ stellt eine Abweichung zu Theorievorhersagen fest. Dank seiner Spezialisierung auf die Untersuchung von b-Hadronzerfällen kann das LHCb-Experiment eine unabhängige und voraussichtlich präzisere Messung dieser Größe durchführen. In der Analyse erfolgt die Rekonstruktion jeweils über die Zerfälle $\psi(2S)$ bzw. $J/\psi \to \mu^+\mu^-$ und $\Lambda^0 \to p^+\pi^-$. Durch die Normierung auf den Zerfall $\Lambda_b^0 \to J/\psi\Lambda^0$ kürzen sich systematische Unsicherheiten, sowie Unsicherheiten auf Luminosität und Fragmentation aus dem relativen Verzweigungsverhältnis. In diesem Vortrag wird der Stand dieser Analyse mit dem Run I Datensatz des LHCb-Experiments, dessen Größe einer integrierten Luminosität von 3 fb^{-1} entspricht, vorgestellt.

T 29.4 Mo 17:30 VMP6 HS F

Ungetagte Analyse des $B \to \eta\ell\nu$ Zerfalls mit dem Belle-Detektor — •Uwe Gebauer, César Beleño und Ariane Frey — II. Physikalisches Institut, Georg-August-Universität Göttingen, Göttingen

Am Belle-Experiment wurde ein sehr großer Datensatz auf der Υ(4S)-Resonanz aufgenommen, die nahezu vollständig in Paare von B-Mesonen zerfällt. Dies erlaubt die Untersuchung des CKM-unterdrückten Quarkübergangs $b \to u$, wie er auch im semileptonischen Zerfall $B \to \eta\ell\nu$ vorkommt, der in dieser Analyse untersucht wird. Das Zerfallsprodukt η wird in zwei Zerfallskanälen rekonstruiert, $\eta \to \gamma\gamma$ und $\eta \to \pi^+\pi^-\pi^0$. Um eine möglichst hohe Effizienz zu erzielen, wird das zweite B-Meson nicht rekonstruiert. Daraus folgt ein sehr großer Untergrundanteil, zu dessen Reduktion für jeden Kanal spezifische Boosted Decision Trees eingesetzt werden. Anschließend wird durch einen zweidimensionalen Fit von Monte Carlo Datensätzen an die rekonstruierten Ereignisse deren Signalanteil und daraus das Verzweigungsverhältnis bestimmt. Zusätzlich wird mit den rekonstruierten η-Kandidaten versucht, in diese weiterzerfallende η'-Mesonen zu rekonstruieren und eine analoge Analyse durchzuführen.

T 29.5 Mo 17:45 VMP6 HS F

Dalitz-Plot Analyse von $B^- \to D^+\pi^-\pi^-$ mit dem vollen Belle Datensatz — •Simon Kohl, Michael Feindt, Pablo Goldenzweig, Martin Heck und Manuel Heider — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie

Die Dalitz-Plot Analysetechnik ermöglicht es resonante Drei-Körper-Zerfälle auf ihre Resonanzstruktur hin zu untersuchen und so simultan die Zerfallsbreiten und die Massen der resonanten Zustände sowie die Verzweigungsverhältnisse der Zerfälle via diesen Resonanzen zu messen.

Im Kanal $B^- \to D^+\pi^-\pi^-$ besteht neben dem direkten Zerfall die Möglichkeit eines D-Wellen-Zerfalls der D_2^{*0}-Resonanz sowie eines S-

Wellen-Zerfalls der D_0^{*0}-Resonanz. Die beiden B-Fabriken BaBar und Belle haben den Zerfallskanal mittels dieser Technik untersucht. Noch unveröffentlichte Belle Ergebnisse in einem anderen Kanal weisen insbesondere hinsichtlich der Masse des D_0^{*0} Spannung im Vergleich mit den beiden zuvor genannten Messungen auf. Da die Belle Messung lediglich ungefähr die Hälfte des vollen Datensatzes von 772 Millionen $B\bar{B}$-Mesonenpaaren verwendet hat, kann eine neue Analyse mit dem vollen Datensatz eine präzisere Antwort geben.

Dieser Vortrag stellt die Dalitz-Plot Technik im Rahmen des untersuchten Zerfalls vor und präsentiert die aktuelle Ergebnislage der Analyse.

T 29.6 Mo 18:00 VMP6 HS F

Analyse des Zerfalls $\overline{B}^0 \to D^0 p\overline{p}$ bei LHCb — •Miriam Hess — Universität Rostock, Rostock, Deutschland

B-Mesonen eignen sich für die Untersuchung baryonischer Zerfälle, da sie aufgrund ihrer hohen Masse in eine Vielzahl baryonischer Endzustände zerfallen können. Zum Verständnis der Baryonen und deren Entstehung aus Mesonen sind experimentelle Messungen notwendig, durch die phänomenologische Modelle zur Beschreibung der Produktionsmechanismen von Baryonen entwickelt werden können, da diese nicht durch störungstheoretische Modelle beschrieben werden können.

Der Zerfall $\overline{B}^0 \to D^0 p\overline{p}$ mit $D^0 \to K^-\pi^+$ wurde bereits von den B-Fabriken BaBar und Belle beobachtet. Mit den Daten des LHCb Experiments ist mit ausreichender Statistik eine Analyse der Dalitz-Ebene möglich. In der invarianten Proton-Antiproton Massenverteilung wird eine Anreicherung an der unteren Massenschwelle erwartet, das sogenannte „Threshold Enhancement". Dieses ist auch schon bei anderen B-Zerfällen mit Baryon-Antibaryon Paar im Endzustand beobachtet worden. Das Ergebnis der B-Fabriken lässt mögliche Resonanzen in der D^0p-Massenverteilung vermuten. Daher sollen hier die vorläufigen Ergebnisse des LHCb-Experiments der Dalitz-Analyse des Zerfalls $\overline{B}^0 \to D^0 p\overline{p}$ vorgestellt werden.

T 29.7 Mo 18:15 VMP6 HS F

Search for exclusive charmless semileptonic decays of $B \to \pi\pi\ell\nu$ with the Belle detector — •Cesar Beleno and Ariane Frey for the Belle-Collaboration — II. Physikalisches Institut, Goettingen University, Germany

Semileptonic decays of B mesons are the most suitable way to measure the magnitude of CKM matrix elements such as $|V_{ub}|$ and $|V_{cb}|$. One technique for extracting these quantities is using an exclusive analysis in which a particular channel is reconstructed. For instance, for the study of V_{ub} just about 25% of the exclusive decay channels for charmless semileptonic decays of B mesons have been measured. Currently, the most precise measurement of $|V_{ub}|$ comes from the exclusive channel $B \to \pi\ell\nu$. However, the dominant systematic errors for this measurement stem from uncertainties in the knowledge of branching fractions and form factors of other charmless semileptonic B decays. In this analysis, we perform a spectroscopy study of semileptonic decays with the final state meson decaying into two pions. We implement a boosted decision tree method to reduce the contributions of background using the complete data set collected by the Belle detector.

T 29.8 Mo 18:30 VMP6 HS F

Messung des Parameters $\Delta\Gamma_d$ im B^0-System mit dem LHCb-Experiment — Francesca Dordei[1], Florian Kruse[2], •Titus Mombächer[2], Vanessa Müller[2], Ramon Niet[2] und Julian Wishahi[2] — [1]CERN — [2]Experimentelle Physik 5, TU Dortmund

Die Theorievorhersage für den Zerfallsbreitenunterschied $\Delta\Gamma_d$ zwischen dem schweren und dem leichten Masseneigenzustand der B^0-Mesonen beträgt $\left(26{,}7^{+5,8}_{-6,5}\right) \cdot 10^{-4}\,\mathrm{ps}^{-1}$. Die experimentellen Unsicherheiten sind jedoch um 2 Größenordnungen größer. Zur genaueren Bestimmung dieses Parameters ist das LHCb-Experiment besonders geeignet, da es aktuell den weltgrößten Datensatz an B^0-Mesonenzerfällen mit einer sehr guten Zeitauflösung von $50 - 60\,\mathrm{fs}$ stellt. Aus dem Unterschied der Zerfallszeitverteilungen von Zerfällen in flavourspezifische Endzustände und Zerfällen in CP-Eigenzustände lässt sich $\Delta\Gamma_d$ ermitteln. Um systematische Effekte zu reduzieren werden die topologisch ähnlichen Kanäle $B^0 \to J/\psi K^0_S$ und $B^0 \to J/\psi K^{*0}$ untersucht. Diese wurden bei LHCb bereits im Rahmen von Lebensdauermessungen und Messungen von CP-Verletzung studiert. In diesem Vortrag wird der Stand der Messung, welche mithilfe des vollen Run I Datensatzes des LHCb-Experiments durchgeführt wird, vorgestellt.

T 29.9 Mo 18:45 VMP6 HS F

Messung von $|V_{ub}|$ am LHCb Experiment — •Michael Kolpin, Mika Vesterinen, Svende Braun und Michel de Cian für die LHCb-Kollaboration — Physikalisches Institut, Universität Heidelberg

Im Standardmodell der Teilchenphysik beschreibt das CKM-Matrix-Element V_{ub} die Kopplung zwischen b- und u-Quark aufgrund des geladenen Stroms. Es ist das am wenigsten präzise vermessene Element der CKM-Matrix und ist eine bedeutende Richtgröße für die Vorhersage vieler Standarmodellprozesse. Desweiteren besteht eine signifikante Diskrepanz zwischen Messungen des Betrages $|V_{ub}|$ mit exklusiven im Vergleich zu inklusiven Zerfällen.
Die Analyse von semileptonische Zerfällen von B-Mesonen erlaubt durch deren Häufigkeit eine hohe statistische Präzision, stellt aber aufgrund des nicht rekonstruierbaren Neutrinos eine besondere experimentelle Herausforderung dar. Dieser Vortrag behandelt die Messung von $|V_{ub}|$ am LHCb Experiment mit exklusiven semileptonischen B-Meson Zerfällen.

T 30: Halbleiterdetektoren II (Pixel)

Zeit: Montag 16:45–19:00 Raum: VMP8 HS

T 30.1 Mo 16:45 VMP8 HS

ATLAS Pixel Teststrahlrekonstruktion und Analyse — •Tobias Bisanz, Jörn Grosse-Knetter, Arnulf Quadt und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Für die Entwicklung neuer Pixelsensoren und Auslesesysteme spielen Teststrahlmessungen eine wichtige Rolle. Mit ihrer Hilfe lassen sich Studien zur Charakterisierung neuer Sensoren und Auslesechips durchführen. Unter anderem können Ineffizienzstudien durchgeführt oder Ladungssammlungseigenschaften untersucht werden. Dafür ist es notwendig, dass Teilchenspuren im Testaufbau korrekt rekonstruiert werden. Um dies auch für neuartige Sensoren zu gewährleisten, wurde das ATLAS Pixel Teststrahl Rekonstruktions- und Analyseframework um einige Funktionalität erweitert. Änderungen werden zusammen mit einem Ausblick auf zukünftige Entwicklungen vorgestellt.

T 30.2 Mo 17:00 VMP8 HS

TID-dependent current measurements of IBL readout chips — •Karola Dette for the ATLAS Pixel-Collaboration — TU Dortmund, Experimentelle Physik IV — CERN, Schweiz

The ATLAS detector consists of several subsystems with a hybrid pixel detector as the innermost component of the tracking system. The pixel detector has been composed of three layers of silicon sensor assemblies during the first data taking run of the LHC and has been upgraded with a new 4th layer, the so-called Insertable B-Layer (IBL), in summer 2014. Each silicon sensor of the IBL is connected to a Front End readout chip (FE-I4) via bump bonds. During the first year of data taking an increase of the LV current produced by the readout chips was observed. This increase could be traced back to radiation damage inside the silicon. The dependence of the current on the Total Ionizing Dose (TID) and temperature has been tested with X-ray irradiations and will be presented in this talk.

T 30.3 Mo 17:15 VMP8 HS

Planare n^+-in-n Quadmodule für das ITk-Upgrade des ATLAS-Experiments — Silke Altenheiner[1], Karola Dette[1,2], Sascha Dungs[1], •Andreas Gisen[1], Claus Gössling[1], Reiner Klingenberg[1], Kevin Kröninger[1], Jonas Lönker[1], André Schorlemmer[1] und Felix Wizemann[1] — [1]TU Dortmund, Experimentelle Physik IV — [2]CERN

Der innerste Spurdetektor des ATLAS-Experiments besteht aus planaren Pixelsensoren aus n^+-in-n-Silizium. Für den High Luminosity LHC (HL-LHC) wird ein neuer Spurdetektor geplant, der sogenannte Inner Tracker (ITk). In dessen Pixeldetektor sind Vierchip- bzw. Quadmodu-

le vorgesehen. Diese bestehen aus einem Siliziumsensor, der zusammen mit vier Auslesechips eine Einheit bildet.

Erste Prototypen planarer n^+-in-n Quadmodule wurden im Labor und im Testbeam charakterisiert.

T 30.4 Mo 17:30 VMP8 HS

Charakterisierung von Pixelmodulen für den CMS Phase 1 Pixeldetektor — Lutz Feld, Katja Klein, •Martin Lipinski, Samuel Möller, Frederic Stepp und Michael Wlochal — 1. Physikalisches Institut B, RWTH Aachen University

Für das CMS Experiment wird ein neuer Pixeldetektor gebaut, der voraussichtlich gegen Anfang des Jahres 2017 installiert werden wird. Dieser besitzt eine zusätzliche vierte Lage und bietet außerdem die Möglichkeit, bei wesentlich höheren Teilchenflüssen noch effizient Daten nehmen zu können. Vor dem Zusammenbau des Detektors wird jedes Pixelmodul auf seine Funktion überprüft, um dessen Qualität sicherzustellen. Während der Serienproduktion werden deshalb 350 Module an der RWTH Aachen qualifiziert.

Dieser Vortrag stellt die beiden dafür verwendeten Teststände und Testprozeduren vor. In einem Aufbau durchlaufen die Module eine Reihe von elektrischen Tests und werden thermisch zykliert. In einem Röntgenteststand werden sie außerdem energiekalibriert und Hochratentests unterzogen. Die Ergebnisse der Charakterisierung von mehr als 150 bereits produzierten Modulen werden dargestellt.

T 30.5 Mo 17:45 VMP8 HS

Qualitätskontrolle der Modulproduktion für das Phase I Upgrade des CMS-Pixeldetektors — Tobias Barvich[1], Michele Caselle[2], Benedikt Freund[1], Stefan Heindl[1], Ulrich Husemann[1], Simon Kudella[1], Hans Simonis[1], Pia Steck[1], •Yavuz Taşkirdi[1], Marc Weber[2], Anita Weddigen[1] und Thomas Weiler[1] — [1]Institut für Experimentelle Kernphysik (EKP), KIT — [2]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

Im Zuge des letzten LHC-Upgrades wurde die Kollisionsenergie der Protonen auf 13 TeV gesteigert. Stufenweise wird die instantane Luminosität die doppelte Designluminosität erreichen. Ziel ist es die sich ergebenden Datenmengen bei gleichbleibender Menge an Datenleitungen ohne Informationsverluste zu erfassen. Um dies zu gewährleisten, wird der zukünftige CMS-Pixeldetektor mit einer vierten Lage und einem neuen Auslesechip ausgestattet, welcher über größere Speicher verfügt und eine digitale Codierung verwendet um die steigenden Datenmengen zu bewältigen. Die Hälfte der notwendigen Pixeldetektormodule für die vierte Lage wird am KIT gefertigt. Dieser Vortrag befasst sich mit Funktionalitätstest der am KIT gefertigten Module. Es werden die Ergebnisse der elektrischen Qualifikation und von Messungen mit Röntgenstrahlung vorgestellt. Unter anderem werden die Qualität der Bumpbondverbindungen, das Rauschen und die Ansprechschwelle der Auslesechips gezeigt.

T 30.6 Mo 18:00 VMP8 HS

Bumpbonding-Verbindungstechnologien für das CMS Phase I Upgrade und die Forschung und Entwicklung neuer Detektoren — Tobias Barvich[1], Thomas Blank[2], Michele Caselle[2], Fabio Colombo[1], Benedikt Freund[1], Stefan Heindl[1], Ulrich Husemann[1], •Simon Kudella[1], Hans Jürgen Simonis[1], Pia Steck[1], Marc Weber[2] und Thomas Weiler[1] — [1]Institut für Experimentelle Kernphysik (IEKP), KIT — [2]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

Die Konsolidierung des LHCs (13 TeV Kollisionsenergie) und die geplanten Erhöhung der instantanen Luminosität auf $2 \cdot 10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$ stellen erhöhte Anforderungen an den CMS-Siliziumspurdetektor und machen ein Upgrade und einen Austausch des CMS-Pixeldetektors zum Jahresende 2016 notwendig. Als eines von fünf Produktionszentren für den neuen Pixeldetektor des CMS-Phase-I-Upgrades produziert das KIT 50 % der für die vierte Lage des Barrelbereichs benötigten Pixelmodule. Zentraler Bestandteil ist der Bumpbonding-Prozess, der für diese Produktion am KIT entwickelt wurde und hier vorgestellt und evaluiert wird. Parallel zur Produktion für das Phase-I-Upgrade beteiligt sich das KIT an der Detektorentwicklung für das CMS-Phase-II-Upgrade und stellt mit seinem Goldstud-Bumpbonding-Prozess eine schnelle, günstige und flexible Bumpbonding-Verbindungstechnologie für die Entwicklung von Pixel- und Makropixeldetektoren. Auch dieser Prozess wird hier vorgestellt und evaluiert.

T 30.7 Mo 18:15 VMP8 HS

Untersuchung des Potentials der 180nm TowerJazz Technologie für den ATLAS Spurdetektor — Malte Backhaus[1], Heinz Pernegger[1], •Christian Riegel[1,2] und Wolfgang Wagner[2] — [1]CERN — [2]Bergische Universität Wuppertal

Zentraler Bestandteil des geplanten ATLAS-Detektor-Upgrades im Rahmen der Hochluminositätsphase des LHC ist ein neuer innerer Spurdetektor. Neben den Möglichkeiten, die der Betrieb bei Rekordluminositaeten bietet, steigen auch die Anforderungen an den Pixeldetektor in Bezug auf Teilchenrate und Strahlenhärte. Teil der Bemühungen sind auch die Erforschung von CMOS Silizium Sensor Technologien. Ein Ansatz geht in die Richtung von monolithischen Pixelsensoren. Dieser Vortrag präsentiert die laufenden Messungen an einem Forschungschip, der im 180 nm TowerJazz-Prozess hergestellt ist. Der Sensor ist ausgestattet mit verschiedenen Pixelgrößen und Elektrodengeometrien. Auf diese Weise bietet er eine perfekte Grundlage, um das Potential der Technologie für den ATLAS Inner Tracker zu untersuchen.

T 30.8 Mo 18:30 VMP8 HS

Entwicklung und Test eines Kontroll-Chips für den ATLAS Pixeldetektor — •Niklaus Lehmann, Christian Zeitnitz und Susanne Kersten — Bergische Universität Wuppertal

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. Dieser neue Pixeldetektor benötigt zum sicheren Betrieb ein völlig neues Detektor-Kontroll-System (DCS), welches zur Zeit unter anderem an der Bergischen Universität Wuppertal entwickelt wird. Um die Materialkosten zu minimieren ist eine serielle Speisung für die Pixelmodule vorgesehen. Ein ASIC ist vorgesehen, welcher parallel zu jedem Modul in der Kette eingebaut wird. Zusammen mit anderen Parametern wie Temperatur überwacht dieser DCS Chip die Modulspannung und kann bei Bedarf das Modul überbrücken und dadurch ausschalten. Ein Prototyp für diesen Chip wurde realisiert. In diesem Vortrag werden Ergebnisse der Tests und die nächsten Schritte in der Entwicklung präsentiert.

T 30.9 Mo 18:45 VMP8 HS

Chip Development in 65nm CMOS Technology for the High Luminosity Upgrade of the ATLAS Pixel Detector — Leonard Germic, Tomasz Hemperek, Tetsuichi Kishishita, Hans Krüger, •Piotr Rymaszewski, and Norbert Wermes — University of Bonn, Bonn, Germany

The LHC High Luminosity upgrade will result in a significant change of environment in which particle detectors are going to operate, especially for devices very close to the interaction point like pixel detector electronics. Challenges arising from the increased hit rate will have to be solved by designing faster and more complex readout electronics that will also have to withstand unprecedented radiation doses. Developing such integrated circuit requires a significant R&D effort and resources, therefore a joint development project between several institutes (including ours) was started. This collaboration, named RD53, aims to develop a pixel readout chip suitable for ATLAS' and CMS' upgrades using a 65nm CMOS technology. During this presentation motivations and benefits of using this very deep-submicron technology will be discussed. Most of the talk will be allocated to presenting some of the circuits designed by our group (focusing on developments connected to RD53 collaboration), along with their performance measurement results.

T 31: Elektroschwache Wechselwirkung und BSM (Theorie)

Zeit: Montag 16:45–18:35 Raum: VMP8 SR 105

Gruppenbericht T 31.1 Mo 16:45 VMP8 SR 105

NLO QCD Corrections to Higgs Pair Production including Dimension-6 Operators — Ramona Gröber[1], Margarete Mühlleitner[2], Michael Spira[3], and •Juraj Streicher[2] — [1]INFN - Sezione di Roma Tre, Roma, Italy — [2]Karlsruher Institut für Technologie - Institut für Theoretische Physik, Karlsruhe, Germany — [3]Paul Scherrer Institut, Villigen, Switzerland

The role of the Higgs boson has developed from the long-sought particle into a tool for exploring beyond Standard Model (BSM) physics. While the Higgs boson signal strengths are close to the values predicted in the Standard Model (SM), the trilinear Higgs-selfcoupling can still deviate significantly from the SM expectations in some BSM scenarios. The Effective Field Theory (EFT) framework provides a way to describe these deviations in a rather model independent way, by including higher-dimensional operators which modify the Higgs boson couplings and induce novel couplings not present in the SM.

The trilinear Higgs-selfcoupling is accessible in Higgs pair production, for which the gluon fusion is the dominant production channel. The next-to-leading (NLO) QCD corrections to this process are important for a proper prediction of the cross section and are known in the limit of heavy top quark masses. In our work, we provide the NLO QCD corrections in the large top quark mass limit to Higgs pair production including dimension-6 operators. The various higher-dimensional contributions are affected differently by the QCD corrections, leading to deviations in the relative NLO QCD corrections of several per-cent, while modifying the cross section by up to an order of magnitude.

T 31.2 Mo 17:05 VMP8 SR 105

Implementation dimension-6 operators into WHIZARD — •So Young Shim and Juergen Reuter — Notkestrasse 85, DESY, Hamburg, Germany

To test physics beyond the Standard Model (SM) at the LHC in a model-independent way, we studied an Effective Field Theory (EFT) consisting of the SM with additional dimension-6 operators. Using a special basis for the operators, the GIMR basis, we implemented the complete set of dim-6 operators into the Monte Carlo Event Generator WHIZARD. Focusing on electroweak boson observables, we show preliminary results for LHC Run II at 13 TeV.

T 31.3 Mo 17:20 VMP8 SR 105

Vector Boson Scattering at CLIC — Wolfgang Kilian[1], Juergen Reuter[2], Marco Sekulla[3], and •Christian Fleper[1] — [1]Department Physik, Universitaet Siegen, 57068 Siegen, Deutschland — [2]DESY Theory Group, 22603 Hamburg, Deutschland — [3]Institut für Theoretische Physik, Karlsruher Institut für Technologie, 76131 Karlsruhe, Deutschland

Linear colliders operating in a range of multiple TeV are able to investigate the details of vector boson scattering and electroweak symmetry breaking.
We calculate cross sections with the Monte Carlo generator WHIZARD for vector boson scattering processes at the future linear e^+e^- collider CLIC. By finding suitable cuts, the vector boson scattering signal processes are isolated from the background. Finally, we are able to determine exclusion sensitivities on the non-Standard Model parameters of the relevant dimension eight operators.

T 31.4 Mo 17:35 VMP8 SR 105

Anomalous couplings in WZ production beyond NLO QCD — Francisco Campanario[1], •Robin Roth[1], Sebastian Sapeta[2], and Dieter Zeppenfeld[1] — [1]Institute for Theoretical Physics, KIT, Karlsruhe, Germany — [2]CERN PH-TH, Geneva, Switzerland

We study WZ production with anomalous couplings (AC) at $\bar{n}$NLO QCD using the LoopSim method in combination with the Monte Carlo program VBFNLO. Higher order corrections to WZ production are dominated by additional hard jet radiation. Those contributions are insensitive to AC and should thus be suppressed in analyses. We do this using a dynamical jet veto based on the transverse energy of the QCD and EW final state particles. This removes jet dominated events without introducing problematic logs like a fixed p_T jet veto.

T 31.5 Mo 17:50 VMP8 SR 105

Resonances at the LHC beyond the Higgs: The Scalar/Tensor Case — Wolfgang Kilian[1], Thorsten Ohl[2], Jürgen Reuter[3], and •Marco Sekulla[4] — [1]Department of Physics, University of Siegen, Germany — [2]Faculty of Physics and Astronomy, Würzburg University, Germany — [3]DESY Theory Group, Hamburg, Germany — [4]Institute for Theoretical Physics, Karlsruhe Institute of Technology, Germany

Weak vector boson scattering (VBS) at high energies will be one of the key measurements in current and upcoming LHC runs. It is most sensitive to any new physics associated with electroweak symmetry breaking. However, a conventional EFT analysis will fail at high energies.

In this talk I present an extension of the bottom-up EFT, which includes the 125 GeV Higgs boson. Within a simplified model the effects of generic tensor and scalar resonances are considered. The spurious degrees of freedom of tensor resonances that would lead to bad high-energy behavior are treated using a gen- eralization of the Stueckelberg formalism. To ensure that the scattering amplitudes are well behaved on the whole phase space, the T-matrix unitarization procedure is used.

The implementation of this model into the Monte Carlo generator WHIZARD can be used for further studies at the LHC as I will show with exemplary plots.

T 31.6 Mo 18:05 VMP8 SR 105

Automation of electroweak NLO corrections in general models — •Jean-Nicolas Lang — Universität Würzburg

I discuss the automation of generation of scattering amplitudes in general quantum field theories at next-to-leading order in perturbation theory. The work is based on Recola, a highly efficient one-loop amplitude generator for the Standard Model, which I have extended so that it can deal with general quantum field theories. Internally, Recola computes off-shell currents and for new models new rules for off-shell currents emerge which are derived from the Feynman rules. My work relies on the UFO format which can be obtained by a suited model builder, e.g. FeynRules. I have developed tools to derive the necessary counterterm structures and to perform the renormalization within Recola in an automated way. I will describe the procedure using the example of the two-Higgs-doublet model.

T 31.7 Mo 18:20 VMP8 SR 105

Nonlinear neutrino-photon interactions inside strong laser pulses — •Sebastian Meuren, Christoph H. Keitel, and Antonino Di Piazza — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg

As different neutrino mass eigenstates exist, only the lightest neutrino is absolutely stable. However, due to the small phase space and the GIM suppression mechanism the radiative neutrino lifetime is much larger than the age of the universe [1]. Interestingly, the photon-emission probability by a neutrino is drastically increased in the presence of an external background field [2]. Therefore, it is natural to ask the question whether this so-called "electromagnetic catalysis" could be studied in an laboratory experiment using existing and upcoming laser facilities [3]. To shed light on this question, we derive the vector-axialvector coupling tensor in the presence of an arbitrary plane-wave background field [4], which is needed for the calculation of the radiative neutrino decay. Furthermore, we study the Adler-Bell-Jackiw anomaly associated with this object in detail.

[1] P.B. Pal and L. Wolfenstein, Phys. Rev. D **25**, 766 (1982)
[2] A.A. Gvozdev et al., Phys. Lett. B **313**, 161 (1993)
[3] Di Piazza et al., Rev. Mod. Phys. **84**, 1177 (2012)
[4] S. Meuren, C. H. Keitel and A. Di Piazza, JHEP **6**, 127 (2015)

T 32: Flavourphysik (Theorie)

Zeit: Montag 16:45–19:00 Raum: VMP8 SR 106

T 32.1 Mo 16:45 VMP8 SR 106

Explaining $R_{D^{(*)}}$ with leptoquarks and flavor symmetries — •Kay Schönwald — TU Dortmund

Recently LHCb confirmed the anomalies in $R_{D^{(*)}}$ previously measured by BaBar and Belle. We use flavor symmetries capable of explaining the observed mixing in the quark and lepton sector to constrain leptoquark couplings and study whether this models can explain the anomalies in $R_{D^{(*)}}$.

T 32.2 Mo 17:00 VMP8 SR 106

precise predictions for inclusive semi-tauonic B decay rate — Thomas Mannel and •Farnoush Shahriaran — University of Siegen

We get Standard Model prediction for the decay rate of $B \to X_c \tau \nu$ transitions. The triple differential decay rate has been derived including the nonperturbative corrections of order Λ^3_{QCD}/m_b^3 and the leading $\mathcal{O}(\alpha_s)$ corrections.
The total decay width is obtained by numerical integration with an estimated uncertainty of rouphly 5%. We cmpare our result to the sum of the rates of the exclusive $B \to D\tau\nu$, $B \to D^*\tau\nu$ and $B \to D^{**}\tau\nu$ decays.

T 32.3 Mo 17:15 VMP8 SR 106

Impact of leptonic tau decays on the distribution of $\bar{B} \to D\mu\bar{\nu}$ — •Marzia Bordone, Gino Isidori, and Danny van Dyk — Physik-Institut, Universität Zürich, Winterthurer Strasse 190, 8057 Zürich, Schweiz

We present results for the decay rate of $\bar{B} \to D\tau(\to \mu\bar{\nu}\nu)\bar{\nu}$, which is a sizeable background to $\bar{B} \to D\mu\bar{\nu}$ decays. In particular, we calculate analytically the differential decay rate with respect to all seven kinematic variables. We consider the impact of this decay on the distributions of $\bar{B} \to D\mu\bar{\nu}$ in either the muon helicity angle or the muon energy in the $\bar{B}$ rest frame. Our numerical results are obtained from Monte Carlo pseudo events. Finally, we provide necessary information for cross checks of the experimental analyses.

T 32.4 Mo 17:30 VMP8 SR 106

The impact of $\Lambda_b \to \Lambda \ell^+\ell^-$ in global fits of rare $b \to s\ell^+\ell^-$ decays — Stefan Meinel[1,2] and •Danny van Dyk[3] — [1]University of Arizona, Tucson (AZ), USA — [2]RIKEN BNL Research Center, Upton (NY), USA — [3]Universität Zürich, Zürich, Switzerland

We carry out a global fit of the Wilson coefficients C_7, C_9 and C_{10} based on the most recent experimental results on exclusive and inclusive rare $b \to s\gamma$ and $b \to s\ell^+\ell^-$ decays. We specifically investigate the impact of the decay $\Lambda_b \to \Lambda(\to p\pi^-)\ell^+\ell^-$. Updates of the $\Lambda_b \to \Lambda$ form factors from lattice QCD reduce the theoretical uncertainties for this channel.

T 32.5 Mo 17:45 VMP8 SR 106

Higher-Twist Effects in the $B \to \pi$ Transition Form Factor from QCD Light-Cone Sum Rules — Alexander Khodjamirian and •Aleksey Rusov — Universität Siegen Fakultät IV/Department Physik Theoretische Physik 1 Walter-Flex-Straße 3 57068 Siegen

I will report on the progress in calculating new higher-twist corrections to the QCD light-cone sum rule for the $B \to \pi$ transition form factor. First, the expansion of the massive heavy-quark propagator in the external gluonic field near the light-cone was extended to include new terms containing the gluon-field strength derivatives. The resulting analytical expressions for the twist-5 and twist-6 contributions to the correlation function were obtained in a factorized approximation, expressed via the product of the quark-condensate density and the lower-twist pion distribution amplitudes. The numerical analysis of new higher-twist effects is in progress.

T 32.6 Mo 18:00 VMP8 SR 106

Relating masses and mixing angles: a model-independent model — •Wolfgang Gregor Hollik[1] and Ulises Jesus Saldana-Salazar[2] — [1]DESY, Hamburg — [2]CINVESTAV, Mexico

In general, mixing angles and fermion masses are seen to be independent parameters of the Standard Model. However, exploiting the observed hierarchy in the masses, it is viable to construct the mixing matrices for both quarks and leptons in terms of the corresponding mass ratios only. A closer view on the symmetry properties leads to potential realizations of that approach in extensions of the Standard Model. We discuss the application in the context of flavored multi-Higgs models.

T 32.7 Mo 18:15 VMP8 SR 106

Corrections to the Bag Factor in B-$\bar{B}$-Mixing — Andrey G. Grozin[1], •Rebecca Klein[2], Thomas Mannel[2], and Alexei A. Pivovarov[2] — [1]BINP, Novosibirsk — [2]Universität Siegen

B-$\bar{B}$-Mixing is parameterized by the matrix elements of local operators O_i. For the computation of these matrix elements a bag factor B_i can be introduced $\langle \bar{B}|\mathcal{O}_i|B\rangle = B_i \langle \bar{B}|\mathcal{O}_i|B\rangle^{fac}$, which is unity in naive factorization. Any deviation from unity describes the accuracy of the naive factorization prescription. Corrections to B_i emerge from QCD radiative corrections and from nonperturbative contributions at order $1/m_b$. We present the current status of these corrections to B_i.

T 32.8 Mo 18:30 VMP8 SR 106

Precise predictions for CP asymmetries in B decays — •Ulrich Nierste and Philipp Frings — Institut für Theoretische Teilchenphysik, KIT, Karlsruhe

The extraction of fundamental CP phases from B_d or B_s decays to charmonium is affected by penguin contributions. We show how these contributions can be calculated with dynamical QCD-based methods and present our predictions for a variety of decay modes and briefly discuss branching ratios in $B \to DD$ decays.

T 32.9 Mo 18:45 VMP8 SR 106

Standard Model Wilson coefficients for $c \to u\ell^+\ell^-$ transitions at next-to-leading order — Stefan de Boer[1], •Bastian Müller[2], and Dirk Seidel[3] — [1]TU Dortmund — [2]Uni Siegen — [3]Uni Siegen

The standard theoretical framework to deal with exclusive, weak decays of heavy mesons is the so-called weak effective Hamiltonian. It involves the short-distance Wilson coefficients, which depend on the renormalization scale μ. For specific calculations one has to evolve the Wilson coefficients down from the electroweak scale μ_W to the typical mass scale of the decay under consideration. This is done by solving a renormalization group equation for the effective operator basis.

In this talk the results of a consistent two-step running of the $c \to u\ell^+\ell^-$ Wilson coefficients are presented. This running involves the intermediate scale μ_b (with $\mu_W > \mu_b > \mu_c$) where the bottom quark is integrated out. All the matching coefficients and anomalous dimensions are taken to the required order by generalizing and extending results from $b \to s$ or $s \to d$ transitions available in the literature.

T 33: Detektorsysteme I

Zeit: Montag 16:45–19:05 Raum: VMP8 SR 205

Gruppenbericht T 33.1 Mo 16:45 VMP8 SR 205

Run II Performance of Luminosity and Beam Condition Monitors at CMS — •Jessica Lynn Leonard — DESY, Hamburg, Germany

The BRIL (Beam Radiation Instrumentation and Luminosity) system of CMS consists of instrumentation to measure the luminosity online and offline, and to monitor the LHC beam conditions inside CMS. An accurate luminosity measurement is essential to the CMS physics program, and measurement of the beam background is necessary to ensure safe operation of CMS. Many of the BRIL subsystems have been upgraded and others have been added for LHC Run II to complement the existing measurements.

The beam condition monitor (BCM) consists of several sets of diamond sensors used to measure online luminosity and beam background with a single-bunch-crossing resolution. The BCM also detects when beam conditions become unfavorable for CMS running and may trigger a beam abort to protect the detector. The beam halo monitor (BHM) uses quartz bars to measure the background of the incoming beams at larger radii. The pixel luminosity telescope (PLT) consists of telescopes of silicon sensors designed to provide a CMS online and offline luminosity measurement. In addition, the forward hadronic calorimeter (HF) delivers an independent luminosity measurement, making the whole system robust and allowing for cross-checks of the systematics.

An overview of the performance during 2015 LHC running for the new/updated BRIL subsystems will be given, including the uncertainties of the luminosity measurements.

T 33.2 Mo 17:05 VMP8 SR 205

Analyse von Teststrahldaten von ATLAS DBM pCVD-Modulen — Fabian Hügging, •Jens Janssen und Norbert Wermes — Physikalisches Institut, Universität Bonn

Der Diamond Beam Monitor (DBM) ist ein Luminositäsmonitor für den ATLAS Detektor, der im Zuge eines Upgrades des ATLAS Pixeldetektors im Jahr 2013 eingebaut wurde. Hauptbestandteil des DBM ist der FE-I4B Pixel-Auslesechip, dessen strahlenharte Ausleseelektronik für die B-Lage des ATLAS Pixeldetektors entwickelt worden ist. Der Auslesechip ist für hohe Ausleseraten bei gleichzeitig hohen Teilchenspurdichten geeignet. 18 der 24 Auslesechips des DBM wurden mit etwa 21 mm×18 mm großen und 500 μm dicken polykristallinen Diamant-Sensoren (pCVD) bestückt. Die Module wurden in etwa 1 m Entfernung vom Wechselwirkungspunkt als 3-lagige Strahlenteleskope um das Strahlrohr angeordnet. Der DBM soll als Ergänzung bestehender Luminositätsmonitore dienen und findet zusätzlich Verwendung als Tracker für die Untersuchung von Halo- und Kollisionspartikeln. In dem Vortrag werden Teststrahldaten, die am SPS aufgenommen worden sind und mehrere pCVD-Module umfassen, vorgestellt.

T 33.3 Mo 17:20 VMP8 SR 205

Testbeam Results of the Upgraded Fast Beam Condition Monitor at CMS — •Maria Hempel[1,2], Konstantin Afanaciev[7], Piotr Burtowy[4], Hans Henschel[2], Olena Karacheban[1,2], Wolfgang Lange[2], Jessica Lynn Leonard[2], Itamar Levy[5], Wolfgang Lohmann[1,2], Dominik Przyborowksi[6], Vladimir Ryjov[4], Sergey Schuwalow[3], Roberval Walsh[3], and Agnieszka Zagozdzinska[4] — [1]BTU, Cottbus, Germany — [2]DESY, Zeuthen, Germany — [3]DESY, Hamburg, Germany — [4]CERN, Geneva, Switzerland — [5]Tel Aviv University,Tel Aviv, Israel — [6]AGH-UST, Cracow, Poland — [7]NCPHEP, Minsk, Belarus

The Fast Beam Condition Monitor BCM1F at CMS is based on single-crystal diamond sensor with nanosecond time resolution. BCM1F delivered luminosity and machine induced background information to the CMS and LHC control room during the first running period of the LHC. A major upgrade to BCM1F was developed and built during the long shutdown of the LHC in 2014. The increased rate and the 25ns spacing should be handled with sensors subdivided by a double pad metallization and a faster new front-end ASIC. A prototype with these new components was investigated in the testbeam at DESY-II. The results are presented and also verified by Superfish simulations.

T 33.4 Mo 17:35 VMP8 SR 205

A new luminometer and beam conditions monitor for the CMS experiment. — •Olena Karacheban[1,2], Anne Dabrowski[3], Hans Henschel[2], Maria Hempel[1,2], Wolfgang Lange[2], Jessica Leonard[4], Itamar Levy[5], Wolfgang Lohmann[1,6], Dominik Przyborowski[7], Vladimir Ryjov[3], Sergej Schuwalow[2,4], David Stickland[3], Roberval Walsh[4], and Agnieszka Zagozdzinska[3] — [1]Brandenburg University of Technology, Cottbus — [2]DESY-Zeuthen, Germany — [3]CERN, Geneva, Switzerland — [4]DESY-Hamburg, Germany — [5]Tel Aviv University, Tel Aviv, Israel — [6]RWTH Aachen University, Aachen, Germany — [7]AGH-UST University, Cracow, Poland

The luminosity is a key quantity of any collider, which allows for the determination of the absolute cross sections from the observed rate in a detector. The Fast Beam Conditions Monitor (BCM1F) was upgraded in the last LHC long technical stop (LS1) to 24 diamond sensors read out by a dedicated fast ASIC in 130 nm CMOS technology. The backend comprises a deadtime-less histogramming unit, with a 6.25 ns bin width, in VME standard. A microTCA system with better time resolution is in development. BCM1F is used for luminosity and machine induced background measurements at the CMS experiment. The performance of the detector in the first running period, as well as results on the calibration (Van-der-Meer scan) and the measurements of the luminosity will be presented.

T 33.5 Mo 17:50 VMP8 SR 205

MPX Detectors as LHC Luminosity Monitor — •Andre Sopczak[1], Babar Ali[1], Nedaa Ashba[2], Benedikt Bergmann[1], Khaled Bekhouche[3], Davide Caforio[1], Michael Campbell[4], Erik Heijne[1], Claude Leroy[2], Anna Lipniacka[5], Marzio Nessi[4], Stanislav Pospisil[1], Frank Seifert[1], Jaroslav Solc[1], Paul Soueid[2], Michal Suk[1], and Daniel Turecek[1] — [1]IEAP CTU in Prague — [2]University of Montreal — [3]Biskra University — [4]CERN — [5]Bergen University

A network of 16 Medipix-2 (MPX) silicon pixel devices was installed in the ATLAS detector cavern at CERN. It was designed to measure the composition and spectral characteristics of the radiation field in the ATLAS experiment and its surroundings. This study demonstrates that the MPX network can also be used as a self-sufficient luminosity monitoring system. The MPX detectors collect data independently of the ATLAS data-recording chain, and thus they provide independent measurements of the bunch-integrated ATLAS/LHC luminosity. In particular, the MPX detectors located close enough to the primary interaction point are used to perform van der Meer calibration scans with high precision. Results from the luminosity monitoring are presented for 2012 data taken at $\sqrt{s} = 8$ TeV proton-proton collisions. The characteristics of the LHC luminosity reduction rate are studied and the effects of beam-beam (burn-off) and beam-gas (single bunch) interactions are evaluated. The systematic variations observed in the MPX luminosity measurements are below 0.3% for one minute intervals.

T 33.6 Mo 18:05 VMP8 SR 205

Electric field deformation in diamond sensors induced by radiation defects — •Florian Kassel[1], Wim de Boer[1], Felix Bögelspacher[1], Anne Dabrowski[2], Alexander Dierlamm[1], Moritz Guthoff[2], Thomas Müller[1], and Pia Steck[1] — [1]Institut für Experimentelle Kernphysik (IEKP), Karlsruher Institut für Technologie (KIT) — [2]CERN

The BCML system is a beam monitoring device in the CMS experiment at the LHC. As detectors 32 poly-crystalline CVD diamond sensors are positioned in a ring around the beam pipe at a distance of +-1.8 m and +-14.4 m from the interaction point. The radiation hardness of the diamond sensors in terms of measured signal during operation was significantly lower than expected from laboratory measurements. At high particle rates, such as those occurring during the operation of the LHC, a significant fraction of the defects act as traps for charge carriers. This space charge modifies the electrical field in the sensor bulk leading to a reduction of the charge collection efficiency (CCE).

A diamond irradiation campaign was started to investigate the rate dependent electrical field deformation with respect to the radiation damage. Besides the electrical field measurements via the Transient Current Technique, the CCE was measured. The experimental results were used to create an effective trap model that takes the radiation damage into account. Using this trap model the rate dependent electrical field deformation and the CCE were simulated with the software "SILVACO TCAD". This talk will compare the experimental measurement results with the simulations.

T 33.7 Mo 18:20 VMP8 SR 205

Messungen zur Ladungssammlung an pCVD Diamant mit der *transient-current-technique* (TCT) — •Helge Christoph Beck, Lars Graber, Arnulf Quadt und Jens Weingarten — II. Physikalische Institut, Georg-August-Universität Göttingen

Für zukünftige Hochenergieteilchenexperimente mit höherer Luminosität werden strahlenharte Detektormaterialien für Spurdetektoren benötigt. Industriell mit dem *chemical vapour deposition* (CVD) Verfahren hergestellte Diamanten könnten dafür in Frage kommen. Diese werden je nach Wachstumsverfahren in einkristalline (scCVD) oder polykristalline (pCVD) Diamanten unterschieden. Bei der Herstellung entstehen besonders bei pCVD Diamanten viele Korngrenzen, an denen driftende Ladungen eingefangen werden können. Um die Eignung als Sensormaterial bestimmen zu können, muss daher das Ladungssammlungsverhalten studiert werden, z.B. mit TCT Messungen: Mit einer α-Quelle werden dazu Elektron-Loch Paare nahe einer Elektrode im Material erzeugt. Durch die Nähe zur Elektrode wird eine Sorte Ladungsträger beinahe sofort gesammelt, sodass mit einem angelegten

elektrischen Feld der durch die andere Ladungsträgersorte induzierte Strom gemessen werden kann. Aus der Form des Signals kann auf viele Eigenschaften des Materials, z.B. auf die Mobilität der Ladungsträger und die *charge collection distance* (mittlere Strecke, die von Ladungsträgern zurück gelegt wird, bevor sie eingefangen werden), geschlossen werden.

In diesem Vortrag werden Ergebnisse von TCT Messungen an einem pCVD Diamanten präsentiert.

T 33.8 Mo 18:35 VMP8 SR 205

Full simulation of the beam-related backgrounds at the ILC — •Anne Schütz — DESY/KIT

The ILC has been proposed as the next machine at the energy frontier and a Technical Design Report was presented in 2012. As part of the site-specific studies to prepare the hosting of the ILC in Japan, the final focus region of the ILC had to be adapted. In this contribution, updated results for the beam-related background as well as new results for the backgrounds originating from the beam dump are presented. The beam-related backgrounds are simulated using GuineaPig and are then propagated through the full simulation of the SiD detector. The impact of various modifications in the final-focus region on the detector occupancies are then evaluated. For the neutron background from the beam dump, the FLUKA simulation suite is used, which is well established for dosimetry and shielding studies. With this program, the effect of the neutrons from the ILC beam dumps on the ILC detectors are studied.

T 33.9 Mo 18:50 VMP8 SR 205

CLAWS: Beam background monitoring in the commissioning of SuperKEKB — •Miroslav Gabriel, Hendrik Windel, Naomi van der Kolk, and Frank Simon — Max Planck Institute for Physics

The background levels, in particular those originating from the continuous injection to maximize luminosity, are a concern for the inner vertex detector of Belle-II at the SuperKEKB accelerator. To better understand this background, and in particular its time dependence, dedicated measurements will be made during the commissioning phase of the accelerator, scheduled to begin in February 2016. One of the detectors for these measurements, CLAWS, is based on scintillators coupled to SiPMs which were originally developed for timing measurements of hadronic showers in the CALICE calorimeters. The data acquisition is based on digitizers with very deep buffers allowing the continuous recording of more than 1000 revolutions of the accelerator to provide a detailed analysis of the evolution of the background levels after injection. In this contribution, we will present the overall CLAWS setup, the technical solutions adopted for the data acquisition and analysis, and discuss the performance of the detector elements.

T 34: Starke Wechselwirkung (Experiment) II

Zeit: Montag 16:45–18:30 Raum: VMP8 SR 206

T 34.1 Mo 16:45 VMP8 SR 206

Measurement of the transverse momentum and ϕ^*_η distributions of Drell-Yan lepton pairs in proton-proton collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector — •Samuel Webb, Matthias Scott, and Tai-Hua Lin — Johannes-Gutenberg-Universitaet Mainz

Measurements of Z-boson transverse momentum ($p_T^{\ell\ell}$), spectra in Drell-Yan events are important tests of QCD – at high $p_T^{\ell\ell}$ the spectra may be described by fixed-order perturbative QCD predictions and at lower $p_T^{\ell\ell}$ using soft-gluon resummation together with a non-perturbative contribution from the parton intrinsic transverse momentum. The correct modelling of $p_T^{\ell\ell}$ is also important for physics analyses at the LHC for which the production of W and/or Z bosons constitutes a background and is a crucial ingredient for a precise measurement of the W-boson mass. A complementary observable ϕ^*_η, defined in terms of the well-measured decay-lepton directions, can be used to probe the low $p_T^{\ell\ell}$ domain with higher precision. Measurements of $p_T^{\ell\ell}$ and ϕ^*_η using ATLAS data at a centre of mass energy of $\sqrt{s}$ = 8 TeV are presented. These measurements are performed in bins of lepton-pair mass above, around and below the Z-boson mass peak and are compared to a variety of theoretical predictions including from ResBos and DYNNLO.

T 34.2 Mo 17:00 VMP8 SR 206

Production of b-jets and pairs of b-jets with associated jets at CMS at 13 TeV — •Patrick Connor, Paolo Gunnellini, and Hannes Jung — Deutsches Elektronen-Synchrotron, Hamburg

In the Standard Model, the b-quark is the heaviest quark that can hadronise, and is therefore an excellent probe for higher-order QCD contributions. The CMS detector provides a sufficient resolution to measure the production of b-jets and pairs of b-jets with associated jets. In particular, we investigate transverse-momentum effects in the parton density functions (TMDs).

In the talk, we present Monte Carlo studies and preliminary results from 13 TeV data.

T 34.3 Mo 17:15 VMP8 SR 206

Messung des J/ψ Meson und des $b\bar{b}$ Wirkungsquerschnitt bei 13 TeV in Run-II des LHCb Experiments — •Svende Braun, Sevda Esen und Stephanie Hansmann-Menzemer — Physikalisches Institut Universität Heidelberg

In Run-II des LHC ist es erstmals möglich Proton-Proton Kollisionen mit einer Schwerpunktsenergie von 13 TeV zu studieren. Eine Studie zur Produktion von Quarkonium, B- und D-Mesonen bei dieser Energie ist wichtig fuer das Verständnis der QCD. In diesem Vortrag wird die Messung des J/ψ Meson Produktions-Wirkungsquerschnittes bei 13 TeV vorgestellt und mit verschiedenen Theorievorhersagen verglichen. Es wird hierfuer ein Datensatz von 3 pb^{-1} untersucht, der im Juli 2015 aufgezeichnet wurde. Es werden direkt in der pp-Kollision produzierte J/ψ Mesonen und J/ψ aus B-Mesonen Zerfaellen unterschieden. Letztere werden benutzt um den totalen $b\bar{b}$ Wirkungsquerschnitt zu bestimmen.

T 34.4 Mo 17:30 VMP8 SR 206

Precision studies of three pion final states of J/Ψ and Ψ' at BESIII — •Stuart Fegan — Johannes Gutenberg Universität, Mainz

The BESIII experiment at the Institute of High Energy Physics, Chinese Academy of Sciences, in Beijing, has been operating since 2008 with the aim of accumulating large data samples from e^+e^- collisions for detailed studies in the fields of charm physics and hadron spectroscopy. These data include large samples of J/Ψ and Ψ' decays collected during run periods in 2009 and 2012.

The three pion final states ($\pi^+\pi^-\pi^0$) of J/Ψ and Ψ' production were previously studied using the 2009 BESIII data, confirming the unexpectedly low branching fraction of the Ψ' and revealing markedly different di-pion mass spectra and Dalitz ditributions in comparison to the J/Ψ. These differences have yet to be fully explained, and form the basis of the so-called '$\rho\pi$ puzzle'.

The work presented will focus on efforts to realise more precise studies of these states in BESIII by including the larger 2012 data set in the analysis, and the application of robust partial wave analysis (PWA) techniques being developed in Mainz.

T 34.5 Mo 17:45 VMP8 SR 206

Measurement of the very-forward energy spectrum in pp collisions at $\sqrt{s}$ = 13 TeV with CMS — •Sebastian Baur, Melike Akbiyik, Colin Baus, Igor Katkov, Ralf Ulrich, and Hauke Wöhrmann — Karlsruher Institut für Technologie

The energy spectrum dN/dE in pp collisions at a centre-of-mass energy of $\sqrt{s}$ = 13 TeV is measured with the CASTOR calorimeter of CMS at pseudorapidities $-5.2 > \eta > -6.6$. The spectrum of the total energy, as well as the hadronic and electromagnetic energy, is presented and compared to models used to describe high-energy hadronic interactions. The performance also of model used to describe ultra-high energy cosmic ray air showers is tested and the possible impact of the measurement on the air shower development is illustrated.

T 34.6 Mo 18:00 VMP8 SR 206

Hadron Production in Photon-Photon Processes at the ILC — •Kollassery Swathi Sasikumar[1,2], Carl Mikael Berggren[1], and Jenny List[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The International linear Collider (ILC) is a proposed e^+e^- collider, designed to operate at energies from 91 GeV upto about 500 GeV (with the possibility to upgrade to 1 TeV). The highly clean conditions provided by the ILC enables us to make high precision measurements e.g. of the Higgs boson and to search for new particles.

In addition to the desired e^+e^- collisions, parasitic collisions of real and virtual photons radiated off the $e^\pm$ beams occur at rates of a few $\gamma\gamma$ collisions per bunch crossing. The $\gamma\gamma$ centre of mass energies reach from few 100 MeV up to the full e^+e^- centre of mass energy. For all these energies, in particular the production of hadrons,needs to be modelled correctly in order to estimate the impact of these backgrounds which pile-up on each e^+e^- event. This contribution discusses the current simulations of $\gamma\gamma \to$ hadron processes, evaluates their impact on the detector and introduces new methods to remove them from the interesting physics events.

T 34.7 Mo 18:15 VMP8 SR 206

Measurement of resonance production in pion-carbon interactions at 158 and 350 GeV/c with NA61/SHINE — •Alexander Herve for the NA61/SHINE-Collaboration — KIT, Karlsruhe, Germany

The interpretation of extensive air shower measurements, produced by ultra-high energy cosmic rays, relies on the correct modelling of the hadron-air interactions that occur during the shower development. The majority of hadronic particles is produced at equivalent beam energies below the TeV range.

NA61/SHINE is a fixed target experiment at the CERN Super Proton Synchrotron, studying hadron production in hadron-nucleus and nucleus-nucleus collisions to provide valuable contributions to a number of subjects, from neutrino through cosmic-ray to heavy-ion physics.

Pion-Carbon interactions have been performed, at 158 and 350 GeV/c, to give precise particle production measurements for the most numerous projectile in air showers, the π meson. The ability to measure the production of resonances, such as the ρ^0 and ω mesons, is particularly important to predict the number of muons produced in air showers.

In this contribution we present updated results of resonance spectra at 158 and 350 GeV/c measured by NA61/SHINE.

T 35: Top Quark II (Masse, Kin. Fits, Jets in tt)

Zeit: Montag 16:45–19:00 Raum: VMP9 HS

T 35.1 Mo 16:45 VMP9 HS

Messung der Topquarkmasse in Endzuständen angereichert mit elektroschwach produzierten Single-Top-Ereignissen mit dem ATLAS-Detektor bei $\sqrt{s} = 8$ TeV — Johannes Erdmann, Claus Gössling, •Michael Homann, Reiner Klingenberg und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Seit der Entdeckung des Topquarks wurden direkte Massenmessungen in $t\bar{t}$-Ereignissen durchgeführt. Eine alternative Ereignisselektion mit zwei Jets und einem Lepton wählt einen Phasenraum aus, der zu jenen bisherigen Analysen orthogonal ist. Die neue Selektion enthält auch Single-Top-Ereignisse. Die dieser Analyse zugrundeliegenden Daten wurden mit dem ATLAS-Experiment in pp-Kollisionen bei $\sqrt{s} = 8$ TeV genommen und entsprechen einer Luminosität von $\mathcal{L} = 20{,}3\,\mathrm{fb}^{-1}$.

In diesem Vortrag wird die Analysestrategie vorgestellt. Anschließend wird die Verbesserung des Signal-zu-Untergrund-Verhältnisses mit Hilfe eines neuronalen Netzes diskutiert. Die Messung der Topquarkmasse erfolgt durch einen Templatefit an die Verteilung der invarianten Masse des Leptons und des b-Jets.

T 35.2 Mo 17:00 VMP9 HS

Messung der Topquarkmasse im semileptonischen Zerfallskanal am CMS Experiment — •Christoph Garbers, Peter Schleper, Hartmut Stadie, Fred Stober, Markus Seidel, Nataliia Kovalchuk und Andre Schmalfeld — Universität Hamburg, Hamburg, Germany

Das Topquark ist das schwerste nachgewiesene Elementarteilchen. Eine genaue Bestimmung seiner Eigenschaftem ist nicht nur für eine noch genauere Kenntniss des Standarmodells der Teilchenphysik wichtig, sondern auch ein guter Indikator für Suchen nach neuer Physik. Die bisher präziseste, direkte Bestimmung der Masse des Topquarks ergab in der ersten Datennahmenphase des LHC am CMS-Experiment $m_t = 172.38 \pm 0.16(\text{stat.} + \text{JSF}) \pm 0.49(\text{syst.})$ GeV. Der zweiten Lauf des LHC mit seiner von 8 TeV auf 13 TeV erhöhten Schwerpunktsenergie liefert die Möglichkeit, den statistischen Fehler weiter zu verringern. Gleichzeitig stehen neue MC-Generatoren zur verfügung, die die Beschreibung der Daten durch Simulationen weiter verbessern. In diesem Beitrag werden die ersten Schritte einer Topquarkmassenmessung mit dem Ziel, die Genauigkeit des ersten Laufs zu übertreffen, vorgestellt. Wie bei der bisherigen Analyse werden aus dem CMS-Datansatz Ereignisse mit mindestens vier Jets, von denen zwei aus Bottomquarkzerfällen stammen, und genau einem isoliertem Elektron oder Myon ausgewählt. Mit einem kinematischen Fit werden diese Topquarkkandidaten an eine $t\bar{t}$ Hypothese angepasst und ihre Masse rekonstruiert.

T 35.3 Mo 17:15 VMP9 HS

Particle flow jets in the $t\bar{t}$ l+jets channel in ATLAS — •Peter Falke, Regina Moles-Valls, and Ian Brock — Universität Bonn, Bonn, Germany

The ATLAS particle flow algorithm combines tracking and calorimeter information to achieve an improved resolution for jets and missing transverse momentum. Studies based on 8 TeV ATLAS data have shown improvements for the energy response and jet angular resolution. Additionally the pile-up contribution is considerably reduced.

Jets stemming from b-quarks are important for top-quark and Higgs boson physics as well as for searches for new physics. Particle flow inherently adds tracker information to the jets and thus could allow improvements of the b-jet performance.

This contribution presents the studies done using $t\bar{t}$ events in the l+jets channel at 13 TeV in ATLAS. The $t\bar{t}$ topology is advantageous, due to its clean signature and a large fraction of b-jets from the top-quark decays. The invariant mass distributions of the hadronically decaying W boson and top-quark are used to investigate the performance of particle flow jets in comparison to jets based only on calorimeter information. The calibration of the jet collection, which is the first step after the jet reconstruction, has been slightly modified for particle flow due to the different nature of the jets. A further emphasis is placed on properties of b-jets (e.g. the b-hadron decay mode and the decay multiplicity) within particle flow, which could allow the jet energy scale and jet energy resolution as well as b-tagging efficiencies to be further improved.

T 35.4 Mo 17:30 VMP9 HS

In-situ Kalibration der Jet-Energie-Skala in $t\bar{t}$-Ereignissen — •Martin Meisel, Fred Stober und Peter Schleper — Universität Hamburg

Eine wichtige Messung am Large Hadron Collider (LHC) ist die Bestimmung der Top-Masse, insbesondere auch in Run 2 bei höherer Schwerpunktsenergie und Luminosität. Um die Top-Masse in semileptonischen $t\bar{t}$-Zefällen präzise zu bestimmen, ist eine genaue Kenntnis der Jet-Energie-Skala (JES) im hadronischen Zerfall von W-Bosonen notwendig. Derartige Ereignisse werden mit Hilfe eines kinematischen Fits rekonstruiert, der mit Nebenbedingungen die JES in-situ bestimmt. Insbesondere bei niedrigen transversalen Impulsen der Jets können aber die angewandten Vorselektionskriterien die JES beeinflussen. Um die dabei auftretenden Unsicherheiten weiter zu reduzieren, werden verschiedene Ansätze untersucht. So kann es mittels einer analytischen Methode möglich sein, den Einfluss der Schnitte am Jet zu reduzieren. Ebenso kann die Wahl einer geeigneten Fitfunktion dazu dienen, die Effekte der eingeschränkten Jet-Akzeptanz zu verringern. Die verschiedenen Methoden zur Bestimmung der JES in semileptonischen $t\bar{t}$-Ereignissen werden vorgestellt und verglichen.

T 35.5 Mo 17:45 VMP9 HS

Vergleich der Performance des KLFitter-Algorithmus für den LHC-8 TeV- und den 13 TeV-Run an Hand des Lepton+Jets $t\bar{t}$-Zerfallskanals — Johannes Erdmann, Kevin Kröninger, Claus Gössling und •Tobias Nickel — TU Dortmund, Experimentelle Physik IV

Für viele Analysen von $t\bar{t}$-Ereignissen am ATLAS-Experiment ist es wichtig, die Topologie des Zerfalls zu rekonstruieren. Je genauer die

Rekonstruktion, desto besser lassen sich kinematische Größen wie zum Beispiel die Top-Quark-Masse oder p_T des Top-Quarks bestimmen. Für die vorgestellte Studie wird der KLFitter-Algorithmus benutzt, um eine Rekonstruktion des Lepton+Jets-Kanals des $t\bar{t}$-Zerfalls durchzuführen. Dies geschieht unter der Modellannahme, dass beide Top-Quarks jeweils in ein W-Boson und ein b-Quark zerfallen, wobei eines der W-Bosonen in ein Lepton und ein Neutrino zerfällt, das andere in zwei leichte Quarks. Mit Hilfe der Kinematik von Jets, Lepton und E_T^{miss} werden die Massen der zu Grunde liegenden Modellteilchen berechnet. Aus diesen wird unter Berücksichtigung der Detektorauflösung die wahrscheinlichste Jetpermutation berechnet. Ein Vergleich der rekonstruierten kinematischen Variablen zwischen dem 8 TeV- und dem 13 TeV-Run ermöglicht eine Bewertung der Performance des KLFitter-Algorithmus für den 13 TeV-Run.

T 35.6 Mo 18:00 VMP9 HS

Kombination von Topquark-Messungen im Rahmen einer effektiven Feldtheorie mit EFTfitter — Johannes Erdmann[1], Claus Gössling[1], •Cornelius Grunwald[1], Kevin Kröninger[1] und Nils-Arne Rosien[2] — [1]TU Dortmund, Experimentelle Physik IV — [2]Georg-August-Universität Göttingen, II. Physikalisches Institut

Das Topquark spielt in vielen Erweiterungen des Standardmodells eine Schlüsselrolle. Die direkte Suche nach neuen Phänomenen im Topsektor ist daher ein essentieller Teil des Physikprogramms am LHC bei $\sqrt{s} = 13$ TeV. Bisher wurden allerdings keine signifikanten Abweichungen von den im Standardmodell vorhergesagten Eigenschaften des Topquarks gemessen. Sollte die Skala neuer Phänomene höher sein als am LHC erreichbar, so können die Effekte solcher Modelle im Rahmen effektiver Feldtheorien (EFT) parametrisiert werden. Messungen im Topsektor können die Stärke der in EFT auftretenden Operatoren einschränken. In diesem Vortrag wird das Tool EFTfitter vorgestellt, das die Interpretation verschiedener experimenteller Ergebnisse im Rahmen von EFT erlaubt, wobei die experimentellen Korrelationen in der Kombination der Ergebnisse berücksichtigt werden können.

T 35.7 Mo 18:15 VMP9 HS

Messung der Zerfallsbreite des Top-Quarks im $t\bar{t}$ Lepton+Jets-Kanal bei ATLAS — Boris Lemmer, Arnulf Quadt und •Philipp Stolte — II. Physikalisches Institut, Georg-August-Universität Göttingen

Eine Größe des Top-Quarks, die bislang weder bei ATLAS noch bei CMS, den beiden Vielzweckdetektoren am LHC, direkt gemessen wurde, ist die Zerfallsbreite des Top-Quarks. Obschon in vielen Messungen entsprechend der Standardmodell (SM)-Erwartung als Input verwendet, steht eine experimentelle Verifikation dieser Größe noch aus. Eine derartige direkte Analyse ist den bislang realisierten indirekten vorzuziehen, da sie modellunabhängiger ist - auf weniger Annahmen aus dem SM beruhend - und da sie entsprechend eine große Vielzahl von Modellen zur Physik außerhalb jenes Modells besser zu testen vermag.

In diesem Vortrag wird der Status einer direkten Messung der Zerfallsbreite des schwersten aller Quarks mit dem ATLAS-Detektor im Lepton+Jets-Kanal vorgestellt, basierend auf Daten, die bei einer Schwerpunktsenergie von $\sqrt{s} = 8$ TeV in 2012 aufgenommen wurden.

Zentrale Schwerpunkte werden dabei auf die Verwendung des *kinematischen Likelihood-Fitters* (KLFitter), ein Werkzeug für die adäquate Rekonstruktion von Top-Quark-Signalereignissen, sowie auf Studien zur verwendeten Fit-Methode gelegt, mit welcher die Breite aus den Messdaten extrahiert werden soll. Diesbezüglich wurden zahlreiche Tests zu möglichen Schnitten, zu verschiedenen infrage kommenden Observablen, zur Dimension des Fits und auch zur Validierung desselben durchgeführt.

T 35.8 Mo 18:30 VMP9 HS

Bestimmung der top-Quarkmasse an Hand des Lepton-Transversalimpulses — •Michael Bender und Otmar Biebel — Ludwig-Maximilians-Universität München

Aus Messdaten, die vom ATLAS Experiment bei 8 TeV Kollisionsenergie am LHC aufgezeichnet wurden, wird die Masse des top-Quarks im Lepton+Jets Kanal bestimmt. Die erzeugten top-Quark-Paare zerfallen jeweils fast ausschließlich in ein b-Quark und W-Boson. Als Lepton+Jets Kanal wird derjenige Zerfall bezeichnet, bei dem eines der beiden W-Bosonen hadronisch und das andere leptonisch zerfällt.

Anders als bei direkten Massenbestimmungen wird in dieser Messung der transversale Impuls des Leptons zur Bestimmung der top-Quarkmasse verwendet. Hierbei gilt, je größer die Masse des top-Quarks, desto höher der transversale Impuls des Leptons aus dem Zerfall des zugehörigen W-Bosons. Aus der gemessenen Verteilung der Lepton-Impulse kann daher die top-Quarkmasse bestimmt werden. Die vorgestellte Methode verbessert hierbei direkte Massenbestimmungen auf Grund ihrer unterschiedlichen Sensitivität auf systematische Fehlerquellen.

In diesem Vortrag wird das Prinzip der Messung vorgestellt, Messergebnisse und systematische Unsicherheiten werden diskutiert.

T 35.9 Mo 18:45 VMP9 HS

MC Generator Tuning for Run II — •Jannik Geisen, Maria Moreno Llacer und Arnulf Quadt — II. Physikalisches Institut, Georg-August-Universität Göttingen

Die Theorie der QCD ist in den Bereichen gut verstanden, wo wir die Störungstheorie anwenden können, d.h. bei hohen Energien und kleinen α_S Werten. Jedoch müssen weiche Effekte wie z.B. das Abstrahlen von niederenergetischen Gluonen und die Hadronisation nicht-perturbativ modelliert werden, was wir mit MC Generatoren erzielen. Solche Modelle basieren auf Parametern, die nicht im Standardmodell vorhergesagt werden und stattdessen an experimentell gemessene Daten angepasst werden müssen.

Präsentiert werden zwei neue Parameterkonfigurationen, die für den Parton-Schauer von Pythia8 optimiert sind, welcher an den Next-to-leading Order Matrix-Element-Generator MadGraph5_aMC@NLO gekoppelt wird. Beide Konfigurationen basieren auf Daten, die mit dem ATLAS Detektor bei $\sqrt{s} = 7$ TeV gemessen wurden. Dabei verwendet eine Konfiguration Observablen aus Top-Quark-, Z-Boson- und inklusiven Jet-Prozessen, während die andere auf Top-Quark Messungen spezialisiert ist. Beide Parameteroptimierungen werden mit bisherigen ATLAS Standards verglichen und eine gute Übereinstimmung wird festgestellt.

T 36: Neutrinoloser Doppelbeta-Zerfall II

Zeit: Montag 16:45–19:05 Raum: VMP9 SR 07

Gruppenbericht T 36.1 Mo 16:45 VMP9 SR 07

Status of Gerda Phase II — •Victoria Wagner for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The GERDA experiment is designed to search for neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. In Phase I of the experiment a background index (BI) of 10^{-2} cts/(keV·kg·yr) was reached. No signal has been found and a lower limit on the half-life of $2.1{\cdot}10^{25}$ yr (at 90% C.L.) is extracted. The aim of Phase II is to double the Ge mass and further reduce the BI by an order of magnitude to explore half-lives of about 10^{26} yr. Thirty new Broad Energy Germanium (BEGe) detectors have been produced. These detectors are distinct for their improved energy resolution and enhanced pulse shape discrimination of signal from background events. Further background reduction will be reached by an active veto to read out argon scintillation light. The Phase II commissioning showed that two of the major background components, external γ-rays from ^{214}Bi and ^{208}Tl decays, can be suppressed up to two orders of magnitude. This talk will present the current status of the GERDA Phase II upgrade.

T 36.2 Mo 17:05 VMP9 SR 07

A new approach to Neganov-Trofimov-Luke cryogenic light detectors for Astroparticle Physics — •Elizabeth Mondragón[1], X. Defay[1], J-C. Lanfranchi[1], A. Langenkämper[1], A. Münster[1], E. Olivieri[2], W. Potzel[1], S. Schönert[1], H. Steiger[1], S. Wawoczny[1], M. Willers[1], and A. Zöller[1] — [1]Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching — [2]Centre de Sciences Nucléaires et Sciences de la Matière (CSNSM), IN2P3 Orsay, France

There is a common need in Astroparticle experiments such as direct Dark Matter detection, neutrinoless double beta decay and coherent neutrino nucleus scattering experiments for detectors with a very low energy threshold. By employing the **Neganov-Trofimov-Luke Ef-**

fect (NTLE) the thermal signal of particle interactions in a semiconductor absorber, operated at cryogenic temperatures, can be amplified by drifting electrons and holes under an electric field inside the semiconductor. We present here the first results of a novel type of a NTLE light detector with a planar electric field configuration designed to improve the charge collection within the semiconductor. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe ", by the Helmholtz Alliance for Astroparticle Physikcs, by the Maier-Leibnitz-Laboratorium (Garching) and by the BMBF.

T 36.3 Mo 17:20 VMP9 SR 07

The next Enriched Xenon Observatory - A Search for Neutrinoless Double Beta Decay — •Reimund Bayerlein, Patrick Hufschmidt, Ako Jamil, Judith Schneider, Michael Wagenpfeil, Gerrit Wrede, Tobias Ziegler, Jürgen Hössl, Gisela Anton, and Thilo Michel — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

The question whether the neutrino could be its own antiparticle is still not answered. The most practical way to test this is the search for the neutrinoless double beta decay. The half-life of this decay is related to the value of a linear combination of the masses of the neutrino mass eigenstates and therefore provides information about the absolute mass scale of neutrinos. The nEXO experiment - the successor of EXO200 - is currently under research and development. The baseline concept comprises a single-phase liquid xenon (LXe) time projection chamber (TPC) filled with about 5 tons of liquid xenon enriched to about 80% Xe-136 as the double beta decay nuclide.

In order to fully cover the range of the effective Majorana neutrino mass in the inverted hierarchy scheme, excellent energy resolution is required. Therefore, a position-resolving, low-noise charge readout and very efficient light collection and detection are mandatory. For the purpose of very low background levels radiopure Silicon Photomultipliers (SiPMs) have to be used to detect the scintillation light of LXe. Due to the large half-life a huge detector mass and long term measurement are needed. In this talk the baseline-concept of the experimental setup will be presented.

T 36.4 Mo 17:35 VMP9 SR 07

Silicon Photomultipliers for the detection of VUV scintillation light in LXe for the nEXO experiment — •Tobias Ziegler, Ako Jamil, Reimund Bayerlein, Jürgen Hössl, Patrick Hufschmidt, Judith Schneider, Michael Wagenpfeil, Gerrit Wrede, Gisela Anton, and Thilo Michel — Erlangen Centre for Astroparticle Physics, Erlangen 91058, Deutschland

The future nEXO (next Enriched Xenon Observatory) experiment with a single phase TPC design will use about $4\,m^2$ of SiPMs for the detection of the VUV (vacuum ultraviolet) scintillation light ($\lambda = 175\,nm$) from LXe to search for the neutrinoless double beta ($0\nu\beta\beta$) decay of ^{136}Xe. Commercially available SiPMs are not sensitive to ultraviolet light, because of an antireflective coating on top of the sensitive area. In addition, they suffer from relatively high dark count rate at room temperature and correlated avalanches, such as crosstalk and afterpulsing. The core criteria, for having an energy resolution of about 1% (σ) at the Q-value of the $0\nu\beta\beta$ decay of ^{136}Xe (2457.8 keV), are a photon detection efficiency (PDE) of at least 15% at 175 nm and a correlated avalanche probability (CAP) of less than 20% at -100 °C. We considered different approaches for optimizing both PDE and CAP. These improved SiPMs from several vendors were tested in different test setups at temperatures of about -100 °C with respect to the criteria required in the nEXO experiment.

T 36.5 Mo 17:50 VMP9 SR 07

Setup for SiPM characterization in liquid xenon for the nEXO experiment — •Patrick Hufschmidt, Reimund Bayerlein, Ako Jamil, Judith Schneider, Michael Wagenpfeil, Gerrit Wredel, Tobias Ziegler, Gisela Anton, Juergen Hoessl, and Thilo Michel — ECAP, Friedrich-Alexander-Universitaet Erlangen Nuernberg

The nEXO (next enriched xenon observatory) is a future experiment to search for the neutrinoless double beta decay of Xe-136 with a single-phase time-projection-chamber filled with liquid xenon. Besides position resolved detection of the released charge with low noise electronics, efficient collection and detection of the xenon scintillation light with its short wavelength of 175 nm is important to obtain good energy resolution. Due to the demands on radiopurity of the materials employed in the detector, Silicon Photomultipliers (SiPM) shall be used to detect the scintillation light. Dedicated SiPMs, compatible with the requirements of the experiment, have to be developed. In order to characterize SiPMs - for example with respect to photon detection efficiency at 175 nm, cross-talk probability, dark-rate, after-pulse probability - we have set up a SiPM test stand in which SiPMs can be operated in liquid or in gaseous xenon. Cooling is performed with a cold finger immersed in liquid nitrogen. Scintillation photons are produced by the interaction of alpha particles from a radioactive source. In addition to the SiPMs, a VUV-sensitive photomultipier tube is present in the xenon cell so that coincidence measurements can be performed. In this contribution we present the status of our test setup.

T 36.6 Mo 18:05 VMP9 SR 07

Search for neutrinoless double beta decay beyond GERDA — •Bernhard Schwingenheuer — MPI Kernphysik, Heidelberg

The search for neutrinoless double beta decay might be the only window to observe lepton number violation and to determine the nature of neutrinos. Is is therefore considered to be of highest relevance. The isotope Ge-76 has historically been most important for this search and the ongoing experiment GERDA has the lowest background of all experiments in the field. The proposed experimental program beyond GERDA (and Majorana) is presented.

T 36.7 Mo 18:20 VMP9 SR 07

Untersuchung von TPB-Beschichtungen auf optischen Fasern zur Auslese des Szintillationlichts von flüssigem Argon in GERDA — •Julian Kratz für die GERDA-Kollaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, James-Franck-Straße 1, 85748 Garching,

Das GERDA-Experiment sucht nach dem neutrinolosen Doppel-β-Zerfall von ^{76}Ge. Germanium-Detektoren werden dabei direkt in einem Kryostaten, gefüllt mit 64 m^3 flüssigem Argon (LAr), betrieben. Untergrundereignisse können über das Szintillationslicht im LAr unterdrückt werden. Eine Kombination von optischen Fasern und Silizium-Photomultipliern (SiPM) wird als Teil des LAr-Veto eingesetzt. Die Fasern werden mit TPB (Tetraphenyl butadiene) beschichtet, ein Wellenlängenschieber, der durch seine Eigenschaften die Fasern für das Szintillationslicht von Argon (127 nm) empfindlich macht. In einer Vakuumkammer wird das TPB verdampft und die Fasern damit beschichtet. Verschiedene Verdamfungszeiten und Temperaturen erzeugen unterschiedliche Schichtdicken, so können die Eigenschaften von TPB untersucht werden. Durch die optimale Schichtdicke wird die Lichtausbeute maximiert und die Unterdrückung des Untergrunds verbessert. Dieser Vortrag zeigt die Entwicklung von TPB-beschichteten Fasern mit unterschiedlichen Schichtdicken und deren Verhalten im Szintillationslicht von flüssigem Argon für die Anwendung in GERDA.
Diese Arbeit wurde durch das BMBF unterstüzt.

T 36.8 Mo 18:35 VMP9 SR 07

Development of phonon and photon detectors for rare events searches using scintillating crystals — •Felix Ahrens[1], Christian Enss[1], Andreas Fleischmann[1], Loredana Gastaldo[1], Clemens Hassel[1], Sebastian Hendricks[1], Sebastian Kempf[1], Yong-Hamb Kim[2], Martin Loidl[3], Xavier-François Navick[3], and Matias Rodrigues[3] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg, Deutschland — [2]Korea Research Institute of Standards and Science, Daejeon, Rep. of Korea — [3]Commissariat à l'énergie atomique, Saclay, France

The use of scintillating crystals in cryogenic experiments searching for neutrinoless double beta decay and for direct interaction of dark matter particles allows for an efficient background reduction due to particle discrimination. We develop phonon and photon detectors based on metallic magnetic calorimeters (MMCs) to perform simultaneous measurements of heat and light generated by the interaction of a particle in a scintillating crystal. As designed we expect for the phonon sensor an energy resolution of $\Delta E_{FWHM} < 100\,eV$ and a signal rise time $\tau < 200\,\mu s$ whereas for the photon detector we expect $\Delta E_{FWHM} < 5\,eV$ and $\tau < 50\,\mu s$. We discuss the design and the fabrication of these detectors and present recent results.

T 36.9 Mo 18:50 VMP9 SR 07

Suppression of the background coming from ^{42}Ar in the GERDA experiment — •Alexey Lubashevskiy for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg

The GERDA experiment aims at the $0\nu\beta\beta$ search in ^{76}Ge. The search is performed with high purity germanium detectors operated in liq-

uid argon. One of the most dangerous backgrounds in GERDA is the background from ^{42}K which is a daughter isotope of cosmogenically produced ^{42}Ar, presented in natural argon. ^{42}K ions collect on the surface of the detector and increase its background level. Several ways to suppress such background has been investigated. The tests were performed at LArGe low-background test facility, which gives a possibility to operate bare detectors in about 1m^3 of LAr. It is equipped with a scintillation veto, so particles which deposit part of their energy in LAr can be detected by PMTs. The experimental setup is located at LNGS underground laboratory close to GERDA experiment location. Different experimental techniques were tested together with pulse shape discrimination (PSD) method in order to suppress ^{42}K background. The chosen solution for GERDA Phase II is so called "nylon mini-shroud" (NMS). It is made from nylon foil and covered with wavelength shifter from both sides. NMS allows to suppress collection of ^{42}K ions towards to the surface significantly. It was demonstrated in LArGe that together with PSD and scintillation veto the ^{42}K background can be suppressed in more than 1000 times. The results obtained during commissioning runs in GERDA Phase II will be also presented.

T 37: Neutrinoastronomie II

Zeit: Montag 16:45–19:05 Raum: VMP9 SR 08

Gruppenbericht T 37.1 Mo 16:45 VMP9 SR 08

KM3NeT/ARCA - Status und Perspektiven — •Tamas Gal für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

KM3NeT/ARCA ist ein Neutrinoteleskop mit einem instrumentierten Volumen von einem Kubikkilometer, das der Untersuchung hochenergetischer, kosmischer Neutrinos dienen wird.
Anfang Dezember 2015 wurde die erste ca. 800m hohe Detektorstruktur (DU) im Mittelmeer vor der sizilianischen Küste in 3500m Wassertiefe installiert und erfolgreich in Betrieb genommen. Die Struktur besteht aus insgesamt 18 optischen Modulen mit jeweils 31 Photomultipliern die seither Daten über ein optisches Netzwerk an die Küstenstation in Capo Passero senden. Bereits wenige Stunden nach der Versenkung konnten die ersten Ereignisse– atmosphärische Myonen – detektiert und rekonstruiert werden.
Die Installation der ersten Struktur lieferte viele wichtige Erkenntnisse für den zukünftigen Ausbau des KM3NeT Neutrinoteleskops, welches in der aktuellen Phase-1 aus 24 DUs und in der geplanten Phase-2.0 aus insgesamt 230 DUs bestehen wird. Der Vortag stellt den Status des Projekts und seine Perspektiven vor.

T 37.2 Mo 17:05 VMP9 SR 08

ORCA sensitivity to ν_τ appearance — •Steffen Hallmann for the ANTARES-KM3NeT-Erlangen-Collaboration — ECAP / Universität Erlangen-Nürnberg

The KM3NeT collaboration has started the construction of ORCA, a densely instrumented water Cherenkov detector in the Mediterranean Sea. In the first construction phase, a prototype consisting of six detection lines will be installed. For the complete detector setup, 115 detection lines are planned. The primary science goal of ORCA is to resolve the neutrino mass hierarchy problem by measuring oscillations of atmospheric neutrinos (ν_μ and ν_e) produced in cosmic ray air-showers. In ORCA, the oscillation into ν_τ will be visible on a statistical basis as an excess over the flux from ν_μ and ν_e only.

The talk will present the sensitivities to observe ν_τ appearance with the prototype and the full ORCA detector. Precise determination of the ν_τ flux in ORCA will also give the opportunity to probe deviations from the normalisation expected from unitary mixing in the three neutrino framework.

T 37.3 Mo 17:20 VMP9 SR 08

Search for point-like sources using the diffuse astrophysical muon-neutrino flux in IceCube — •René Reimann, Christian Haack, Leif Rädel, Sebastian Schoenen, Lisa Schumacher, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen

IceCube, a cubic-kilometer sized neutrino detector at the geographic South Pole, has recently confirmed a flux of high-energy astrophysical neutrinos in the track-like muon channel. Although this muon-neutrino flux has now been observed with high significance, no point sources or source classes could be identified yet with these well pointing events. We present a search for point-like sources based on a six year sample of upgoing muon-neutrinos with very low background contamination. To improve the sensitivity, the standard likelihood approach has been modified to focus on the properties of the measured astrophysical muon-neutrino flux.

T 37.4 Mo 17:35 VMP9 SR 08

Search for Tau-Neutrino Induced Cascades in the Ice Cube Detector — •Marcel Usner and Marek Kowalski for the IceCube-Collaboration — DESY Zeuthen

The IceCube Neutrino Observatory at the South Pole is a Cherenkov detector built to measure high-energy neutrinos from cosmic sources. A total volume of about one cubic kilometer of the Antarctic ice is instrumented with 5160 optical modules. A tau lepton is created in the charged current interaction of a tau neutrino with an ice nucleus. The Double Bang signature links two subsequent cascades from the hadronic interaction and the tau decay within the detection volume. It can only be resolved at the highest energies around 1 PeV where the decay length of the tau is about 50 m. The work is focused on optimizing reconstruction methods of Double Bang events incorporating the latest ice model. The goal is to measure a flavor ratio that, for the first time, is sensitive to tau neutrinos.

T 37.5 Mo 17:50 VMP9 SR 08

Core-collapse supernovae as possible counterparts of IceCube neutrino multiplets — •Nora Linn Strotjohann[1], Markus Voge[2], Marek Kowalski[1], and Anna Franckowiak[1] for the IceCube-Collaboration — [1]Desy Zeuthen, Platanenallee 6, 15738 Zeuthen, Germany — [2]Physikalisches Institut, Nussallee 12, 53115 Bonn, Germany

While an astrophysical neutrino flux has been detected by the IceCube Neutrino Observatory its sources remain so far unidentified. IceCube's Optical Follow-up Program is designed to search for the counterparts of neutrino multiplets using the full energy range of the IceCube detector down to 100 GeV. Two or more muon neutrinos arriving from the same direction within few seconds can trigger follow-up observations with optical and X-ray telescopes. Since 2010 the Palomar Transient Factory has followed up about 40 such neutrino alerts and detected several supernovae. Many of the detections are however likely random coincidences. In this talk I will describe our search for supernovae and the prospects of identifying a supernova as a source of high-energy neutrinos.

T 37.6 Mo 18:05 VMP9 SR 08

Towards an Unbiased, Full-Sky Clustering Search with IceCube in Real Time — Elisa Bernardini, Anna Franckowiak, •Thomas Kintscher, Marek Kowalski und Alexander Stasik für die IceCube-Kollaboration — DESY (Zeuthen)

The IceCube neutrino observatory is a 1 km^3 detector for Cherenkov light in the ice at the South Pole. Having observed the presence of a diffuse astrophysical neutrino flux, static point source searches have come up empty handed. Thus, transient and variable objects emerge as promising, detectable source candidates. An unbiased, full-sky clustering search – run in real time – can find neutrino events with close temporal and spatial proximity. The most significant of these clusters serve as alerts to third-party observatories in order to obtain a complete picture of cosmic accelerators. The talk will showcase the status and prospects of this project.

T 37.7 Mo 18:20 VMP9 SR 08

Messung des Anti-Neutrino/Neutrino-Verhältnisses von atmosphärischen Neutrinos bei Icecube — •David Kappesser, Sebastian Böser, Gerald Krückl und Lutz Köpke — Johannes Gutenberg-Universität, Mainz, Deutschland

IceCube ist ein Neutrinoteleskop im Südpoleis. Als Tscherenkow-Detektor kann es im Allgemeinen nicht zwischen Teilchen und Antiteilchen unterscheiden. Für Ereignisse deren hadronische Kaskade und

erzeugtes Lepton ihre Energie vollständig im Detektor deponieren kann die Bjorken'sche Skalenvariable bestimmt werden. Aufgrund von Unterschieden im Phasenraum von Wechselwirkung mit Neutrino bzw. Antineutrino ergibt sich ein Zusammenhang zwischen Skalenvariable und Ereignisrate. Durch Fit der Monte-Carlo Simulation an die tatsächlich gemessenen Ereignisse lässt sich so das Neutrino-Antineutrino Verhältnis bestimmen.

T 37.8 Mo 18:35 VMP9 SR 08

Entfaltung der Neutrino-Energie-Spektren verschiedener Quelltypen mit IceCube Daten — •Thorben Menne, Tim Ruhe, Mathis Börner, Thomasz Fuchs, Philipp Schlunder, Maximilian Meier und Alexander Sandrock für die IceCube-Kollaboration — Fakultät Physik, TU Dortmund, 44227 Dortmund, Deutschland

Der IceCube Detektor ist ein kubikkilometer großes Neutrino-Teleskop am geographischen Südpol. Eines der Hauptziele ist die Entdeckung von Neutrinos aus punktförmigen, astrophysikalischen Quellen. Es wird eine Analyse vorgestellt, in der die Entfaltung von Neutrino-Energie-Spektren verschiedener Quelltypen mithilfe der Stacking Methode durchgeführt wird. Dazu werden die Signalregionen mehrerer Quellen eines Typs zusammengefasst, um ein besseres Signal zu Untergrund Verhältnis zu erhalten. Eine modellunabhängige Entfaltung wird anschließend durchgeführt, um Spektren in der realen Neutrino-Energie zu bestimmen. Es wird hier versucht die existierenden, modellunabhängigen Grenzen aus einer früheren Analyse basierend auf IC59 Daten weiter zu verbessern, indem Messungen aus weiteren Jahren mit größerer Statistik benutzt werden.

T 37.9 Mo 18:50 VMP9 SR 08

Search for neutrino point sources with an all-sky autocorrelation analysis in IceCube — •Andrea Turcati, Anna Bernhard, and Stefan Coenders for the IceCube-Collaboration — TU, Munich, Germany

The IceCube Neutrino Observatory is a cubic kilometre scale neutrino telescope located in the Antarctic ice. Its full-sky field of view gives unique opportunities to study the neutrino emission from the Galactic and extragalactic sky. Recently, IceCube found the first signal of astrophysical neutrinos with energies up to the PeV scale, but the origin of these particles still remains unresolved. Given the observed flux, the absence of observations of bright point-sources is explainable with the presence of numerous weak sources. This scenario can be tested using autocorrelation methods. We present here the sensitivities and discovery potentials of a two-point angular correlation analysis performed on seven years of IceCube data, taken between 2008 and 2015. The test is applied on the northern and southern skies separately, using the neutrino energy information to improve the effectiveness of the method.

T 38: Gammaastronomie II

Zeit: Montag 16:45–18:45 Raum: VMP9 SR 27

T 38.1 Mo 16:45 VMP9 SR 27

Konzept zur Messung des Pointings der mittelgroßen CTA-Teleskope mit einer optischen CCD-Kamera — •Domenico Tiziani und Christopher van Eldik — ECAP, Universität Erlangen-Nürnberg

Das Cherenkov Telescope Array (CTA) ist das bodengebundene Experiment der nächsten Generation zur Messung kosmischer Gammastrahlung im Energiebereich von einigen zehn GeV bis zu über 100 TeV. Es wird aus Cherenkov-Teleskopen dreier verschiedener Größen bestehen. Das Projekt befindet sich gerade in der Prototyp-Phase.

Eine wichtige Kalibrierung für CTA ist das sogenannte "Pointing". Darunter versteht man sowohl die genaue Ausrichtung eines Cherenkov-Teleskops als auch die Fähigkeit, eine Position am Himmel in die Ebene der Cherenkov-Kamera zu transformieren und umgekehrt. Eine Methode, das Pointing zu messen, besteht darin, eine optische CCD-Kamera an das Teleskop zu montieren, die gleichzeitig die Positionen der Cherenkov-Kamera und der Sterne am Nachthimmel in einem Bild aufnimmt.

In diesem Vortrag wird die Adaptierung dieser Methode für die mittelgroßen CTA-Teleskope vorgestellt. Es werden Techniken beschreiben, mit denen Aufnahmen einer Pointing-Kamera simuliert und analysiert werden können.

T 38.2 Mo 17:00 VMP9 SR 27

Upgrade of the MAGIC telescopes single wavelength micro power LIDAR system — •Dominik Müller for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München

Since 2011 a single wavelength LIDAR system is operated alongside the observations of the MAGIC telescopes. It is used for real-time monitoring of the atmospheric transmission and for detecting cloud layers within the field of view of MAGIC. The system uses a pulsed Nd:YAG laser with 532nm wavelength and a pulse energy of 5μJ as transmitter. The receiver is mounted to a 60cm spherical single mirror telescope with a F/D ratio of 2.5. To compensate for the low light intensities a sensitive detector with the capability of single photon detection as well as charge integration is needed. For this purpose, a hybrid photo diode with a peak quantum efficiency of 55% an a pulse width of 2.5ns is used in a custom designed detector. The analog signal is recorded by a computer mounted 8-bit FADC with 200MS/s. A signal analysis algorithm converts the LIDAR return signal into a number of single photoelectron counts per range bin. The atmospheric transmission is calculated by fitting a Rayleigh back-scattering model with a sliding window. The resulting transmission profile is used to correct the MAGIC gamma ray data for adverse weather conditions. After five years of data taking the MAGIC LIDAR system is upgraded with a stronger laser and a new detector unit in order to extend the measurement range and to optimize the operation.

T 38.3 Mo 17:15 VMP9 SR 27

FACT - Streamed data analysis and online application of machine learning models — •Kai Arno Brügge and Jens Buss for the FACT-Collaboration — Technische Universität Dortmund, Astroteilchenphysik

Imaging Atmospheric Cherenkov Telescopes (IACTs) like FACT produce a continuous flow of data during measurements. Analyzing the data in near real time is essential for monitoring sources. One major task of a monitoring system is to detect changes in the gamma-ray flux of a source, and to alert other experiments if some predefined limit is reached. In order to calculate the flux of an observed source, it is necessary to run an entire data analysis process including calibration, image cleaning, parameterization, signal-background separation and flux estimation. Software built on top of a data streaming framework has been implemented for FACT and generalized to work with the data acquisition framework of the Cherenkov Telescope Array (CTA). We will present how the streams-framework is used to apply supervised machine learning models to an online data stream from the telescope.

T 38.4 Mo 17:30 VMP9 SR 27

Time and charge calibration of Cherenkov telescope data acquired by Domino Ring Sampler 4 chips — •Mario Hörbe[1], Marlene Doert[1], Kai Brügge[2], Jens Buss[2], Christian Bockermann[2], and Alexej Egorov[2] — [1]Ruhr-Universität Bochum — [2]TU Dortmund

Very-high-energy gamma-ray astronomy aims to give an insight into the most energetic phenomena in our Universe. Earthbound Cherenkov telescopes can measure Cherenkov light emitted by atmospheric particle showers which are produced by incoming cosmic particles at high energies. Current Cherenkov telescopes, e.g. operated in the FACT and the MAGIC experiments, utilize Domino Ring Sampler 4 (DRS4) chips for recording signals at high speed coming from the telescopes' cameras. DRS4 chips will also be used in the cameras of the Large-Size telescopes of the projected Cherenkov Telescope Array (CTA). We aim at developing a software solution for the calibration of DRS4 data based on the *streams*-framework, a software tool for streaming analysis which has been developed within the Collaborative Research Center SFB 876. The objectives and the current status of the project will be presented.

T 38.5 Mo 17:45 VMP9 SR 27

FACT - New Image Parameters Based on the Watershed-Algorithm — •Lena Linhoff, Kai Arno Bruegge, and Jens Buss

for the FACT-Collaboration — TU Dortmund, Dortmund, Deutschland, Experimentelle Physik 5b

FACT, the First G-APD Cherenkov Telescope, is the first imaging atmospheric Cherenkov telescope that is using Geiger-mode avalanche photodiodes (G-APDs) as photo sensors. The raw data produced by this telescope are processed in an analysis chain, which leads to a classification of the primary particle that induce a shower and to an estimation of its energy. One important step in this analysis chain is the parameter extraction from shower images. By the application of a watershed algorithm to the camera image, new parameters are computed. Perceiving the brightness of a pixel as height, a set of pixels can be seen as 'landscape' with hills and valleys. A watershed algorithm groups all pixels to a cluster that belongs to the same hill. From the emerging segmented image, one can find new parameters for later analysis steps, e.g. number of clusters, their shape and containing photon charge. For FACT data, the FellWalker algorithm was chosen from the class of watershed algorithms, because it was designed to work on discrete distributions, in this case the pixels of a camera image. The FellWalker algorithm is implemented in FACT-tools, which provides the low level analysis framework for FACT. This talk will focus on the computation of new, FellWalker based, image parameters, which can be used for the gamma-hadron separation. Additionally, their distributions concerning real and Monte Carlo Data are compared.

T 38.6 Mo 18:00 VMP9 SR 27

Active learning for Corsika — •Dominik Baack, Fabian Temme, Jens Buss, Max Nöthe, and Kai Brügge for the FACT-Collaboration — TU Dortmund, Dortmund, Deutschland

Modern Cosmic-Ray experiments need a huge amount of simulated data. In many cases, only a portion of the data is actually needed for following steps in the analysis chain,for example training of different machine learning algorithms. The other parts are thrown away by the trigger simulation of the experiment or so not increase the quality of following analysis steps.

In this talk, I present a new developed package for the air shower simulation software corsika. This extension includes different approaches to reduce the amount of unnecessary computation. One approach is a new internal particle stack implementation that allows to priorice the processing of special intermediate shower paricles and the removal of not needed shower particles.

The second approach is the possibility to sent various information of the initial particle and parameters of the status of the partial simulated event to an external application to approximate the information gain of the current simulator event. If the information gain is to low, the current event simulation gets terminated and all information get stored into a central database. For the Simulation - Server communication a simple network protocol has been developed.

T 38.7 Mo 18:15 VMP9 SR 27

FACT - More than four Years of Blazar Monitoring — •Daniela Dorner for the FACT-Collaboration — Universität Würzburg, Deutschland

Since October 2011, the First G-APD Cherenkov Telescope (FACT) has been collecting more than 5500 hours of physics data. Thanks to the silicon based photosensors (SiPMs, aka G-APDs), observations during bright ambient light like full moon can be carried out without degradation of the sensors. Keeping the gain of the SiPMs stable using an online feedback system, a stable and homogeneous detector performance is achieved. Based on this and an automatic data taking procedure, an unbiased longterm data sample is collected. An automatic quick look analysis provides results shortly after the data are taken allowing to send flare alerts within the same night. The main targets for FACT are the bright TeV blazars Mrk 421 and Mrk 501 which are monitored since January 2012. In addition, several other sources like for example the Crab Nebula, 1ES 1959+650, 1ES 2344+54.1 are observed. In this presentation, the results from more than four years of monitoring will be summarized. Several flares from Mrk 501 and Mrk 421 will be discussed in the multi-wavelength (MWL) context. Mrk 501 underwent major outbursts in June 2012 and June 2014 during the yearly MWL campaigns. Mrk 421 showed a bright flare in April 2013 where also MWL observations are available. 1ES 1959+650 showed enhanced flux in autumn 2015. Results from these observations will be discussed.

T 38.8 Mo 18:30 VMP9 SR 27

FACT - Energy Spectrum of the Crab Nebula — •Fabian Temme, Sabrina Einecke, and Jens Buss for the FACT-Collaboration — TU Dortmund, Experimental Physics 5, Otto-Hahn-Str.4, 44221 Dortmund, Germany

The First G-APD Cherenkov Telescope is the first Imaging Air Cherenkov Telescope which uses silicon photon detectors (G-APDs aka SiPM) as photo sensors. With more than four years of operation, FACT proved an application of SiPMs is suitable for the field of ground-based gamma-ray astronomy. Due to the stable flux at TeV energies, the Crab Nebula is handled as a "standard candle" in Cherenkov astronomy. The analysis of its energy spectrum and comparison with other experiments, allows to evaluate the performance of FACT. A modern analysis chain, based on data stream handling and multivariate analysis methods was developed in close cooperation with the department of computer science at the TU Dortmund. In this talk, this analysis chain and its application will be presented. Further to this, results, including the energy spectrum of the Crab Nebula, measured with FACT, will be shown.

T 39: Suche nach dunkler Materie II

Zeit: Montag 16:45–19:05 Raum: VMP9 SR 28

Gruppenbericht T 39.1 Mo 16:45 VMP9 SR 28

XENON1T experiment: searching for Dark Matter with a ton-scale liquid xenon detector — •Matteo Alfonsi for the XENON-Collaboration — Johannes Gutenberg Universität Mainz

The XENON1T detector is the first dual-phase Time Projection Chamber (TPC) searching for Dark Matter with a ton scale ultra-pure liquid xenon target. We aim at the discovery of Weakly Interacting Massive Particles (WIMPs), well motivated particle candidates to explain the current abundance of Dark Matter in the Universe.

In Fall 2015 the construction in Hall B at the Laboratory Nazionali del Gran Sasso in Italy has been completed and the commissioning of the TPC, the active muon veto, all the cryogenics and the xenon purification infrastructures, is in a well advanced status. The first signals from the 248 ultra-low background Photomultiplier Tubes from Hamamatsu Photonics have been collected with the Data Acquisition system developed for XENON1T, and this allows for the validation of the reconstruction and analysis software as well. The first science run is expected to start in the first half of 2016: with 1 ton of xenon fiducial mass (out of a total of 3.3 ton) and 2 years exposure, we expect to reach a sensitivity to spin-indipendent WIMP-nucleon cross section better than 2×10^{-47} cm^2 (90% confidence level) .

In this talk I report about the progress of the XENON1T commissioning and the ongoing studies on novel calibration techniques with XENON100, the still operational predecessor experiment.

T 39.2 Mo 17:05 VMP9 SR 28

Commissioning of the XENON1T liquid level measurement system — •Christopher Geis — Institut für Physik, Johannes Gutenberg-Universität, Mainz

Two-phase xenon time projection chambers (TPCs) have been operated very successfully in direct detection experiments for dark matter. This kind of detector uses liquid xenon as the sensitive target and is operated in two-phase (liquid/gas) mode, where the liquid level needs to be monitored and controlled with sub-millimeter precision.

We present the installation, commissioning and first measurement data of two kinds of level meters operated in the XENON1T TPC: short level meters are three-plated capacitors measuring the level of the liquid-gas interface with a measurement range $h \approx 5\,\mathrm{mm}$ and a resolution of $\Delta C/h \approx 1\,\mathrm{pF/mm}$. The long level meters are cylindrical double-walled capacitors, measuring the overall filling level of the XENON1T TPC at a measurement range of $h = 1.4\,\mathrm{m}$ and a resolution of $\Delta C/h \approx 0.1\,\mathrm{pF/mm}$. Further, we present the design and programming of the readout electronic based on the UTI chip by Smartec, which allows to read all six levelmeters simultaneously.

T 39.3 Mo 17:20 VMP9 SR 28

XENON1T radon assay — •Stefan Brünner for the XENON-Collaboration — MPIK, Heidelberg, Deutschland

The radioactive isotope ^{222}Rn is one of the most dominant intrinsic background sources for experiments dealing with a low event rate like the XENON1T Dark Matter detector. Being part of the primordial decay chain of ^{238}U the noble gas ^{222}Rn permanently emanates from almost all materials. Therefore, it is crucial to determine the radon emanation rate of those detector components that will be in contact with the xenon target. The technique of the radon emanation measurements, making use of ultra low background proportional counters is presented as well as selected results for XENON1T.

T 39.4 Mo 17:35 VMP9 SR 28

Analyse von Verunreinigungen in Xenon für das XENON1T Experiment — •Constanze Hasterok für die XENON Kollaboration — Max Planck Institut für Kernphysik

Schwere schwach wechselwirkende Teilchen (WIMPs) sind eine populäre Erklärung für das Wesen der dunklen Materie. Bei der direkten Suche nach WIMPs wird der gerade in Betrieb genommene XENON1T Detektor eine führende Rolle einnehmen. Dieser ist mit 3.5 t Xenon gefüllt. Radioaktive Verunreinigungen wie Krypton-85, welches in der Atmosphäre vorkommt, tragen zum Untergrund bei. Elektronegative Verunreinigungen wie Sauerstoff und Wasser können Signalladungsträger wegfangen. Die Reinheit des verwendeten Xenons wurde durch graschromatographische Messungen vor der Befüllung sicher gestellt. Die Ergebnisse dieser Messungen sollen im Vortrag vorgestellt und diskutiert werden.

T 39.5 Mo 17:50 VMP9 SR 28

Commssioning of the cryogenic distillation column for the XENON1T experiment — •Michael Murra for the XENON-Collaboration — Institut für Kernphysik, WWU Münster

The recently inaugurated XENON1T experiment, located in the Laboratori Nazionali del Gran Sasso (LNGS), is the next generation experiment for the direct detection of dark matter in the form of Weakly Interacting Massive Particles (WIMPS). The new detector will utilize about 3.5 tons of liquid xenon in order to reach a projected sensitivity of $2{\cdot}10^{-47} cm^2$ for a WIMP mass of 50 GeV/c^2 . A key requirement to reach this sensitivity is the reduction of radioactive backgrounds such as ^{85}Kr, which has a beta-decay with an endpoint energy of 687 keV. Due to the difference in vapor pressure, the concentration of natural krypton in xenon can be reduced by several orders of magnitude by using cryogenic distillation. A krypton concentration of less than $0.2 \cdot 10^{-12}$ (0.2 parts per trillion) in xenon is required to achieve the desired sensitivity of the XENON1T experiment. Within this talk, the commissioning of the cryogenic distillation column, specially developed for XENON1T, at LNGS, along with the validation of a reduction factor greater 10^5, will be presented. Different aspects of this project have been funded by Großgeräte (DFG + state NRW), BMBF and Helmholtz-Alliance for Astroparticle Physics (HAP).

T 39.6 Mo 18:05 VMP9 SR 28

Geant4 simulations of the Münster dual phase xenon TPC — •Lutz Althüser — IKP, Westfälische Wilhelms-Universität Münster

The XENON Dark Matter Project uses the concept of a dual phase xenon time projection chamber (TPC) for a direct detection of weakly interacting massive particles (WIMPs). In the current operating step, XENON1T, the sensitivity of the detector will be increased by two orders of magnitude compared to its predecessor XENON100.

In order to investigate and test new systems for this experiment, as well as to do further studies, a small dual phase xenon TPC (height: 17 cm, diameter: 8 cm) with a light readout by 14 photomultiplier tubes (PMTs) was built at Muenster. For calibration of such a TPC regarding its light yield (LY) and light collection efficiency (LCE), radioactive sources can be placed near or inside the detector. The penetration of these sources depends on the inner volume of the detector, due to the self shielding effect of xenon, and on the used materials. The suitability of available radioactive sources can be determined by a Geant4 simulation package of the Münster TPC, which was used to test different calibration scenarios. This includes an internal low energy calibration with ^{83m}Kr.

Within this talk an introduction to the Geant4 Münster package and the simulation of different calibration possibilities of the Münster TPC is shown.

T 39.7 Mo 18:20 VMP9 SR 28

Measuring radon reduction in xenon boil-off gas — Stefan Bruenner, •Dominick Cichon, Sebastian Lindemann, Teresa Marrodán Undagoitia, and Hardy Simgen — MPIK, Heidelberg, Germany

^{222}Rn, which originates from the decay of primordial ^{238}U, is one of the major background sources for ultra-low background noble gas detectors. One of them is XENON1T, which is a dark matter direct detection experiment looking for hypothetical weakly interacting massive particles (WIMPs). It uses liquid xenon (LXe) as a detection medium and aims to be sensitive to spin-independent WIMP-nucleon cross-sections of $\sigma \sim 2 \cdot 10^{-47} cm^2$ at a WIMP mass of $\sim$ 50 GeV/c^2. To achieve this goal, radon activity inside the detector must be limited to a few mBq/kg.

One possible way for reducing the concentration of ^{222}Rn inside such an LXe detector is using the so-called "boil-off method". It takes advantage of the fact, that the radon concentration in boil-off xenon is smaller compared to the concentration in the liquid xenon from which the boil-off xenon evaporated. This can be understood by the different vapor pressures of radon and xenon. In this talk, tests conducted at the MPIK are outlined which probe the feasibility and effectiveness of the boil-off method. The results prove, that a reduction of the radon concentration can indeed be achieved. In addition, an outlook for possible future applications of this technique is given.

T 39.8 Mo 18:35 VMP9 SR 28

Characterization of a cryogenic distillation column with a Kr-83m tracer method — •Stephan Rosendahl[1], Ion Cristescu[2], Alexander Fieguth[1], Chrisian Huhmann[1], Michael Murra[1], and Christian Weinheimer[1] — [1]Institut für Kernphysik, Wilhelm-Klemm Strasse 9, 48149 Münster — [2]Karlsruher Institut für Technologie, Tritium Laboratory, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

The XENON1T experiment aims for the direct detection of dark matter with unreached precision of $2 \times 10^{-47}\ cm^2$ for the spin-independent WIMP-nucleon cross section. The cryogenic distillation is an important tool to reduce the intrinsic contamination with radioactive ^{85}Kr which undergoes a beta-becay with an endpoint energy of 687 keV, being one major source of background. Hence, a novel cryogenic distillation column has been designed and constructed in order to reduce the krypton concentration to $^{\mathbf{nat}}$Kr/Xe$<$0.2 ppt.

For the investigation of the performance and the dynamics of the distillation process on the sub-ppt level, a new $^{\mathbf{83m}}$Kr tracer method has been applied. For the $^{\mathbf{83m}}$Kr detection custom made PMT based detectors are used. In this talk the method as well as the results of the studies of the krypton seperation are presented.

Different aspects of the project are funded by DFG-Großgeräte, BMBF and Helmholtz-Alliance for Astroparticle Physics HAP.

T 39.9 Mo 18:50 VMP9 SR 28

Qualification Tests of 248 Photomultiplier Tubes for XENON1T — •Ludwig Rauch — Max-Planck-Insitut für Kernphysik, Heidelberg, Deutschland

The dark matter direct-detection experiment XENON1T employs photosensors with high detection efficiencies to obtain a low energy threshold of the detector enabling a search for small WIMP masses. In addition, the tube is designed for a low intrinsic radioactivity to minimize the background of the experiment. The expected sensitivity of the dark matter interaction cross sections to the xenon nucleon reaches $2{\times}10^{47}$ cm^2 with a particle with mass of 50 GeV/c^2.

This talk presents the setups and test procedures of the 248 installed photomultiplier tubes (PMTs) for XENON1T in order to decide whether they fulfil the experiment's requirements. In addition, an analysis of the performance of the used PMTs is presented and the implications for a dark matter search are outlined.

T 40: Kosmische Strahlung II

Zeit: Montag 16:45–19:05 Raum: VMP9 SR 29

Gruppenbericht T 40.1 Mo 16:45 VMP9 SR 29

Ultra-high energy cosmic rays: Results and status of the Pierre Auger Observatory — •Christine Peters for the Pierre-Auger-Collaboration — III. Physikalisches Institut A, RWTH Aachen University

The Pierre Auger Observatory is the world's largest experiment detecting extensive air showers initiated by cosmic rays at the highest energies. An area of 3000 km^2 is instrumented by 1660 water Cherenkov detector stations, and 27 fluorescence telescopes overlook the atmosphere above the surface detector array. A hybrid detection principle is achieved by utilizing information of both detectors. A major upgrade of the experiment (AugerPrime) has been decided adding a third detector type, scintillator detector stations located on the water Cherenkov tanks. Thereby, the composition sensitivity of the Pierre Auger Observatory is extended by an improved determination of the muonic shower component. Additionally, underground muon detectors (AMIGA) are deployed. The experiment has been further extended by antennas measuring the emission of radio signals from air showers (AERA).
An overview about recent results and the current status of the experiment will be given in this talk. Highlights are updated results, e.g. on the energy spectrum, chemical composition or proton-air cross section.

T 40.2 Mo 17:05 VMP9 SR 29

Extragalaktische Propagation ultrahochenergetischer Photonen zur Abschätzung des Photonhorizonts — •Christopher Heiter, Martin Erdmann, Daniel Kuempel und David Walz — III. Physikalisches Institut A, RWTH Aachen University

Bei der Suche nach ultrahochenergetischen Photonen mit Energien oberhalb von 10^{17} eV werden die beobachtbaren Photonenquellen innerhalb einer maximalen Distanz erwartet. Dieser sogenannte Photonhorizont ergibt sich aus den Wechselwirkungen der Photonen mit Materie und den Feldern des Universums. Um den beobachtbaren Distanzbereich von Quellkandidaten abschätzen zu können, werden Simulationen der Photonpropagation durch den extragalaktischen Raum durchgeführt. Mit den Simulationsprogrammen EleCa und CRPropa 3 werden sowohl die Wechselwirkungen der Photonen mit den kosmischen Photonfeldern als auch die Ablenkungen der geladenen Sekundärteilchen in extragalaktischen Magnetfeldern berücksichtigt. Simulationsstudien für verschiedene astrophysikalische Szenarien werden diskutiert sowie Abschätzungen für die beobachtbaren Quelldistanzen vorgestellt.

T 40.3 Mo 17:20 VMP9 SR 29

Die Suche nach dem Sonnen- und Mondschatten in den Daten des Pierre-Auger-Observatoriums — •Patrick Noever, Markus Lauscher und Thomas Hebbeker für die Pierre-Auger-Kollaboration — III. Physikalisches Institut A, RWTH Aachen University

Das Pierre-Auger-Observatorium in Argentinien hat eine instrumentierte Fläche von ca. 3000 km^2 und detektiert die Ankunftsrichtungen und Energien ($E > 10^{18}$ eV) der ultrahochenergetischen kosmischen Strahlung. Wie bei anderen astrophysikalischen Experimenten kann auch hier der Teilchendurchgang durch Mond und Sonne ein Defizit an erwarteten Beobachtungen verursachen. Die Detektion eines solchen "Schattens" könnte dazu genutzt werden, um eine direkte Messung der Winkelauflösung des Oberflächendetektors (SD) zu erhalten. Des Weiteren kann eine Analyse in Äquatorialkoordinaten Erkenntnisse über Systematiken bei der Richtungsrekonstruktion liefern.

Bei den Daten des Pierre-Auger-Observatoriums ist dies aufgrund der limitierten Statistik eine besondere Herausforderung. Es wird eine Analyse vorgestellt, die es ermöglicht, in den Daten des Pierre-Auger-Observatoriums nach Sonnen- und Mondschatten zu suchen. Die erwartete Performance dieser Analyse wird mit Hilfe von Monte-Carlo-Simulationen unter vereinfachten Bedingungen gezeigt. Anschließend wird eine erste Anwendung auf die Daten des Pierre-Auger-Observatoriums präsentiert.

T 40.4 Mo 17:35 VMP9 SR 29

Super-preshowers* — •Alex Kääpä for the Pierre-Auger-Collaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Based on the current data from the Pierre Auger Observatory, no evidence of cosmic ray photon primaries has been found. However, photon primaries could induce so-called "super-preshowers", which have not been considered sofar, but are a promising candidate for explaining the "composition puzzle" at ultra-high energies. In this presentation, possible super-preshower processes are examined, and their effects on important Auger parameters, such as the energy deposit and muon production, are studied via simulations.

*Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik

T 40.5 Mo 17:50 VMP9 SR 29

Das Energiespektrum der höchstenergetischen kosmischen Strahlung gemessen mit dem Pierre-Auger-Observatorium — •Daniela Mockler, Alexander Schulz und Markus Roth für die Pierre-Auger-Kollaboration — Karlsruher Institut für Technologie

Das Energiespektrum der kosmischen Strahlung kann am Pierre-Auger-Observatorium in vier unterschiedlichen, voneinander unabhängigen, Messungen bestimmt werden. Die Kombination dieser Datensätze erlaubt die präzise Vermessungen des kosmischen Strahlungsflusses über mehr als drei Energiedekaden. Die Präzision wird von den systematischen Unsicherheiten der verschiedenen Spektren wesentlich beeinflusst.

In diesem Beitrag wird eine Analyse vorgestellt, bei der alle auftretenden Systematiken in der Maximum-Likelihood berücksichtigt werden. Diese Methode dient nicht nur der verbesserten Kombination der Auger-Spektren, sondern kann auch auf die Spektrenkombination unterschiedlicher Experimente erweitert werden.

T 40.6 Mo 18:05 VMP9 SR 29

Search for ultra-high energy photons with AMIGA muon counters — •Nicolas Martin Gonzalez for the Pierre-Auger-Collaboration — Instituto de Tecnologias en Deteccion y Astroparticulas, Buenos Aires, Argentina. — Institut für Kernphysik, Karlsruher Institut für Technologie.

The study of the composition of ultra-high energy (UHE) cosmic rays (CR) is one of the topical problems of astroparticle physics. The discovery of UHE photons, i.e. photons with energies around 1 EeV, in primary cosmic rays could be of particular interest for the field of astroparticle physics, and also for fundamental physics, since they are tracers of the highest-energy processes in the Universe. For the search for UHE photons at the Pierre Auger Observatory (PAO), several parameters have been proposed to distinguish between primary hadrons and photons. One of the most promising approaches to search for primary gamma rays is the study of the muon component in extensive air showers (EAS) produced in the interaction between the CR and the nuclei in the atmosphere. The number of muons in showers induced by gamma primaries is an order of magnitude lower than the hadronic primaries counterpart. The AMIGA extension of the PAO, consisting of an array of buried scintillators counters, allows the study of the muons produced during the EAS development. In this talk, the sensitivity of the muon counters to photon-initiated EAS and the possible discrimination procedures will be discussed using dedicated EAS simulations with software package CORSIKA, including the detector response using the Offline package developed by the Pierre Auger Collaboration.

T 40.7 Mo 18:20 VMP9 SR 29

Photon/Hadron-Unterscheidung in Hybrid-Ereignissen des Pierre-Auger-Observatoriums — Marcus Niechciol, Markus Risse, •Philip Ruehl und Alexey Yushkov für die Pierre-Auger-Kollaboration — Universität Siegen

Die Frage nach der Zusammensetzung der kosmischen Strahlung bei den höchsten Energien (oberhalb von 10^{18} eV) ist eine Schlüsselfrage der Astroteilchenphysik. Der Nachweis ultrahochenergetischer Photonen spielt dabei eine entscheidende Rolle und wäre nicht nur für Astrophysik und Teilchenphysik, sondern auch für die fundamentale Physik von großer Bedeutung. Das Pierre-Auger-Observatorium bei Malargüe, Argentinien, ist das größte Luftschauerexperiment zum Nachweis ultrahochenergetischer kosmischer Strahlung. Es besteht aus ∼1660 Wasser-Čerenkov-Detektoren, die eine Fläche von ∼3000 km^2 abdecken. Eine zusätzliche, unabhängige Nachweismethode ermöglichen 27 Fluoreszenzteleskope an vier Standorten am Rand des Detektorfeldes.

In diesem Vortrag wird eine Methode diskutiert, die die vorliegenden Informationen aus beiden Detektorsystemen (Hybrid-Ereignisse) ver-

wendet um daraus ein Kriterium zur Unterscheidung von primären Photonen und Hadronen in der ultrahochenergetischen kosmischen Strahlung abzuleiten.

Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik und die Helmholtz-Allianz für Astroteilchenphysik.

T 40.8 Mo 18:35 VMP9 SR 29

Possible sources of UHECRs: characteristics, predictions and observational consequences — •Soraya Behroozian, Markus Risse, and Alexey Yushkov — University of Siegen

Ultra-high energy cosmic rays (UHECRs) are charged particles with energies above 1 EeV originating from astrophysical sources. Due to interactions with the extragalactic and galactic magnetic fields during propagation the arrival directions of the UHECRs do not point back to the sources and the origin of these particles is an open question. Many models have been developed proposing astrophysical objects such as SNe, AGNs (Cen A being the most addressed one), quasars, blazars and GRBs as plausible acceleration sites. We review some characteristics of such sources and discuss the observational predictions comparing them to the recent results on the mass composition from the Pierre Auger Observatory. This work was supported by the BMBF Verbundforschung Astroteilchenphysik.

T 40.9 Mo 18:50 VMP9 SR 29

First simultaneous fit of the energy spectrum, mass composition and anisotropy of the Auger/Telescope Array cosmic ray data* — •David Wittkowski and Karl-Heinz Kampert — Bergische Universität Wuppertal

The first detection of ultra-high energy cosmic rays (UHECR, $E > 1$ EeV) dates back to Linsley (1963), but only very little is currently known about their sources. To obtain information about the sources of UHECR, the Pierre Auger Observatory and the Telescope Array have been detecting the UHECR arriving at Earth for about a decade. The collected data can be compared to corresponding results from simulations of the propagation of UHECR allowing to test assumptions regarding the UHECR sources. In this talk we will report on sophisticated simulations carried out with the Monte-Carlo Code CRPropa 3 that - in contrast to earlier simulations - take into account deflections of UHECR in cosmic magnetic fields as well as cosmological effects such as the redshift evolution of the photon background and the adiabatic expansion of the universe. We carried out such simulations assuming different properties of the UHECR sources (e.g., the density and mass spectrum of the particles at the sources). Based on these simulations, we will present and discuss results from the first simultaneous fit of the energy spectrum, mass composition and anisotropy of the UHECR observed at the Pierre Auger Observatory and Telescope Array. This includes especially the astrophysical scenario with the closest agreement with the current UHECR data.

* *Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 41: Neutrinoastronomie

Zeit: Montag 16:45–19:00 Raum: VMP9 SR 30

T 41.1 Mo 16:45 VMP9 SR 30

Analysis of Electron-Neutrino induced Cascades in IceCube — •Eike Otto for the IceCube-Collaboration — TU Dortmund, Dortmund, Deutschland

IceCube is a neutrino observatory located at the South Pole. It is capable of detecting neutrinos over a large energy range. The search for astrophysical neutrinos faces the challenges of a very low signal-to-background ratio due to the large amount of atmospheric muons.

Electron neutrinos that interact with nuclei in the surrounding ice produce secondary particles that create a unique spherical pattern called 'cascade' which can be detected with the IceCube detector.

This work concentrates on the analysis of electron neutrino induced cascades in IceCube using multivariate methods. The event selection puts focus on selecting neutrino candidates from the atmospheric and muon background. The overall analysis goal is an estimation of the electron neutrino energy spectrum.

In this talk I will present the current state of my analysis and give a perspective on following steps.

T 41.2 Mo 17:00 VMP9 SR 30

Calculation of the Cherenkov Light Yield of High-Energetic Particle Cascades in IceCube — •Ömer Penek, Leif Rädel, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut, RWTH Aachen University, D-52056 Aachen, Germany

Cherenkov light occurs if a charged particle in a dielectric moves faster than the phase velocity of light. The radiation emitted by a single track per unit path length and unit frequency of light is given by the well-known Frank-Tamm formula. This formula assumes single particle tracks that are much longer than the emitted wavelength and the size of the polarization region. We will present a first principle calculation of the Cherenkov light yield which is applicable for the case of very high particle densities where the polarization regions of the tracks may overlap. This can be relevant for the recently observed ultra-high-energetic neutrino interactions in IceCube.

T 41.3 Mo 17:15 VMP9 SR 30

Higher order corrections to muon cross sections — •Alexander Sandrock for the IceCube-Collaboration — Technische Universität Dortmund

The energy reconstruction of high-energetic muons in the IceCube neutrino observatory is based on the energy losses through electromagnetic interactions. The systematic uncertainties of IceCube are among others the result of uncertainties in the muon cross-sections for bremsstrahlung, pair production and photonuclear interaction. This presentation will give a brief overview about the status of currently used parametrizations and a new calculation for the bremsstrahlung cross section that also takes into account higher order corrections.

T 41.4 Mo 17:30 VMP9 SR 30

Search for Indications of the Neutrino Mass Hierarchy Using IceCube/DeepCore — •Martin Leuermann, Markus Vehring, Marius Wallraff, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen, Germany

In 2015, the Nobel prize in physics was awarded for "the discovery of neutrino oscillations, which shows that neutrinos have mass", showing the high relevance of neutrino masses for modern particle physics. However, the ordering of the three neutrino masses is still unknown and is often referred to as neutrino mass hierarchy. Its measurement is a major goal for future experiments. One strategy is to measure matter effects in the oscillation pattern of atmospheric neutrinos e.g. as proposed for the PINGU extension of the IceCube neutrino observatory. Already now, the IceCube/DeepCore detector at the Geographic South Pole can be used to search for this signature. In this talk, we present an analysis based on data taken between 2011 and 2015. Due to recent improvements in the detector's reconstruction performance and the quality of the data selection, a measurement on the significance level of 1 sigma is expected.

T 41.5 Mo 17:45 VMP9 SR 30

Search for neutrino emission from the Galactic plane with IceCube using starting events — •Kai Krings for the IceCube-Collaboration — TU München, Physik-Department, Excellence Cluster Universe, Boltzmannstr. 2, 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, searching for an integrated neutrino signal along 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 starting inside 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 generic Galactic plane models, using two years of starting event data.

T 41.6 Mo 18:00 VMP9 SR 30

Korrekturen an Paarproduktions-Wirkungsquerschnitten für

Neutrinosimulationen bei IceCube — •Jan Soedingrekso für die IceCube-Kollaboration — TU Dortmund, Dortmund, Deutschland

Ein Ziel des Neutrinoteleskops IceCube ist die Energiebestimmung der den Detektor durchlaufenden Leptonen. Die Rekonstruktion dieser Energie basiert auf Monte Carlo Simulationen. Für geringere systematische Unsicherheiten bei experimentell beobachteten Ereignissen und somit genauere Vorhersagen, müssen in der Simulation die Wechselwirkungen der Teilchen mit der Materie möglichst genau berechnet sein. Dabei tragen bei hohen Energien hauptsächlich die Bremsstrahlung, Paarproduktion und photonukleare Wechselwirkung zum Energieverlust bei.

In dem Vortrag wird ein Überblick über den aktuell im Leptonpropagator PROPOSAL verwendeten Wirkungsquerschnitt der Paarproduktion gegeben, sowie weitere Einflüsse und Korrekturterme vorgestellt.

T 41.7 Mo 18:15 VMP9 SR 30

Rekonstruktion der Myon-Energie am IceCube-Neutrinodetektor durch k-NN-Regression — •Mirco Hünnefeld für die IceCube-Kollaboration — TU Dortmund, Dortmund, Deutschland

Die Energierekonstruktion von Myonen stellt eine zentrale Herausforderung am IceCube-Neutrinodetektor dar. Bisherige Implementationen nutzen die Spurlänge bei niederenergetischen und bei höherenergetischen Myonen den myonspezifischen Energieverlust dE/dx, um die Energie zu bestimmen.

Deutliche Performance-Steigerungen sind durch die Verwendung maschineller Lernverfahren möglich. Als Beispiel wird die k-NN-Regression zur Energierekonstruktion von Myonen vorgestellt und mit den bestehenden Rekonstruktionsmethoden verglichen.

Die vorgestellte Methodik ist zudem analog auf andere Probleme anwendbar, wie zum Beispiel die Spurrekonstruktion von Elektron-Neutrinos am IceCube-Neutrinodetektor.

T 41.8 Mo 18:30 VMP9 SR 30

Luminescence as a new detection method for non-relativistic highly ionizing particles in water/ice neutrino telescopes — •Anna Pollmann for the IceCube-Collaboration — Bergische Universität Wuppertal

Cosmic ray detectors use air as a radiator for luminescence. In water and ice detectors Cherenkov light is the dominant light producing mechanism when the particle velocity exceeds the Cherenkov threshold, approximately three quarters of the speed of light.

Luminescence is produced by highly ionizing particles passing through matter due to the excitation of the surrounding atoms. The observables of luminescence, such as the wavelength spectrum and decay times, are highly dependent on the properties of the medium. Therefore, the results of measurements, in which luminescence was produced by particles passing through water or ice, vary by two orders of magnitude in intensity.

It will be shown that, even for the most conservative intensity value, luminescence can be used as a detection method for highly ionizing particles with velocities below the Cherenkov threshold. These could be magnetic monopoles or other massive and highly penetrating exotic particles. In the most optimistic case, luminescence contributes even to the light output of standard model particles.

T 41.9 Mo 18:45 VMP9 SR 30

Search for neutrinos from flaring blazars — •Michael Kreter[1,2], Thomas Eberl[2], Clancy James[2], and Matthias Kadler[1] for the ANTARES-KM3NeT-Erlangen-Collaboration — [1]Lehrstuhl für Astronomie, Universität Würzburg, Emil-Fischer-Strasse 31, 97074 Würzburg, Germany — [2]ECAP, Universität Erlangen-Nürnberg, Erwin-Rommel-Str. 1, 91058 Erlangen, Germany

Jets from Active Galactic Nuclei (AGN) are among the best candidates for the recently detected extraterrestrial neutrino flux. Hadronic AGN jet-emission models predict a tight correlation between the neutrino flux and the time-variable gamma-ray emission. At the same time, the atmospheric-background (noise) signal, which often dominates in neutrino-astronomical observations, can be substantially reduced by rejecting long-lasting periods of low flux. For these reasons, short high-amplitude gamma-ray flares, as often observed in blazars, can be used to substantially increase the sensitivity of neutrino telescopes in point-source searches. We develop a strategy to search for TeV neutrinos from flaring blazar jets from the TANAMI sample using the ANTARES telescope and Fermi gamma-ray light curves. An unbinned maximum-likelihood method is applied to optimize the probability of a neutrino detection from TANAMI sources.

T 42: Trigger und DAQ II

Zeit: Montag 16:45–18:45 Raum: VMP11 HS

T 42.1 Mo 16:45 VMP11 HS

The Data Handling Processor of the Belle II DEPFET Detector — •Leonard Germic, Tomasz Hemperek, Tetsuichi Kishishita, Botho Paschen, Florian Lütticke, Hans Krüger, Carlos Marinas, and Norbert Wermes for the Belle II-Collaboration — Universität Bonn

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. Additional feature of the Data Handling Processor is the control block, providing control signals for the on-module ASICs used in the pixel detector. In this contribution, the description of the latest chip revision in TSMC 65 nm technology together with the latest test results of the interface functionality tests are presented.

T 42.2 Mo 17:00 VMP11 HS

Test Runs of a Belle II PXD Prototype Readout System — •Dennis Getzkow[1], Thomas Gessler[2], Wolfgang Kühn[1], Sören Lange[1], and Klemens Lautenbach[1] for the Belle II-Collaboration — [1]Justus-Liebig-Universität Gießen, II. Physikalisches Institut — [2]KEK, Tsukuba (Japan)

The Belle II PXD readout system (called ONSEN for Online Selection Nodes) uses ATCA (Advanced Telecommunications Architecture) boards with Xilinx Virtex-5 FX70T FPGAs and high speed optical links (6.5 Gbit/s each). The full system consists of 9 carrier boards and 33 daughter cards. The ONSEN system has several interfaces: (a) it receives PXD data from the DHH (Data Handling Hybrid) system, (b) it receives ROI (Regions-of-Interest) data for online data reduction from the HLT (High Level Trigger) system by GbE, and (c) it features data ports to two event builders: EVB1 combines data from all detectors except PXD (in order to generate the ROIs) and EVB2 combines the reduced PXD data with all other data. One of the critical issues is the matching of trigger numbers in the data (received by DHH from the timing distribution system) and trigger numbers in the ROIs (received by the HLT). In order to test the interfaces, in particular for a high HLT rate up to 30 kHz, a prototype system with 3 daughter cards was installed at KEK and tested with DHH, HLT and EVB2. Test results will be presented.

This work was supported by the Bundesministerium für Bildung und Forschung under grant number 05H15RGKBA.

T 42.3 Mo 17:15 VMP11 HS

First considerations for a readout system for the ILD TPC with the Timepix3 — •Tobias Schiffer for the LCTPC-Deutschland-Collaboration — Universität Bonn

For the planned International Linear Collider (ILC) two detectors are proposed. One of them, the International Large Detector (ILD) uses a Time Projektion Chamber (TPC) as the main tracking device. As a readout system for this TPC, pixel chips are one of the considered options. An integrated Micromegas stage is foreseen as gas amplification stage, which is built directly on top of the chip.

Since first tests of a Pixel-TPC with 160 Timepix ASICs showed promising results, one is interested in developing a detector using the

Timepix3 ASIC. It has several advantages, first of all its feature to measure ToT and a ToA at the same time and its significantly increased readout rate.

For this purpose a readout system needs to be developed which fulfils the requirements of the Timpix3 ASIC and also has a high scalability. The main challenges are the high speed readout with a clock of up to 640 MHz and the reliability of the system. Also, the data driven as well as the frame-based readout of the Timepix3 needs to be considered for the implementation. The main goal is to provide a fast and parallel readout of several million channels.

An overview and the status of the planning will be given. Also, the development challenges will be discussed.

T 42.4 Mo 17:30 VMP11 HS

The DATCON System of the Belle II Experiment - Tracking and Data Reduction — •Christian Wessel, Jochen Dingfelder, Carlos Marinas, and Bruno Deschamps — Universität Bonn - Physikalisches Institut

The SuperKEKB e^+e^- accelerator at KEK in Japan will have a luminosity which is a factor of 40 higher than the luminosity of its predecessor KEKB. The Belle II detector at SuperKEKB will contain a two-layer pixel detector at radii of 1.421 and 2.179 cm from the interaction point, based on the DEPFET (DEpleted P-channel Field Effect Transistor) technology. It is surrounded by four layers of strip detectors. Due to the high collision rate, the data rate of the pixel detector needs to by drastically reduced by an online data reduction system. The DATCON (Data Acquisition Tracking and Concentrator Online Node) system performs track reconstruction in the SVD (Strip Vertex Detector) and extrapolates to the PXD (PiXel Detector) to calculate ROI and to keep only hits in the ROI. The track reconstruction algorithm is based on a Hough transform, which reduces track finding to finding intersection points in the Hough parameter space. In this talk the employed algorithm for fast online track reconstruction on FPGA, ROI finding and the performance of the data reduction are presented.

T 42.5 Mo 17:45 VMP11 HS

Online Track and Vertex Reconstruction on GPUs for the Mu3e Experiment — •Dorothea vom Bruch for the Mu3e-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The Mu3e experiment searches for the lepton flavour violating decay $\mu \to eee$, aiming at a branching ratio sensitivity better than 10^{-16}.To reach this sensitivity, muon rates above 10^9 μ/s are required. A high precision silicon tracking detector combined with excellent timing resolution from scintillating fibers and tiles will measure the momenta, vertices and timing of the decay products of muons stopped in the target to suppress background.

The trigger-less readout system will deliver about 100 GB/s of zero-suppressed data. A network of optical links and switching FPGAs sends the complete detector data for a time slice to one node of the filter farm. An FPGA inside the filter farm PC transfers the event data to the GPU via PCIe direct memory access. The GPU finds and fits tracks using a 3D tracking algorithm for multiple scattering dominated resolution. In a second step, a three track vertex fit is performed, allowing for a reduction of the output data rate to below 100 MB/s by removing combinatorial background. The talk discusses the data flow from the FPGA to the GPU as well as the implementation and performance of the track and vertex fits on the GPU.

T 42.6 Mo 18:00 VMP11 HS

GPU-based online track reconstruction for the MuPix-telescope — •Carsten Grzesik for the Mu3e-Collaboration — JGU, Mainz

The MuPix telescope is a beam telescope consisting of High Voltage Monolithic Active Pixel Sensors (HV-MAPS). This type of sensor is going to be used for the Mu3e experiment, which is aiming to measure the lepton flavor violating decay $\mu \to eee$ with an ultimate sensitivity of 10^{-16}. This sensitivity requires a high muon decay rate in the order of 1 GHz leading to a data rate of about 1 TBit/s for the whole detector. This needs to be reduced by a factor 1000 using online event selection algorithms on Graphical Processing Units (GPUs) before passing the data to the storage.

A test setup for the MuPix sensors and parts of the Mu3e tracking detector readout is realized in a four plane telescope. The telescope can also be used to show the usability of an online track reconstruction using GPUs. As a result the telescope can provide online information about efficiencies of a device under test or the alignment of the telescope itself. This talk discusses the implementation of the GPU based track reconstruction and shows some results from recent testbeam campaigns.

T 42.7 Mo 18:15 VMP11 HS

Flex-prints for the Mu3e experiment — •Sebastian Dittmeier for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

Mu3e is a novel experiment dedicated to the search for the charged lepton flavor violating decay $\mu^+ \to e^+e^-e^+$ with a targeted sensitivity of a branching ratio (BR) down to 10^{-16}. Within the standard model of particle physics this process is extremely suppressed to $BR < 10^{-54}$. Thus, any observation would be a clear sign for new physics beyond the standard model. The Mu3e detector consists of a silicon pixel tracking detector using the novel HV-MAPS (High Voltage Monolithic Active Pixel Sensor) technology to measure the momentum of the decay products, and scintillating fibres and tiles for precise timing. The pixel sensors are thinned to $50\mu m$ to achieve a material budget of about 0.1% radiation length per tracking layer. The pixel sensors are powered and connected to readout frontend boards using custom designed flex-prints, which are low material interconnects with a high signal density. We present studies of high speed data transmission up to 3.2 Gb/s over flex-print prototypes produced in-house. The design of the flex-prints for the Mu3e detector will be discussed. A 3-layer design including power, ground and slow control distribution, as well as 9 1.25 Gb/s data transmission lines for the readout of the pixel sensors is foreseen.

T 42.8 Mo 18:30 VMP11 HS

Integration des aktualisierten USBPix Testsystems in die Steuersoftware STcontrol — •Eric Buschmann, Jörn Grosse-Knetter und Arnulf Quadt — Georg-August-Universität Göttingen

Die geplante Luminositätserhöhung des LHC (HL-LHC) vergrößert die Strahlenbelastung der Detektoren und hebt die Ansprüche an Orts- und Zeitauflösung. Dies erfordert eine neue Generation von Sensoren und Auslesechips, welche zu ihrer vollständigen Charakterisierung verbesserte Testsysteme bedingen. USBpix 3 ist die nächste Generation der USB-basierten USBpix Test- und Auslesesysteme, die in Labor- und Teststrahl-Umgebungen verwendet werden. Die neue Hardware ermöglicht hohe Übertragungsraten mit USB 3.0 und bietet Leistungsreserven für zukünftige Entwicklungen. Durch den verwendeten FPGA ist das System flexibel anpassbar. Dabei kommt eine Firmware basierend auf dem modularen Basil-Framework zum Einsatz. Die Steuerung erfolgt über eine graphische Benutzeroberfläche basierend auf der offiziellen ATLAS Pixelsoftware PixLib. Im Vortrag wird das System und dessen Integration in die Steuersoftware STcontrol vorgestellt.

T 43: Hauptvorträge

Zeit: Dienstag 8:30–10:30 Raum: VMP4 Audimax 1

Hauptvortrag T 43.1 Di 8:30 VMP4 Audimax 1

Suche nach neuer Physik am LHC — •Frederik Rühr — Albert-Ludwigs-Universität Freiburg

Auf der Suche nach Physik jenseits des Standardmodells wurden letzte Ergebnisse mit Proton-Proton Kollisionen bei 8 TeV veröffentlicht, während neue Daten bei einer Schwerpunktsenergie von 13 TeV bereits einen ersten Blick auf vorher nicht zugängliche Bereiche des Phasenraums erlauben.

Der maximale Gewinn durch die erhöhte Schwerpunktsenergie des LHC kann bei hohen Skalen gezogen werden, was schon jetzt zulässt, vorherige Ergebnisse signifikant zu übertreffen. In der ersten Datennahmeperiode des LHC konnten die Experimente ATLAS und CMS keine Beweise für die Existenz neuer Physik finden, aber eine Anzahl an Regionen identifizieren, für die zusätzliche Daten besonders inter-

essant sind. Auf diesen liegt ein zusätzlicher Fokus neuer Studien.

An der Schwelle zum Neustart der Datennahme nach der Winterpause des LHC wird eine Zwischenbilanz der Suche nach neuer Physik, inklusive Supersymmetrie, durch die ATLAS und CMS Kollaborationen gezogen und diskutiert.

Hauptvortrag T 43.2 Di 9:10 VMP4 Audimax 1
CERN physics programme — •Eckhard Elsen — CERN, Geneva, Switzerland

The Large Hadron Collider has provided first pp-collisions at 13 TeV in 2015, extending the energy reach by almost a factor 2 and leading to a wealth of results at this conference. While waiting for a signal from Japan to host the electron positron International Linear Collider ILC for precision studies of the electroweak symmetry breaking the Future Circular Collider FCC design study has been launched to push the energy frontier in pp-collisions thus complementing similar goals for ee-colliders for the Compact Linear Collider CLIC. A joint platform activity on neutrinos has been launched at CERN facilitating European participation in short and long baseline accelerator experiments. These are but some of the elements of the ongoing physics programme at CERN.

Hauptvortrag T 43.3 Di 9:50 VMP4 Audimax 1
Low energy precision experiments with muons — •Niklaus Berger — Institute for Nuclear Physics and PRISMA Cluster of Excellence, JGU Mainz

Many of the most stringent tests of the Standard Model of particle physics are performed in low energy experiments involving muons. One of them is the measurement of the anomalous magnetic moment of the muon, where a 3.5 σ discrepancy between theory and measurement is seen. A new, improved experiment at Fermilab will start taking data soon. A second experiment employing an innovative cold muon beam is planned at J-PARC in Japan.

Another area is the search for charged lepton flavour violation, where the existing limits already strongly constrain models for physics beyond the standard model and a variety of new experiments is in the planning and construction phase. The MEG experiment at PSI searches for the decay $\mu \to e\gamma$ and just underwent a major upgrade. Several experiments are planned to search for the conversion of a muon to an electron in the field of a nucleus. At PSI, a new experiment to search for the decay $\mu \to eee$ is being designed.

The talk will report the current status of precision muon experiments and give an outlook on the upcoming measurements and the exciting new experimental technologies involved.

T 44: Eingeladene Vorträge I

Zeit: Dienstag 13:45–16:15 Raum: VMP4 Audimax 1

Eingeladener Vortrag T 44.1 Di 13:45 VMP4 Audimax 1
Der Ausbau des Inneren Spurdetektors am ATLAS-Experiment — •Susanne Kühn — Universität Freiburg

Die Detektoren des ATLAS-Experiments sind äußerst leistungsfähig und haben in den vergangenen Jahren erfolgreich mehrere fb^{-1} an Daten von Proton-Proton-Kollisionen am LHC gesammelt. Ab 2023 werden der Beschleuniger und die Experimente am LHC zum sogenannten *High−Luminosity* LHC, für den Betrieb bei einer zehnfach höheren Luminosität als die Designluminosität des LHC, ausgebaut. Die erhöhte Luminosität bedeutet für Detektoren wie den ATLAS-Detektor zum einen, eine entsprechend gestiegene Strahlenbelastung, insbesondere für den Inneren Spurdetektor, und zum anderen einen starken Anstieg der Teilchenraten. Um die Leistungsfähigkeit bei diesen extremen Anforderungen zu erhalten, wird der Innere Spurdetektor des ATLAS-Experiments durch Siliziumpixel- und -streifenzähler ersetzt. Der Vortrag erläutert die Herausforderungen bei der Erneuerung des Inneren Spurdetektors. Er gibt einen Überblick über den aktuellen Stand der Forschungs- und Entwicklungsarbeiten und zeigt sowohl die Konzepte als auch Technologieentscheidungen für den Ausbau des neuen Siliziumspurdetektors, insbesondere des Siliziumstreifendetektors. Er präsentiert neue Ergebnisse von Untersuchungen verschiedener möglicher Detektorlayouts und stellt aktuelle Studien unteschiedlicher Prototypen vor. Darüber hinaus gibt er einen Ausblick auf die Realisierung des Detektorsystems im kommenden Jahrzehnt.

Eingeladener Vortrag T 44.2 Di 14:15 VMP4 Audimax 1
The SNO+ experiment: current status and future prospects — •Valentina Lozza — Institut fuer Kern- und Teilchenphysik, Zellescher Weg 19, 01069 Dresden, Germany

SNO+ is a large liquid scintillator based experiment that reuses the Sudbury Neutrino Observatory detector. The detector, located 2 km underground in a mine near Sudbury, Canada, consists of a 12 m diameter acrylic vessel which will be filled with 780 tonnes of liquid scintillator. The main physics goal of SNO+ is to search for the neutrinoless double-beta ($0\nu\beta\beta$) decay of ^{130}Te. During the double-beta phase, the liquid scintillator will be initially loaded with 0.3–0.5% natural tellurium. In 5 years of data taking, SNO+ expects to reach a sensitivity on the effective Majorana neutrino mass of 55–133 meV, just above the inverted neutrino mass hierarchy region. Recently, the possibility to deploy up to 10 times more natural tellurium has been investigated, by which SNO+ could explore deep into the parameter space for the inverted hierarchy in the near future. Designed as a general purpose neutrino experiment, SNO+ can additionally measure the reactor antineutrino oscillations, geo-neutrinos in a geologically-interesting location, watch supernova neutrinos and measure low-energy solar neutrinos. A first commissioning phase with the detector filled with water will begin soon. The scintillator phase is expected to start after few months of water data taking. The $0\nu\beta\beta$ decay phase is foreseen for the 2017. In this talk the current status and the broad physics program of SNO+ will be presented.

This work is supported by the German Research Foundation (DFG).

Eingeladener Vortrag T 44.3 Di 14:45 VMP4 Audimax 1
Messung von *CP*-Verletzung im System neutraler *B*-Mesonen mit dem LHCb-Experiment — •Julian Wishahi — Experimentelle Physik 5, TU Dortmund

Ein Forschungsschwerpunkt des LHCb-Experiments am CERN ist die Präzisionsmessung *CP*-verletzender Prozesse neutraler *B*-Mesonen. Mit dem im Laufe des LHC Run I aufgenommenen, weltweit größten Datensatz rekonstruierter *B*-Meson-Zerfälle konnte die erste Präzisionsmessung des CKM-Parameters $\sin(2\beta)$ an einem hadronischen Beschleuniger durchgeführt werden. Trotz der experimentellen Herausforderungen, wie hohen Spurmultiplizitäten und Untergrundraten, wurde hierbei eine Präzision erreicht, die den Ergebnissen der *B*-Fabriken, BaBar und Belle, gleicht. Mit weiter steigender Präzision der experimentellen Messungen wird ein besseres Verständnis von Prozessen höherer Ordnung nötig, um diese von potentiellen Beiträgen durch Physikprozesse jenseits des Standardmodells zu unterscheiden. Hierbei können Messungen weiterer *CP*-Observablen beitragen.

Eine Vielzahl von *CP*-Observablen, die im Zusammenhang mit CKM-Winkeln stehen, lassen sich in Zerfällen neutraler B^0- und B_s^0-Mesonen durch Analyse der Zerfallsraten in Abhängigkeit des Produktionsflavours und der Zerfallszeit bestimmen. In diesem Vortrag wird ein Überblick über aktuelle zerfallszeitaufgelöste Messungen von *CP*-Verletzung im System der neutralen *B*-Mesonen durch das LHCb-Experiment gegeben.

Eingeladener Vortrag T 44.4 Di 15:15 VMP4 Audimax 1
Aiming for a precise Measurement of $\mathrm{K}^+ \to \pi^+\nu\bar{\nu}$: the Start of the NA62 Experiment — •Gia Khoriauli for the NA62-Collaboration — Johannes Gutenberg University Mainz

NA62 is a fixed target experiment at CERN. The main goal of the experiment is to measure precisely the rare Kaon decay $\mathrm{K}^+ \to \pi^+\nu\bar{\nu}$. Kaons are produced together with other particles by hitting a Beryllium target with a 400 GeV/c proton beam supplied by the CERN SPS. A secondary Kaon beam with 75 GeV/c ($\pm 1\%$) momentum and signal events are selected with the NA62 detector. $\mathrm{K}^+ \to \pi^+\nu\bar{\nu}$ is an extremely interesting decay, since its tiny branching ratio is precisely known in the Standard Model. Therefore, this decay is sensitive to possible new physics phenomena, which can alter its branching ratio. As a FCNC interaction, the decay is forbidden at the tree level in the Standard Model. The most recent theoretical calculation provides $BR(\mathrm{K}^+ \to \pi^+\nu\bar{\nu}) = (9.11 \pm 0.72) \cdot 10^{-11}$ with the uncertainty stemming mostly from the knowledge on $|V_{ts}|$. The NA62 experiment aims

to test the Standard Model expectation by reaching an uncertainty of 10% in $BR(K^+ \to \pi^+\nu\bar{\nu})$. NA62 collected first data during a pilot run in 2014. The first physics run took place in 2015. Important steps have been made in understanding and optimization of the performance of the NA62 sub-detectors and the physics triggers during the physics run 2015. First preliminary physics results as well as the theory framework and the NA62 detector are presented in this work.

Eingeladener Vortrag T 44.5 Di 15:45 VMP4 Audimax 1
Suche nach neuen Phänomenen mit Topquarks beim ATLAS-Experiment — •Johannes Erdmann — TU Dortmund, Experimentelle Physik IV

In vielen Erweiterungen des Standardmodells (SM) spielt das Topquark auf Grund seiner großen Masse und der damit im SM verbundenen großen Kopplung an das Higgs-Boson eine besondere Rolle. Bei einer pp-Schwerpunktsenergie von 8 TeV, beziehungsweise jetzt 13 TeV, mit dem ATLAS-Detektor am LHC genommene Daten erlauben damit die Suche nach neuen Phänomenen auf der TeV-Skala.

In diesem Vortrag werden exemplarisch einige Analysen aus diesem Forschungsgebiet diskutiert. Ein Fokus liegt dabei auf Suchen nach massiven Resonanzen, die in Topquarks zerfallen, den neuen experimentellen Herausforderungen im Bereich großer Topquark-Impulse, und der Suche nach Topquark-assoziierter Higgs-Boson-Produktion.

T 45: Eingeladene Vorträge II

Zeit: Dienstag 13:45–16:15 Raum: VMP8 HS

Eingeladener Vortrag T 45.1 Di 13:45 VMP8 HS
Hadronic vector-boson pair production at NNLO QCD — •Stefan Kallweit — Johannes Gutenberg University of Mainz, Mainz, Germany

I report on the computation of vector-boson pair production at next-to-next-to-leading order in QCD perturbation theory by means of the transverse-momentum (q_T) subtraction method. This method, which is applicable to achieve NNLO QCD accuracy in the production of any colourless final-state, is introduced, and the technical realization of the calculation within the MATRIX framework is briefly discussed. The main part of this presentation is dedicated to numerical results and comparisons to experimental data on inclusive and fiducial cross sections as well as on selected distributions for the production of $Z\gamma/W\gamma$ and ZZ/WW pairs, including the leptonic decays of the heavy vector bosons.

Eingeladener Vortrag T 45.2 Di 14:15 VMP8 HS
Auslesekonzepte für zukünftige Teilchendetektoren — •Tobias Flick — Bergische Universität Wuppertal

Zukünftige Detektoren werden durch höhere Luminositäten und feinere Granularitäten, sowie Nähe zum Wechselwirkungspunkt, ein Vielfaches des Datenvolumens erzeugen, das derzeit üblich ist. Ebenso entwickelt sich aber auch die Technik, die in der Auslese eingesetzt werden kann. Die Auslese, Verteilung und Speicherung der Daten muss den erzeugten Raten folgen, um effizient Daten zur Analyse zur Verfügung stellen zu können. Sowohl die Trigger-Raten als auch die Übertragungsraten steigen enorm im Vergleich zu den aktuellen Experimenten. Dazu sind high-speed Datenstrecken im Multi-Gigabit/s Bereich nötig, sowie natürlich strahlenharte Elektronik und Optik innerhalb der Detektoren, die diese Raten bewerkstelligen können, wie es derzeit an den LHC-Experimenten geplant wird.

Der Vortrag wird Strategien zur Auslese von zukünftigen Detektoren in der Teilchenphysik beleuchten. Dazu gehören sowohl die klassischen Auslesekonzepte als auch innovative Verfahren, wie "wireless readout", und der Einsatz alternativer Materialien im Datenauslesepfad.

Eingeladener Vortrag T 45.3 Di 14:45 VMP8 HS
Hunting dark matter in the sky and at colliders — •Kai Schmidt-Hoberg — DESY

I will discuss searches for dark matter in astrophysical as well as collider based experiments with a particular focus on the complementarity between different searches.

Eingeladener Vortrag T 45.4 Di 15:15 VMP8 HS
Preparing the start of neutrino mass measurements with KATRIN — •Kathrin Valerius for the KATRIN-Collaboration — Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT)

The Karlsruhe Tritium Neutrino Experiment (KATRIN) is targeted at improving the sensitivity on the electron neutrino mass $m(\nu_e)$ down to 200 meV/c^2 at 90% CL. The model-independent method relies on precision β-decay spectroscopy of molecular tritium near the spectral endpoint using an ultra-luminous gaseous tritium source and a high-resolution electrostatic spectrometer. With the arrival of the last major system components at KIT in the summer of 2015 the final phase in the integration of all subsystems has started.

This talk presents an overview of the current activities in commissioning the full KATRIN beam line, in determining the systematic uncertainties, and in preparing the data analysis. The initial physics programme at the start of tritium measurements will be discussed. Furthermore, the presentation outlines opportunities to search for new physics phenomena in the precision β-decay data of KATRIN.

Eingeladener Vortrag T 45.5 Di 15:45 VMP8 HS
Magnetic fieds and cosmic rays in galaxy clusters — •Annalisa Bonafede — Hamburger Sternwarte, Hamburg

The extreme physical conditions in the intra-cluster medium of galaxy clusters are beyond anything achievable in any laboratory on Earth, and offer us a unique tool to study magnetic fields and cosmic rays on the largest scales in the Universe. A big challenge of modern astrophysics is understanding the origin of radio emission spread over the volume of some galaxy cluster. This emission is a mystery because it requires relativistic electrons moving around magnetic field lines, but both the origin of the magnetic fields and of the electrons are unknown. We are entering into a golden age to address these fundamental problems, thanks to the advent of a new generation of radio telescopes, such as LOFAR, the JVLA, and ASKAP. At the same time, the new eROSITA X-ray satellite is going to provide us with a wealth of new data on the most distant and less massive galaxy clusters and groups. In this talk, I will review our current knowledge about magnetic fields and cosmic ray particle sin galaxy clusters, and I will illustrate the potential of the new generation of radio instruments to answer the many open questions about the origin and evolution of magnetic fields and cosmic rays.

T 46: Higgs-Boson (Zerfall in Tau-Leptonen) III

Zeit: Dienstag 16:45–18:45 Raum: VMP5 HS A

T 46.1 Di 16:45 VMP5 HS A
Preparation for an analysis of Run-2 data at ATLAS of the Higgs boson decaying to a pair of tau leptons — William Davey, Jochen Dingfelder, Benedict Winter, and •Stephanie Yuen — Physikalisches Institut, Universität Bonn, Nussallee 12, 53115 Bonn

In 2014, the ATLAS and CMS collaborations reported the combined Run-1 result of the discovery of the Higgs boson decaying into a pair of tau leptons. The results are consistent with the Standard Model expectation, and further goals for a Run-2 analysis at ATLAS include the discovery of the Higgs in the di-tau decay channel using solely ATLAS data. The $H \to \tau\tau$ decay channel has the highest sensitivity among the channels that probe the coupling of the Higgs boson to leptons. Also, while CP studies in the bosonic decay channels of the Higgs indicate the compatibility of the Higgs boson's CP properties with that of SM predictions, fermions provide unique information on Higgs CP. This talk will discuss the analysis preparation and background estimation

methods for the $H \to \tau_{\text{had}}\tau_{\text{had}}$ decay channel, where both taus decay hadronically, for Higgs coupling and CP measurements with Run-2 data at ATLAS.

T 46.2 Di 17:00 VMP5 HS A

Study of τ-spin correlations in $Z/\gamma \to \tau^+\tau^-$ decays at ATLAS — •Maike Hansen, Philip Bechtle, Klaus Desch, Christian Grefe, and Peter Wagner — Universität Bonn

Major Beyond Standard Model theories, such as supersymmetry, predict a CP-mixing in the Higgs to fermions sector. Such a mixing is not excluded by any of the previous measurements.

In the $H \to \tau\tau$ decay channel, the CP-mixing can be measured based on angles between the τ-decay planes. In the hadronic τ-decay modes, this measurement relies on a high purity τ-decay mode classification and a good reconstruction of the (hadronic) τ-decay products. All this is available now due to the new τ reconstruction in ATLAS.

For this analysis, we focus on fully hadronic $Z/\gamma \to \tau^+\tau^-$ decays, the major, irreducible background for a Higgs CP-measurement. After splitting up the phase space kinematically, all methods can be applied in the same way as for the Higgs. This way, from a measurement in $Z/\gamma \to \tau^+\tau^-$ decays, systematic effects as well as the sensitivity on a Higgs CP-measurement can be understood.

T 46.3 Di 17:15 VMP5 HS A

Untersuchung der CP-Eigenschaften des Higgs-Bosons produziert in Gluonfusion in Assoziation mit zwei Jets im Zerfallskanal $H \to \tau\tau \to 2l4\nu$ mit dem ATLAS-Detektor — Elias Coniavitis, •Alena Lösle und Markus Schumacher — Physikalisches Institut, Universität Freiburg

Nach der Entdeckung des Higgs-Bosons im Jahr 2012 durch die Experimente ATLAS und CMS am CERN ist die Untersuchung der CP-Natur und ein Test der CP-Invarianz in der Higgs-Bosonproduktion von großem Interesse.
Die Produktion in der Gluonfusion mit zwei zusätzlichen Jets erlaubt es, die Tensorstruktur der effektiven Higgs-Gluon-Kopplung, im Besonderen deren CP-Struktur, zu untersuchen.
Der Vortrag diskutiert verschiedene CP-ungerade Observablen, u.a. die Optimale Observable, die zum Test der CP-Invarianz und zur Bestimmung von Grenzen auf CP-verletzende Higgs-Gluon-Kopplungen verwendet werden. Die Sensitivität für den Zerfall $H \to \tau\tau \to 2l4\nu$ basierend auf dem Datensatz des ATLAS-Experiments aus dem Jahre 2012 wird beschrieben.

T 46.4 Di 17:30 VMP5 HS A

Study of τ-reconstruction effects on a Higgs-CP-measurement at ATLAS — •Michael Hübner, Klaus Desch, Peter Wagner, Philip Bechtle, Christian Grefe, and Maike Hansen — Universität Bonn

CP-mixing in the Higgs-to-fermion couplings is predicted by a number of important Beyond the Standard Model theories such as Supersymmetry, and is so far not excluded by LHC measurements. The mixing angle can be measured in the $H \to \tau\tau$ channel, where both taus decay hadronically, via the reconstruction of decay planes spanned by the decay products.

The measurement relies on the 4-momentum reconstruction of the tau decay products and the purity of reconstructing specific decay modes. I will present results of a study of the impact of tau reconstruction effects on the sensitivity of a prospective CP-mixing measurement.

T 46.5 Di 17:45 VMP5 HS A

Search for Neutral MSSM Higgs Bosons in Di-Tau Final States Using Data Recorded by the ATLAS Detector at the LHC at $\sqrt{s} = 13\,\text{TeV}$ — •Lorenz Hauswald, Dirk Duschinger, Wolfgang Mader, and Arno Straessner — Institut für Kern- und Teilchenphysik, TU Dresden

For the search for minimal supersymmetric extensions of the Standard Model (MSSM) additional heavy neutral Higgs bosons are of major interest. Especially promising are final states with two tau leptons, due to the high branching ratio in most of the parameter space. The first results of the analysis of events at 13 TeV centre-of-mass energy recorded with the ATLAS detector, which surpass the corresponding LHC Run 1 analysis sensitivity, are presented.

T 46.6 Di 18:00 VMP5 HS A

Implementation of statistical methods in the context of BSM Higgs boson searches — Andrew Gilbert, Felix Frensch, •Dennis Roy, Günter Quast, and Roger Wolf — EKP, Karlsruhe Institute of Technology (KIT)

After the discovery of the Higgs boson the quest is out to search for additional particles. One of the still most promising models, which predict additional Higgs bosons is the minimal supersymmetric extension of the standard model (MSSM). With new data of the LHC Run-2, we hope to find such new particles. An important channel to consider is the $\phi \to \tau\tau$ channel, which has set the most stringent limits on MSSM Higgs bosons so far.

A new software package called Combine Harvester has been developed within the CMS collaboration to ease statistical manipulations of the data, starting from the creation of the likelihood model up to the plotting of the results. Using the $\phi \to \tau\tau$ channel as an example, this presentation shall introduce and explain the functionality of Combine Harvester and its capabilities.

T 46.7 Di 18:15 VMP5 HS A

Suche nach schweren Higgs-Bosonen mittels eines kinematischen Fits mit dem CMS-Experiment — •Malte Hoffmann, Adrian Perieanu, Peter Schleper, Daniel Troendle, Benedikt Vormwald, Annika Vanhoefer und Oliver Rieger — Institut für Experimentalphysik, Hamburg, Deutschland

Supersymmetrie (SUSY) ist eine mögliche Erweiterung des Standardmodells, die viele der Unzulänglichkeiten des Standardmodells beheben würde. In supersymmetrischen Modellen gibt es neben einem leichten Higgs Boson, welches mit dem entdeckten Boson mit einer Masse von etwa $125.09 \pm 0.24\,\text{GeV}$ identifiziert werden kann, noch vier weitere Higgs Bosonen. In diesem Vortrag wird eine Analyse mit dem CMS-Experiment zur Suche eines schweren Higgs-Bosons, welches über zwei leichte Higgs-Bosonen in zwei Tau-Leptonen und zwei b-Quarks zerfällt, vorgestellt. Dieser Zerfallskanal ist dominant bei kleinen Werten für $\tan\beta$ und einer schweren Higgsmasse von $250 - 350\,\text{GeV}$. Wesentlicher Bestandteil der Analyse ist ein kinematischer Fit. Durch den über ein Minimierungsverfahren bestimmt wird, wie gut gemessene Observablen im Rahmen ihrer Messunsicherheit mit der erwarteten Signaltopologie vereinbar sind. Der verwendete Fit benutzt die invarianten Massen der Zerfallsrodukte der beiden Higgs-Bosonen um die Anzahl der Fitparameter zu reduzieren und die Rekonstruktion der Masse des schweren Higgs-Bosons zu verbessern. Ergebnisse der Analyse der in 2015 mit einer Schwerpunktsenergie von 13 TeV gesammelten Daten werden präsentiert.

T 46.8 Di 18:30 VMP5 HS A

Suche nach resonanter und nicht resonanter Doppelhiggsproduktion im „$hh \to \gamma\gamma\tau\tau$“-Kanal — •Julian Wollrath, Michel Janus, Stan Lai und Jason Veatch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Das Standardmodell beschreibt nebst Kopplung des Higgsbosons zu Fermionen und Vektorbosonen auch eine Selbstkopplung des Higgsbosons. Eine Messung dieser Kopplung ist wichtig für den Test der elektroschwachen Symmetriebrechung. Doppelhiggsproduktion kann im Standardmodell durch Selbstkopplung oder auch durch Higgs-Fermion-Interaktionen, durch sogennante nicht resonante Produktion, auftreten. Physik jenseits des Standardmodells könnte den Wirkungsquerschnitt dieses Prozesses erhöhen und die Kinematik der Ereignisse verändern. Die Existenz eines schweren neutralen Higgsbosons (H) – zum Beispiel in Zwei-Higgs-Dublettmodellen – würde zu einem neuen resonanten Prozess $H \to hh$ führen.

Dieser Vortrag behandelt die Untersuchung des „$hh \to \gamma\gamma\tau\tau$“-Signals am ATLAS-Experiment mit 13 TeV-Daten. Kinematische Verteilungen und eine mögliche Selektion wurden für resonante und nicht resonante Doppelhiggsproduktion untersucht.

T 47: Higgs-Boson (Eigenschaften) (theo.+exp.)

Zeit: Dienstag 16:45–19:00 Raum: VMP5 HS B1

T 47.1 Di 16:45 VMP5 HS B1

QFT justification of the κ-framework using the electroweak chiral Lagrangian — Gerhard Buchalla, Oscar Catà, Alejandro Celis, and •Claudius Krause — Ludwig-Maximilians-Universität München, Fakultät für Physik, Arnold Sommerfeld Center for Theoretical Physics, D-80333 München, Germany

We consider the electroweak chiral Lagrangian as effective field theory (EFT) for the Standard Model at the electroweak scale v. This EFT describes the phenomenology of the Standard Model with generalized Higgs couplings in a consistent way. This is motivated by (but not restricted to) a new, strongly-coupled sector responsible for electroweak symmetry breaking.

After a brief discussion of the systematics of the effective expansion, I will present its application to current LHC Higgs data. I will show how the leading effects are related to the κ-framework that is currently used by the experiments at the LHC. The κ-framework was introduced as a pure phenomenological signal-strength parametrization and is criticized as being inconsistent with quantum field theory. I will show that the latter is not the case and present a justification of the κ-framework using the leading order analysis of the electroweak chiral Lagrangian. It is therefore well defined and can straightforwardly be extended to higher orders within the EFT. I will also present a fit of the chiral Lagrangian to the LHC Higgs data.

T 47.2 Di 17:00 VMP5 HS B1

Suche nach Lepton-Flavour verletzenden Higgszerfällen mit dem CMS-Experiment — Peter Schleper, Daniel Tröndle und •Annika Vanhoefer — Universität Hamburg

Nach der Entdeckung eines Higgsbosons mit einer Masse von 125 GeV durch die ATLAS- und CMS-Kollaboration ist es eine wichtige Aufgabe, dessen Eigenschaften zu untersuchen. Lepton-Flavour verletzende (LFV) Zerfälle des Higgsbosons wären ein Anzeichen für Physik jenseits des Standardmodells der Teilchenphysik, die in vielen Modellen auftreten können, wie zum Beispiel in Modellen mit zwei Higgsdoublets. In diesem Vortrag wird auf die Suche nach LFV Higgszerfällen in ein Elektron und ein Tau-Lepton eingegangen. Mit den Daten des CMS-Experiments, welche bei einer Schwerpunktsenergie von 8 TeV aufgezeichnet wurden, konnten die Ausschlussgrenzen des Verzweigungsverhältnises des Higgsbosons in ein Elektron und ein Tau-Lepton verbessert werden und liegen in der Größenordnung von 1%. Weiterhin wird ein Ausblick auf die Analyse der Daten gegeben, welche bei einer Schwerpunktsenergie von 13 TeV aufgezeichnet wurden.

T 47.3 Di 17:15 VMP5 HS B1

Messung der HZZ Tensorstruktur in $pp \to H \to ZZ^* \to 4\ell$-Zerfällen mit dem ATLAS-Detektor — •Katharina Ecker, Sandra Kortner, Hubert Kroha, Oliver Kortner und Verena Walbrecht — Max-Planck-Institut für Physik, München

Ein wichtiger Zerfallskanal für die Messungen der Eigenschaften des im Jahr 2012 entdeckten Higgs-Bosons am LHC, ist der Zerfall in zwei Z-Bosonen, $H \to ZZ^* \to 4\ell$. Der Endzustand mit vier Leptonen aus Z-Bosonen Zerfällen kann vollständig rekonstruiert werden. Messungen mit Daten aus den Jahren 2011 und 2012 haben bereits gezeigt, dass die vom Standardmodell vorhergesagte Hypothese eines Teilchens mit Spin-0 und positiver CP-Quantenzahl gegenüber anderen Hypothesen bevorzugt ist. Unter der Annahme eines Spin-0 Teilchens wurde nach anomalen und CP-verletzenden Kopplungen des Higgs-Bosons an Z-Bosonen gesucht, die auf Physik jenseits des Standardmodells zurückzuführen sind.

Der Vortrag behandelt die Untersuchung der Kopplungseingenschaften des Higgs-Bosons an Z-Bosonen mit Daten des ATLAS-Experiments von Run-II des LHC. Um die große Anzahl von Kopplungsparametern gleichzeitig korreliert messen zu können, wurde die sogenannte analytische Morphing Methode zur Erstellung des Signalmodells entwickelt. Im Vortrag wird diese Methode im Zerfallskanal $H \to ZZ^* \to 4\ell$ angewendet und es werden sogenannte optimale Observablen vorgestellt, die mit Hilfe der Matrixelementmethode berechnet und zur Messung der HZZ-Kopplungsstruktur verwendet werden.

T 47.4 Di 17:30 VMP5 HS B1

Development of the morphing method for signal modelling and parameter extraction from ATLAS data, using effective operators in the $H \to W^+W^- \to \ell^+\nu\ell^-\bar{\nu}$ process — •Carsten Burgard and Karsten Köneke — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

Given the parameter space of all physically conceivable Lagrange operators connected to physics beyond the Standard Model in the Higgs-boson sector, it seems unfeasible to conduct dedicated analyses for every new scenario. Instead, a fast, continuous, and analytical method of signal modelling would not only help to conduct hypothesis tests more efficiently, but would also allow to directly measure and derive limits on the coefficients of the individual terms in the matrix element. Similar approaches, such as Matrix-Element-Reweighting can not only be outperformed significantly by the morphing technique for some applications, but also be used complementarily and in conjunction with this new approach. This talk explores the applications in the context of effective Lagrangians for analyses of Higgs bosons decaying into two vector bosons for leptonic final states.

T 47.5 Di 17:45 VMP5 HS B1

Gluon Fusion Higgs Production in the CP Violating MSSM — •Shruti Patel[1], Stefan Liebler[2], and Georg Weiglein[3] — [1]DESY, Hamburg, Germany — [2]DESY, Hamburg, Germany — [3]DESY, Hamburg, Germany

The MSSM with complex parameters has emerged as an attractive SUSY candidate providing new sources of CP-violation, which are well motivated in the context of the observed imbalance between matter and antimatter in the universe. In order to study the effects of the complex parameters, which enter via loop contributions, an accurate prediction for the Higgs production cross-section is required. In this talk, we present a study of these effects carried out with an implementation in the program SusHi linked to FeynHiggs.

T 47.6 Di 18:00 VMP5 HS B1

Probing CP Properties of the discovered bosonic resonance with Higgs signal rates from Tevatron and LHC data — •Tobias Klingl[1], Philip Bechtle[1], Tim Stefaniak[2], and Klaus Desch[1] — [1]Universität Bonn — [2]University of California, Santa Cruz

In July 2012, the ATLAS and CMS collaborations reported the discovery of a single, narrow bosonic resonance ϕ with mass of 125 GeV. Although a pure CP-odd state can be excluded by the current data, it is still possible that the CP properties of this resonance deviate from the expectations for a pure CP-even Standard Model (SM) Higgs boson. In general it can be an admixture of a CP-even Higgs-like scalar h and a CP-odd pseudoscalar A described by the general parametrization $\phi = \cos\alpha\, h + \sin\alpha\, A$. We investigate the scope of possible discrepancies between the CP properties and the couplings of the discovered resonance and the properties of a SM Higgs boson. To this end, we consider a Higgs coupling scale factor benchmark scenario with scalar and pseudoscalar scale factors for the Higgs couplings to fermions and one scalar scale factor for the SU(2) gauge bosons. The latter coupling is assumed to be ≤ 1, as predicted in many models such as SUSY or the 2HDM. Additionally, we allow for non-SM Higgs boson decays into invisible final states. We perform χ^2 fits to the available data from the Tevatron and LHC experiments using the Computer Code HiggsSignals, which takes into account signal efficiencies and major correlations of experimental and theoretical uncertainties. We obtain constraints on the mixing angle α and the scalar and pseudoscalar couplings of the field ϕ.

T 47.7 Di 18:15 VMP5 HS B1

Testing CP-Invariance in Higgs VBF production with ATLAS using the Optimal Observable method and di-tau decays — •Coniavitis Elias, Schillo Christian, and Schumacher Markus — Albert-Ludwigs-Universität, Freiburg, Germany

CP-invariance in Higgs boson production via vector boson fusion is tested using the method of the optimal observable. In the present analysis the di-tau channel is utilised. A description of the method and analysis strategy is given, and the results of the ATLAS analysis using 20.3 fb^{-1} of proton-proton collision data at $\sqrt{s} = 8$ TeV are presented, along with a performance comparison to the signed $\Delta\phi$ variable previously proposed for this study.

T 47.8 Di 18:30 VMP5 HS B1

Study of the Higgs CP properties in the $\tau\tau$ decay channel with the CMS experiment — Vladimir Cherepanov, Günter Flügge, Bastian Kargoll, Wolfgang Lohmann, Alexander Nehrkorn, Ian M. Nugent, •Claudia Pistone, Achim Stahl, and Alexander Zotz — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

In 2012 the discovery of a Higgs boson with mass of 125 GeV was announced by the ATLAS and CMS collaborations. Since then, efforts were focused on the measurement of its properties and thus the complete determination of the nature of this particle. We study the CP quantum numbers of the Higgs boson in its decay into tau lepton pairs. Our approach uses the distribution of the signed angle φ^*_{CP} between the decay planes of the tau leptons, which is sensitive to the Higgs CP properties. At the generator level we observe the expected discrimination power between CP-even and CP-odd states, and the results are presented. The sensitivity of our observable is also being investigated at the reconstruction level, and results are presented as well.

T 47.9 Di 18:45 VMP5 HS B1

Probing triple-Higgs productions via $4b2\gamma$ at a 100 TeV hadron collider — Chien-Yi Chen[1,2,3], Qi-Shu Yan[4,5,6], Xiaoran Zhao[4], •Zhijie Zhao[7], and Yiming Zhong[8] — [1]Department of Physics, Brookhaven National Laboratory, Upton, New York 11973, USA — [2]Department of Physics and Astronomy, University of Victoria, Victoria, BC V8P 5C2, Canada — [3]Perimeter Institute for Theoretical Physics, Waterloo, ON N2J 2W9, Canada — [4]School of Physical Sciences, University of Chinese Academy of Sciences, Beijing 100049, P. R. China — [5]Center for High-Energy Physics, Peking University, Beijing 100871, P. R. China — [6]Center for future high energy physics, CAS, P. R. China — [7]Department of Physics, University of Siegen, 57068 Siegen, Germany — [8]C. N. Yang Institute for Theoretical Physics, Stony Brook University, Stony Brook, New York 11794, USA

The quartic self-coupling of the Standard Model Higgs boson can only be measured by observing the triple-Higgs production process, but it is challenging for the LHC Run 2 or ILC at a few TeV because of its extremely small production rate. In this talk, we present a detailed MC simulation study of the triple-Higgs production through gluon fusion at a 100 TeV hadron collider and explore the feasibility of observing this production mode. We focus on the decay channel $HHH \to b\bar{b}b\bar{b}\gamma\gamma$, investigating detector effects and optimizing the kinematic cuts to discriminate the signal from the backgrounds. We also explore the dependence of the cross section upon the trilinear (λ_3) and quartic (λ_4) self-couplings of the Higgs.

T 48: Supersymmetrie (theo.+exp.)

Zeit: Dienstag 16:45–19:00 Raum: VMP5 HS B2

T 48.1 Di 16:45 VMP5 HS B2

Automated calculation of $\sin\theta_W$ and M_W from muon decay within FlexibleSUSY — •Markus Bach[1], Dominik Stöckinger[1], and Alexander Voigt[2] — [1]IKTP, TU Dresden — [2]DESY Hamburg

The spectrum generator generator FlexibleSUSY can be utilized to investigate a variety of supersymmetric and non-supersymmetric models. We present an implementation which calculates the weak mixing angle from the precisely measured muon decay, especially taking vertex and box diagram corrections of the respective model into account. This framework also offers a prediction of the W boson mass which can be compared to the experimental value and thus used to exclude parameter regions.

T 48.2 Di 17:00 VMP5 HS B2

Light singlet scenario in a R-symmetric SUSY model — •Philip Diessner[1], Jan Kalinowski[2], Wojciech Kotlarski[1,2], and Dominik Stöckinger[1] — [1]IKTP, TU Dresden, Deutschland — [2]Universität Warschau, Polen

R-Symmetry is an additional symmetry which can be imposed on a supersymmetric model, leading to interesting phenomenological consequences like the prediction of Dirac Gauginos. A model with a minimal implementation of this symmetry is the MRSSM. This model includes a singlet Higgs state, which could be actually lighter than the 125 GeV SM-like Higgs and evading LEP bounds. Due to the interplay of parameters in the bosonic and fermionic sector in the model this scenario lets us put an upper bound on the mass of the lightest neutralino, which will then be the LSP of our model. In this talk I will present an analysis of the Higgs sector, also discussing the phenomenological impact of LHC searches and how the LSP can be a viable dark matter candidate for this scenario.

T 48.3 Di 17:15 VMP5 HS B2

Einfluss des Neutralino Mischungscharakters auf die Vorhersage der dunklen Materie im MSSM und im NMSSM — •Simon Schnake und Gudrid Moortgat-Pick — Universität Hamburg, Deutschland

Dunkle Materie ist eines der größten ungelösten Rätsel unserer Zeit. In etwa 80% der gravitativen Masse des Universums ist sie nicht sichtbar und ihre Natur und Eigenart ist größtenteils unbekannt. Eine Möglichkeit dunkle Materie mit zu beschreiben ist die Erweiterung des Standardmodells, beispielsweise mit Supersymmetrischen Theorien. Supersymmetrische Theorien zeichnen sich unter anderem dadurch aus, dass sie ein leichtestes supersymmetrisches Teilchen (LSP) liefern, die einen ausgezeichneten Kandidaten für dunkle Materie darstellen. Wir konzentrieren uns in der gegenwärtigen Studie vor allem auf Parameterbereiche im Minimalen Supersymmetric Standard Model (MSSM) und im Next-to-Minimal Supersymmetric Standard Model (NMSSM), die im Einklang mit den experimentellen Ergebnissen am LHC sind. In dieser Analyse ist der Kandidat für dunkle Materie das Neutralino, das einen vielschichtigen Mischungscharakter aufweisen kann. Um die Auswirkungen der Änderung von Parametern des NMSSM und MSSM auf diesen Mischungscharakter und den damit einhergehenden Vorhersagen für die relict density zu betrachten, wurde die Software micrOMEGAs genutzt. Im Rahmen einer Bachelor-Arbeit wurden interessante Bereiche des SUSY Parameterraumes diesbezüglich analysiert und werden hier vorgestellt.

T 48.4 Di 17:30 VMP5 HS B2

Phenomenological study of weakino pair production processes in the MSSM at next-to-leading order — Julien Baglio, Barbara Jäger, and •Matthias Kesenheimer — Eberhard Karls Universität Tübingen

The Minimal Supersymmetric Standard Model (MSSM) predicts the existence of eight weakly interacting particles which are linear combinations of a higgsino and one wino or one bino. These states are called charginos for the electrically charged particles or neutralinos for the neutral particles. Additionally, if R-parity is conserved every weakino production process with following decay results in at least one stable neutralino, which is a good candidate for a dark matter particle. By studying weakino production processes we can gain information about dark matter and SUSY in general. Furthermore, for the analysis of experimental data precise theoretical calculations of production cross sections are essential. With new constrains on SUSY models, we perform a phenomenological study including higher order QCD corrections of chargino and neutralino production processes. Preliminary results of the production cross-section at $\sqrt{s} = 14$ TeV of $p\,p$ collisions are presented.

T 48.5 Di 17:45 VMP5 HS B2

Suche nach natürlicher Supersymmetrie in Multilepton-Endzuständen mit dem ATLAS-Detektor — •Johannes Mellenthin[1], Michael Flowerdew[2] und Hubert Kroha[2] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Max-Planck-Institut für Physik, München

Eines der wichtigsten Ziele der LHC-Experimente ist die Suche nach Supersymmetrie. Um das Problem der Stabilisierung der niedrigen Higgs-Bosonmasse zu lösen, dürfen sich dabei die Massen der Superpartner nicht zu sehr von den Massen der Teilchen des Standardmodells unterscheiden. Ein empfindlicher Kanal zur Suche nach supersymmetrischen Erweiterungen des Standardmodells sind Endzustände mit vier Leptonen. Im Vortrag wird diskutiert, inwiefern vorhandene Analysen Schlüsse auf eine allgemeinere Klasse von Modellen natürlicher Supersymmetrie zulassen.

T 48.6 Di 18:00 VMP5 HS B2

Vergleich der Verzweigungsverhältnisse der schweren Higgs Bosonen im CMSSM und NMSSM — •Conny Beskidt[1], Wim de Boer[1], Dmitri Kazakov[1,2] und Stefan Wayand[1] — [1]Karlsruhe Institute of Technology (IEKP) — [2]JINR, ITEP, Moscow, Russia

Neben dem standardmodellartigen, leichten Higgs Boson werden innerhalb der Supersymmetrie (SUSY) noch weitere Higgs Bosonen vorhergesagt. Dabei werden in dem einfachsten supersymmetrischen Modell, dem eingeschränkten minimalen supersymmetrischen Standardmodell (CMSSM) zwei weitere, schwere Higgs Bosonen mit ähnlicher Masse vorhergesagt, die aus den vorhandenen zwei Higgs Doublets resultieren. In dem nächst-minimalen supersymmetrischen Standardmodell (NMSSM) werden zusätzlich auch noch zwei weitere leichte Higgs Bosonen aufgrund des zusätzlichen Higgs Singlets vorhergesagt. Trotz ähnlicher Massenbereiche weisen diese beiden SUSY Modelle sehr unterschiedliche Zerfälle des schweren Higgs Bosons auf. Im CMSSM zerfallen die schweren Higgs Bosonen bevorzugt in b-Quarks und tau-Leptonen. Im NMSSM sind zusätzlich Zerfälle des schweren Higgs Bosons in zwei leichte Higgs Bosonen, Charginos, Neutralinos und top-Quarks oft dominant. Die Parameterbereiche für diese zusätzlichen Zerfallskanäle sowie deren Verzweigungsverhältnisse werden diskutiert.

T 48.7 Di 18:15 VMP5 HS B2

Dark matter relic density from observations of supersymmetry at the ILC — •Suvi-Leena Lehtinen, Jenny List, and Mikael Berggren — DESY, Hamburg, Germany

If supersymmetric particles were discovered at the International Linear Collider (ILC), would we be able to prove that the dark matter candidate discovered is the only dark matter particle? This was investigated using a scenario with a mostly bino lightest supersymmetric particle and a coannihilating stau. In this scenario, the ILC could find the sleptons and lighter gauginos, while the LHC could discover and measure parts of the coloured spectrum. We will demonstrate which measurements and precisions are needed to determine whether the observed dark matter candidate is the sole constituent of the dark matter relic density. The required precisions will be compared to the predicted precisions at the ILC.

T 48.8 Di 18:30 VMP5 HS B2

Light Stop Decays — Ramona Gröber[1], Margarete Mühlleitner[2], Eva Popenda[3], and •Alexander Wlotzka[2] — [1]INFN, Sezione di Roma Tre, Via della Vasca Navale 84, I-00146 Roma, Italy — [2]Institute for Theoretical Physics, Karlsruhe Institute of Technology, Wolfgang-Gaede Str. 1, D-76128 Karlsruhe, Germany — [3]ehemals: Paul Scherrer Institute, CH-5323 Villigen PSI, Switzerland

We investigate scenarios in the MSSM with a stop being the next-to-lightest supersymmetric particle and a neutralino as lightest supersymmetric particle, where the difference between the stop mass and the neutralino mass is less than the top quark mass. Depending on this mass difference the stop can undergo either a three-body decay into a neutralino, a W boson and a bottom quark, or a four-body decay into a neutralino, a bottom quark and two light fermions, or the stop can decay via flavor-changing neutral currents into an up/charm quark and a neutralino. We improve the calculations of the branching ratios (BRs) of these decay modes by including next-to-leading order corrections for the flavor changing decays and by taking into account the mass of the bottom quark and the tau lepton in the four-body decay. Moreover, flavor effects are incorporated in both the three- and the four-body decay and threshold effects at the W boson threshold are correctly taken into account. We find that the BRs can deviate significantly from one, leading to weaker stop exclusion limits.

T 48.9 Di 18:45 VMP5 HS B2

Constraining baryon number violation at the LHC — •Ruth Pöttgen — Universität Stockholm

There is strong theoretical motivation as well as experimental evidence for baryon number (B) conservation to be violated in nature. It is, for example, one of the Sakharov conditions for baryogenesis in the early universe. In most SUSY models considered in collider searches to date, the conservation of R-parity (RP) is imposed to prevent the proton decay. The proton decay, however, involves simultaneous violation of baryon and lepton number and therefore RP-violating (RPV) SUSY models that allow only baryon number changing processes are not excluded based on the proton lifetime. Typical collider signatures would be events with a large number of jets. In this talk, possibilities of constraining B-violating processes by re-interpreting LHC measurements of different multi-jet final states in a simplified RPV SUSY model will be discussed. Limits are derived in the plane of the two free mass parameters of the model and used to infer bounds on the RPV coupling strength parameters. The relevance of this work for the proposed search for neutron-antineutron oscillations ($\Delta B = 2$) at the European Spallation Source will also be discussed.

T 49: BSM Suchen IV (Dunkle Materie und LED)

Zeit: Dienstag 16:45–18:45 Raum: VMP5 SR 0077

T 49.1 Di 16:45 VMP5 SR 0077

Search for WIMP Dark Matter in VBF- and Monojet Topologies with the ATLAS Experiment at 13 TeV — •Manuel Patrice Geisler — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

The cosmological evidence for Dark Matter is strong, however the nature of Dark Matter is still unknown and it has yet to be detected directly. The presented search with the ATLAS experiment at the LHC, CERN, focuses on WIMP (weakly interacting massive particles) Dark Matter candidates. Different kinds of final states are investigated: both so-called monojets and final states with at least two jets of high transverse momenta and a significant amount of missing transverse momentum. The inclusion of the two-jet selection criteria enhances the sensitivity of this search to vector boson fusion topologies. Furthermore, the selection criteria are optimized in order to suppress background processes that mimic the production of Dark Matter particles. In this talk, further techniques of the search will be presented and aspects of the analysis performed with the 2015 dataset of proton-proton collision at $\sqrt{s} = 13$ TeV will be covered.

T 49.2 Di 17:00 VMP5 SR 0077

Search for dark matter in vector boson + MET final states with the CMS detector — •Viktor Kutzner, Harun Acaroglu, Fabian Bispinck, Michael Brodski, Thomas Hebbeker, Kerstin Hoepfner, Marcel Materok, Arnd Meyer, Dennis Noll, and Klaas Padeken — III. Physikalisches Institut A, RWTH Aachen

The origin of dark matter is one of the most important and challenging questions in high energy physics today. A search for dark matter is performed in the data collected by the CMS experiment in run I and run II. In this search, the dark matter particle recoils against a leptonically decaying W or Z boson, leading to the distinct signatures of either one or two isolated leptons and missing transverse energy. Both channels allow to study various specific features of dark matter production. Different aspects of the background determination and its systematic uncertainties are presented. Dark matter production can be described either by an effective field approach or by fully describing the mediator with a simplified model. Both options will be discussed.

T 49.3 Di 17:15 VMP5 SR 0077

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 Felix Müller — Max-Planck-Institut für Physik

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 massiven schwach wechselwirkenden Elementarteilchen bestehen könnte. Solche Teilchen können am LHC erzeugt und im ATLAS-Detektor in Ereignissen mit hoher fehlender transversaler Energie beobachtet werden. Die Paarproduktion von Teilchen der Dunklen Materie mit einem Higgs-Boson ($pp \to H + \chi\bar{\chi}$) in pp-Kollisionen im sogenannten Mono-Higgs-Kanal liefert eine neue Signatur für Dunkle Materie, wonach nach der Entdeckung des Higgs-Bosons an Beschleunigern gesucht werden kann. 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 ei-

ner starken Kollimation der beiden b-Quarks im Endzustand führt, die daher als ein gemeinsamer Hadron-Jet mit großem Radiusparameter rekonstruiert werden. Die Substruktur solch großer Jets liefert zusätzliche Kriterien zur Unterdrückung des Untergrunds. Für die Suche nach Mono-Higgs-Ereignissen bei erhöhter Schwerpunktsenergie des LHC wurde die Sensitivität für verschiedene Signalmodelle untersucht.

T 49.4 Di 17:30 VMP5 SR 0077

WIMP Search in the Mono-Photon Channel at the International Linear Collider — •Moritz Habermehl[1,2] and Jenny List[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The International Linear Collider (ILC) is a planned electron-positron collider with $\sqrt{s}$ tunable from 250 to 500 GeV, with a possible upgrade to 1 TeV. Besides precision measurements of the Higgs boson its physics goals comprise searches for physics beyond the Standard Model, e.g. searches for Dark Matter.

This collider search assumes the production of WIMPs in pairs. They are not visible in the detector but the energy carried away can be observed via an additional ("tag") particle. Photon emission from the initial state leads to the almost model independent signature: $e^+e^- \to \chi\chi\gamma$. As this analysis tests couplings between WIMPs and leptons it is complementary to analogues searches at the LHC. A precise study is facilitated by the clean environment of lepton colliders with small systematics of electroweak backgrounds.

While the conceptual feasibility and the sensitivity reach of the ILC have been shown in the past, this talk focusses on the consequences for the detector design. The requirements for the central detector as well as for the instrumentation of the forward region will be discussed in the context of the ILD detector concept.

T 49.5 Di 17:45 VMP5 SR 0077

Search for Dark Matter produced in association with a top quark pair — Johannes Haller, Roman Kogler, and •Mareike Meyer — Institut für Experimentalphysik, Universität Hamburg

Direct searches for Dark Matter (DM) particles are mainly scattering experiments of DM on nuclei. No evidence for DM has been found. However, these experiments only probe interactions between light quarks and DM, while the interactions between heavy quarks and DM could still be favored.

In this talk, a search for DM produced in association with a top quark pair is presented. Data collected at a center-of-mass energy of 13 TeV by the CMS experiment is analyzed. The search is performed in the lepton + jets channel with large missing transverse energy caused by the DM particles leaving the experiment undetected. The produced DM particles can have high tranverse momenta resulting in a large Lorentz boost for the recoiling top quarks and large cone jets of their decay products. Therefore, the reconstruction of non-isolated leptons and the application of top-tagging techniques are important for this analysis.

T 49.6 Di 18:00 VMP5 SR 0077

Suche nach Dunkler Materie in Ereignissen mit fehlender transversaler Energie und Jets beim ATLAS Experiment — •Andreas Reiss, Johannes Balz, Katharina Bierwagen, Volker Büscher, Katharina Jacobi, Manuel Lornatus, Jan Schäffer, Alexandra Schulte und Pedro Urrejola — Johannes Gutenberg-Universität, Mainz, Deutschland

Dunkle Materie konnte bisher nur indirekt durch die Auswirkungen der Gravitation im Kosmos beobachtet werden.

Durch die Datennahme mit dem Large Hadron Collider seit 2015 bei einer Schwerpunksenergie von 13 TeV werden weitere Suchen nach neuer Physik beim ATLAS-Experiment ermöglicht.

Die hier vorgestellte Analyse befasst sich mit der Produktion von Dunkler Materie unter Beobachtung von mehreren Jets und fehlender transversaler Energie. Es werden verschiedene Variablen verwendet, um möglichst sensitiv Abweichungen zum Standardmodell zu beobachten. Hierbei werden Formunterschiede verschiedener topologischer Variablen in Multijetereignissen ausgenutzt, die aufgrund unterschiedlicher Produktionsmechanismen von Signal und Untergrund existieren.

T 49.7 Di 18:15 VMP5 SR 0077

Messung der Rekonstruktionseffizienz von Triggerjets für die Dijet-Triggerlevel-Analyse mit dem ATLAS Experiment — •Hanno Meyer zu Theenhausen — Universität Heidelberg, Heidelberg

Bei der Suche nach Mediatorteilchen, die zwischen Teilchen des Standardmodells und Dunkler Materie vermitteln könnten, sind besonders kleine Mediatormassen interessant. Diese bieten sowohl aus kosmologischer als auch aus teilchenphysikalischer Sicht den größten unausgeschlossenen Parameterraum. Im Standardbetrieb des ATLAS Detektors am CERN ist die Sensitivität in diesem Bereich statistisch durch die Datenarchivierungsrate limitiert, wodurch mögliche Signaturen, wie Resonanzen im Dijet Massenspektrum, nicht von Hintergrundereignissen unterscheidbar sind. Die Dijet-Triggerlevel-Analyse (TLA) verwendet daher einen separaten kompakten Datenstrom, der deutlich höhere Ereignisraten bewältigt, aber nur Informationen beinhaltet, die auf Triggerniveau zur Verfügung stehen. Zur Analyse der Daten sollte die Jetrekonstruktion auf Triggerniveau vergleichbar effizient sein wie die Offlinerekonstruktion. In diesem Vortrag wird eine Messung der Rekonstruktionseffizienz der Triggerjets durch eine "Tag and Probe"-Methode im Rahmen der Dijet-TLA präsentiert.

T 49.8 Di 18:30 VMP5 SR 0077

Large Extra Dimension Searches with the CMS Experiment — •Markus Radziej, Thomas Hebbeker, Arnd Meyer, Tobias Pook, and Stefan Schmitz — 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.

This presentation concerns itself with the second generation of leptons. They are able to pierce the calorimeters and leave tracks in the muon system, distinguishing themselves from other elementary particles.

The analysis is based on the data recorded by the CMS experiment. Both the published $\sqrt{s} = 8\,\text{TeV}$ results and preliminary $\sqrt{s} = 13\,\text{TeV}$ ones will be presented.

T 50: Neutrinomasse II

Zeit: Dienstag 16:45–19:00 Raum: VMP5 SR 0079

T 50.1 Di 16:45 VMP5 SR 0079

Separation and Implantation of the Rare Isotope ^{163}Ho — •Tom Kieck[1], Katerina Chrysalidis[1], Holger Dorrer[1], Christoph Düllmann[1,2], Lisa Gamer[3], Loredana Gastaldo[3], Stefan Kormannshaus[1], Sebastian Schmidt[1], Fabian Schneider[1], and Klaus Wendt[1] for the ECHo-Collaboration — [1]JGU Mainz — [2]GSI Darmstadt — [3]Universität Heidelberg

The ECHo collaboration aims at measuring the electron neutrino mass by recording the spectrum following electron capture of ^{163}Ho. To reach a sub-eV sensitivity, a large number of individual microcalorimeters is needed, into which the isotope must be implanted in a well-controlled manner. The necessary amount of ^{163}Ho is produced by neutron irradiation of enriched ^{162}Er in the ILL high flux reactor. This introduces significant contaminations of other radioisotopes, which have to be quantitatively removed both, by chemical and mass spectrometric separation. The application of resonance ionization at the RISIKO mass separator guarantees the required isotope selectivity for purification and suitable energy for ion implantation. The efficiency and stability of the laser ion source was improved by Finite-Element Analysis of the thermal processes. For optimum implantation into the detector pixels ($170 \times 170\ \mu\text{m}^2$) with minimum losses a small ion beam spot at the implantation site is needed. For this purpose, post focusing ion optics were installed. Simulations were performed in order to optimize the homogeneous distribution of the implanted ions. The necessity to alternate implantation phases with deposition of a thin metallic layer for ^{163}Ho activities larger than 10 Bq is being discussed.

T 50.2 Di 17:00 VMP5 SR 0079

Status of the Cryogenic Pumping Section of the KATRIN Experiment — •Carsten Röttele for the KATRIN-Collaboration — Institut für Kernphysik (IKP), Karlsruhe Institute of Technology (KIT)

The **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment uses the kinematics of tritium β-decay to determine the electron antineutrino mass with a sensitivity of $m_\nu = 200\,\mathrm{meV/c^2}$ (90 % C.L.). In order to measure the decay electrons it is important to guide them adiabatically from the source to the spectrometer. In addition the diffusion of tritium into the spectrometers from the source has to be reduced by 14 magnitudes of order as tritium inside the spectrometers would induce additional background. For these two tasks the transport and pumping section were constructed. The last part of this section is the **C**ryogenic **P**umping **S**ection (CPS), which aims to reduce the residual gas flow by not less than seven orders of magnitude. For this a 3 K cold argon frost area (surface $\approx 2\,\mathrm{m^2}$) will be prepared to adsorb the incoming tritium molecules.
This talk will present the milestones which were reached since the CPS arrived on 30th July 2015 on KIT. Amongst others the calculations of the magnetic flux tube through the CPS based on as-built measurements of the coil geometries are presented.

T 50.3 Di 17:15 VMP5 SR 0079

Bestimmung der Stabilität von Elektronenstrahlen hoher Intensität bei Energien bis zu 20 keV mit einer Präzision von 0,1% mit Hilfe von pin-Dioden. — •Enrico Ellinger für die KATRIN-Kollaboration — Bergische Universtität Wuppertal

Der Forward Beam Monitor (FBM) soll im Karlsruher Tritium Neutrino Experiment (KATRIN) eingesetzt werden, um mit Hilfe einer pin-Diode die relative Intensität des von der Tritiumquelle erzeugten Elektronenstrahls mit einer Präzision von 0,1% zu überwachen. An der Messposition werden hohe Intensitäten von bis zu $10^6 \frac{e}{s \cdot m m^2}$ bei geringen Energien bis 20 keV erwartet. Dies stellt hohe Anforderungen an die Messelektronik, welche im wesentlichen aus einer pin-Diode, einem Transimpedanzverstärker und einem digitalen Pulsprozessor, besteht. Die Langzeitstabilität solcher Messungen wird durch Einflüsse wie Temperaturschwankungen sowie internen und externen Rauschquellen beeinträchtigt. Insbesondere die hohe Eventrate an der Nachweisschwelle führt bei Detektordrifts zu systematischen Fehlern.

Der Stand der Entwicklung und die aktuellen Ergebnisse werden präsentiert.

T 50.4 Di 17:30 VMP5 SR 0079

Influence of gas dynamics in the tritium source on the neutrino mass measurement of KATRIN — •Laura Kuckert for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The Karlsruhe Tritium Neutrino Experiment (KATRIN) aims to measure the neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.) in a direct approach using the beta decay of molecular tritium. The neutrino mass is extracted from a fit of modelled beta decay spectra to the measured electron spectrum. Hence, it is important to include modifications from systematic effects in the simulated spectrum. Especially the gas dynamics, density and velocity distribution, in the windowless gaseous tritium source (WGTS) play a key role for accurate modelling. Since in most cases this can not be measured directly, the modelled beta spectrum relies on gas dynamics calculation as well as on monitoring of operation parameter changes. A comprehensive pseudo-3D model has been developed. The accuracy of the gas dynamics model in the spectrum simulation including the monitoring of operation parameters is reviewed and implications on the systematics budget for the neutrino mass measurement are described. Supported by the BMBF under grant no. 05A14VK2 and by the Helmholtz Association

T 50.5 Di 17:45 VMP5 SR 0079

Tritium ions in the Source and Transport Section (STS) of KATRIN — •Manuel Klein for the KATRIN-Collaboration — Karlsruhe Institute of Technology

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 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 through the WGTS, the decay electrons are guided to the detector with a magnetic field. Tritium ions, however, also leave the WGTS following the magnetic field lines.

For KATRIN measurements it is imperative to prevent tritium ions from reaching the detector or the spectrometers, where they could decay and cause an indistinguishable background. Ion blocking measures are implemented by electric blocking potentials and electric dipoles to drift out trapped ions. Their effective operation will be tested during KATRIN commissioning measurements: The ion flux between STS and spectrometers can be measured with the Forward Beam Monitor (FBM). It offers a manipulator arm to introduce a detector into the flux tube. For ion detection, a Faraday Cup for the FBM is being designed and constructed.

Supported by BMBF (Ø5A14VK2) and by the Helmholtz Association.

T 50.6 Di 18:00 VMP5 SR 0079

Determination of the tritium flux in the pre-spectrometer of the KATRIN experiment — •Momin Ahmad for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Experimental Nuclear Physics (IEKP)

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment aims to probe the mass of the electron antineutrino in a model-independent way with an unsurpassed sensitivity of $m_\nu = 200$ meV/c^2 (90% C.L.). The energy spectrum of electrons from tritium β-decay is analyzed by an electrostatic spectrometer which is based on the MAC-E filter principle.
The beamline of the KATRIN experiment starts with the rear section and the windowless gaseous tritium source. Different pumping systems (e.g. cryogenic pumps) follow until the pre-spectrometer, main-spectrometer and the detector finish the beamline. The tritium flux is reduced by many orders and only few molecules can migrate into the pre-spectrometer. The decay of tritium in the volume of the prespectrometer generates magnetically trapped electrons with typical energies on the order of a few keV. Via subsequent ionization of residual gas molecules, the primary trapped electrons produce several secondary electrons which can be detected at the detector system at the downstream end of KATRIN. Analysing these electrons using a Monte Carlo simulation allows a better understanding of the tritium activity. This talk is about the characteristic of the secondary electrons and the relating tritium activity in the pre-spectrometer. This work has been supported by the German BMBF (05A14VK2).

T 50.7 Di 18:15 VMP5 SR 0079

Die Suche nach sterilen Neutrinos auf der eV-Massenskala mit dem KATRIN-Experiment — •Marco Kleesiek — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik

Das KArlsruher TRItium Neutrino Experiment wird nach seiner Inbetriebnahme über einen Zeitraum von fünf Kalenderjahren spektroskopisch den Endpunktsbereich des Tritium-Betazerfalls untersuchen. Hauptziel ist die modellunabhängige Bestimmung der effektiven Masse des Elektronantineutrinos mit einer bislang unerreichten Sensitivität von $0.2\,\mathrm{eV/c^2}$ (90 % C.L.).

Daneben ist KATRIN sensitiv für weitere Anomalien in der Form des Betazerfallsspektrums. Über Neutrinomischung werden hypothetische sterile Neutrinos kinematisch zugänglich und würden abhängig von ihrer Masse das beobachtete Spektrum in charakteristischer Weise modifizieren.

Dieser Beitrag untersucht den Effekt der Beimischung eines leichten sterilen Neutrinos im eV-Bereich bei kleinen Mischungswinkeln, motiviert durch die sogenannte ‚Reaktor-Antineutrino-Anomalie'. Es wird gezeigt, dass das KATRIN-Experiment in der Lage sein wird, mit nur leichten Anpassungen der Messstrategie den in Frage stehenden Parameterraum in einer direkten Messung zu prüfen.

Gefördert durch das BMBF unter Kennzeichen 05A14VK2 und die Helmholtzgemeinschaft.

T 50.8 Di 18:30 VMP5 SR 0079

KATRIN and sterile Neutrinos in the eV — •Marc Korzeczek[1], Thierry Lasserre[2], and Susanne Mertens[1,3] for the KATRIN-Collaboration — [1]Karlsruhe Institute of Technology, Germany — [2]Commissariat à l'énergie atomique, France — [3]Lawrence Berkeley National Laboratory, USA

Sterile neutrinos in the eV-mass range could resolve a number of long-standing anomalies in short baseline neutrino oscillation experiments. The KATRIN Experiment (KArlsruhe TRItium Neutrino) designed to measure the mass of the active neutrino, has the potential to search for a signature of light sterile neutrinos without any hardware modification.

In this talk we explore the combined sensitivity of KATRIN with

CeSOX (CErium Short distance neutrino Oscillations with boreXino), an experiment dedicated to search for light sterile neutrinos via oscillations. In particular, we study the impact of sterile neutrinos on the KATRIN's active neutrino mass measurement.

This work has been supported by the German BMBF (05A14VK2), by the Ministry of Science, Research and the Arts, Baden-Wuerttemberg (MWK), by the CEA and the Deutschlandstipendium (BMBF and SAP SE).

T 50.9 Di 18:45 VMP5 SR 0079

Requirements on read-out electronics for future keV-scale sterile neutrino search with KATRIN — •Kai Dolde — Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Recent publications show the great potential of the KATRIN (KArlsruhe TRItium Neutrino) experiment in the search for sterile neutrinos in the mass range of a few keV down to active-to-sterile mixing angles at least one order of magnitude smaller than current laboratory limits of $\sin^2\theta < 10^{-3}$. In order to be sensitive to the tiny kink-like signature of sterile neutrinos in tritium beta decay, KATRIN requires a novel sophisticated detector and read-out system. Several silicon prototype detectors are under construction at the moment to explore the most suitable detector design for this purpose. The selection of appropriate read-out electronics is strongly triggered by the requirements of allowing only very small systematic uncertainties due to ADC Non-Linearities to reach the expected sensitivity.

This talk investigates the impact of ADC Non-Linearities on the tritium beta decay spectrum, depending on the digitization method of analogue signals of a multi-pixel silicon detector, peak sensing or waveform digitization. The simulations show a higher achievable sensitivity using waveform digitizers and moreover strongly favor additional variable post-acceleration of the electrons to smear out the periodic structure of the ADC Non-Linearities.

This work has been supported by the German BMBF (05A14VK2) and by the Ministry of Science, Research and the Arts, Baden-Wuerttemberg (MWK).

T 51: Kalorimeter I

Zeit: Dienstag 16:45–18:50 Raum: VMP6 HS E

Gruppenbericht T 51.1 Di 16:45 VMP6 HS E

High Luminosity Liquid-Argon Calorimeter Test Beam — •Olga Novgorodova and Arno Straessner — TU Dresden, IKTP

In the future HL-LHC the luminosity will increase by factor of 5-7 with respect to the original LHC design. The HiLum collaboration studied the impact on small-sized modules of the ATLAS electromagnetic, hadronic, and forward calorimeters also instrumented by various intensity and position detectors. The intensity of beam varied over a wide range (10^6 to 10^{12} p/s) and beyond the maximum expected at HL-LHC for these calorimeters.

Results from the last test beam campaign in 2013 on the signal shape analysis from the calorimeter modules are compared with MC simulations. The correlation between high-voltage return currents of the electromagnetic calorimeter and beam intensity is used to estimate critical parameters and compared with predictions.

T 51.2 Di 17:05 VMP6 HS E

Simulation der Energierekonstruktion der verbesserten Flüssigargon-Trigger-Ausleseelektronik bei ATLAS — •Maximilian Hils, Olga Novgorodova und Arno Straessner — IKTP, TU Dresden, Deutschland

Für das Jahr 2020 ist geplant, die Luminosität des LHC auf das doppelte der Design-Luminosität zu erhöhen. Da die Bandbreite des Level-1-Triggers des ATLAS-Detektors auf 100 kHz beschränkt ist und man dennoch physikalisch interessante Ereignisse mit niedriger Transversalenergieschwelle aufzeichnen will, bedarf es einer Verbesserung der Trigger-Auswahl. Aus diesem Grund ist für das Jahr 2018 ein Upgrade der Ausleseelektronik der Flüssigargon-Kalorimeter geplant. Die neue Elektronik ermöglicht die Auslese von Detektorsignalen, die für die Trigger-Entscheidung genutzt werden, mit einer feineren Segmentierung in transversaler und longitudinaler Richtung der gemessenen Teilchenschauer. Untersucht werden digitale Filter zur Energierekonstruktion der neuen, sogenannten Super-Zellen des Flüssigargon-Kalorimeters. Zusätzlich ist es möglich mit der neuen Ausleseelektronik Schauerprofilvariablen zu berechnen, die bereits aus der Offline-Datenanalyse bekannt sind, um so besser zwischen Elektronen und hadronischen Jets zu unterscheiden. Diese Differenzierung hat direkte Auswirkungen auf den Level-1-Trigger.

T 51.3 Di 17:20 VMP6 HS E

Energy Calibration of the Electromagnetic Calorimeter in ATLAS — •Stefanie Hanisch[1,2], Martin Aleksa[1], and Arno Straessner[2] — [1]CERN — [2]TU Dresden

The liquid Argon calorimeter of the ATLAS detector is the essential detector system for precise energy measurement of electrons and photons. Hence, its performance is crucial for a wide range of the ATLAS physics program. To achieve an excellent performance an outstanding calibration is required.

This talk will discuss the general strategy for the current calibration scheme of the EM energy scale and its improvement with respect to run-I, its validation and the recommendations for physics analyses. The MVA techniques used to achieve the calibration at the per-mille level will be presented. Studies to validate their performance using various fit models in single particle and Z→ee simulations as well as a selection of Z→ee events in data recorded with the ATLAS detector in 2015 will be outlined. Further, a discussion of the systematic uncertainties derived from Z→ee data events will be given.

T 51.4 Di 17:35 VMP6 HS E

Kalibration der Jet-Energieskala des CMS-Experiments mit $Z(\rightarrow \mu\mu/ee)$ + Jet Ereignissen — •Max Fischer, Dominik Haitz, Christoph Heidecker und Günter Quast — Karlsruhe Institute of Technology, Karlsruhe, Germany

Für die am LHC durchgeführten Analysen ist die exakte Messung von Jets unerlässlich. Dies wird erschwert durch eine Vielzahl von Störeffekten, von Hintergrundrauschen bis hin zum komplizierten Zusammenspiel mehrerer Detektorelemente. Zur Korrektur dieser Effekte nutzt die CMS Kolaboration einen mehrstufigen Ansatz mit Daten aus Simulation und Experiment.

In der ersten Datennahmeperiode konnte die Jet-Energieskala auf wenige Prozent genau bestimmt werden. Mit der neuen Datennahme bei Schwerpunktsenergien von 13 TeV und höheren Ansprüchen gilt es, diese Leistung zu wiederholen oder übertreffen. Hierfür werden sowohl bewährte als auch neue Methoden genutzt.

Die Kalibration mit $Z(\rightarrow \mu\mu/ee)$ + Jet Ereignissen ist essentiell für den letzten Schritt der Korrekturen der CMS Kolaboration. Die Topologie aus einem Jet transversal balanciert gegen ein Z-Boson erlaubt die Kalibration gegen ein präzise beschriebenes Objekt. Durch dieses können Simulation und Experiment in Einklang gebracht werden. Darüber hinaus gibt die Analyse der Ereignisse einen Überblick über die Genauigkeit und Zuverlässigkeit der aktuellen Energieskala.

T 51.5 Di 17:50 VMP6 HS E

Analysis of CERN 2015 Test Beam Data of the AHCAL engineering prototype — •Ambra Provenza for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The goal of the CALICE Collaboration is to develop calorimeters for a future e^+ e^- linear collider. The Analog Hadronic Calorimeter (AHCAL) is a high granularity calorimeter, developed to use the Particle Flow method, to reach a good jet energy resolution. The AHCAL technological prototype, scalable to full collider detector, is composed of $3 \times 3\,cm^2$ scintillator tiles read out by Silicon Photomultipliers. During the year 2015 two periods of test beams at CERN have been performed, to validate the detector calibration with muon and electron beams, to study the shower evolution with hadron beams, and compare two different kinds of absorber material: steel and tungsten absorber. This talk will focus on the analysis of the test beam data taken at CERN, with particular stress on the calibration of the detector and compare these results with the Monte Carlo simulation.

T 51.6 Di 18:05 VMP6 HS E

Energieauflösung eines hochgranularen Szintillatorkalorimetersystems — •Oskar Hartbrich für die CALICE-D-Kollaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

Ein Ansatz um die Messung von Jetenergien an zukünftigen Leptonbeschleuniger-Experimenten zu verbessern sind sogenannte *Particle Flow* Algorithmen, welche neben guter Energieauflösung eine hohe Granularität der Kalorimetersysteme voraussetzen. Die *CALICE* Kollaboration entwickelt Konzepte und Prototypen für hoch granulare Kalorimeter mit verschiedenen Auslesetechnologien.
Bei einer kombinierten Teststrahlmessung am FNAL Testbeam in 2009 wurden Messungen mit einem Szintillator-Siliziumphotomultiplier Kalorimetersystem bestehend aus einem elektromagnetischen und einem hadronischen Kalorimeterprototypen durchgeführt. Zur Beurteilung des kombinierten Kalorimetersystems ist die Energieauflösung für einzelne Pionen von besonderem Interesse, da diese signifikante Depositionen in beiden Kalorimetern erzeugen können. Der Vortrag beinhaltet die Analyse der klassischen Energieauflösung des vorgestellten Szintillator-Kalorimetersystems für Pionen im Energiebereich 4-32 GeV, die Verbesserung der Energierekonstruktion durch Gewichtung einzelner Energiedepositionen nach lokaler Energiedichte (*Software Compensation*), sowie deren Vergleich mit detaillierten Monte-Carlo Simulationen.

T 51.7 Di 18:20 VMP6 HS E

Hadronic energy reconstruction in the CALICE combined calorimeter system — •Yasmine Israeli for the CALICE-D-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

Future linear electron-positron colliders, ILC and CLIC, aim for precision measurements and discoveries beyond and complementary to the program of the LHC. For this purpose, detectors with the capability for sophisticated reconstruction of final states with energy resolutions substantially beyond the current state of the art are being designed.
The CALICE collaboration develops highly granular calorimeters for future colliders, among them silicon-tungsten electromagnetic calorimeters and hadronic calorimeters with scintillators read out by SiPMs. Such a combined system was tested with hadrons at CERN as well as at Fermilab.
In this contribution, we report on the energy reconstruction in the combined setup, which requires different intercalibration factors to account for the varying longitudinal sampling of sub-detectors. Software compensation methods are applied to improve the energy resolution and to compensate for the different energy deposit of hadronic and electromagnetic showers.

T 51.8 Di 18:35 VMP6 HS E

Messung der Elektron-Hadron Separation und e/h-Verhältnis eines Kalorimeters mit Szintillator-Auslese der CALICE Kollaboration — •Mathias Götze und Christian Zeitnitz für die CALICE-D-Kollaboration — Bergische Universität Wuppertal

Die CALICE Kollaboration entwickelt hochgranulare Kalorimeter. Ziel ist es eine bisher unerreichte Jet-Energie-Auflösung zu erzielen. Die Realisierbarkeit einiger Kalorimeterkonzepte konnte bereits an Hand mehrerer Prototypen gezeigt werden. Die hier benutzten Kalorimeter basieren auf Silizium-Photomultiplier-Auslese von Szintillator-Streifen (elektromagnetisch) bzw. Kacheln (hadronisch). Dabei hat das elektromagnetische Kalorimeter eine effektive Zellgröße von $10\times10\text{mm}^2$ und das hadronische Kalorimeter von $30\times30\text{mm}^2$. Es werden Elektronen und Hadronen im Kalorimeter anhand der Schauerform unterschieden und anschließend das e/h-Verhältnis der Kombination der Kalorimeter bestimmt. Die dabei analysierten Daten stammen aus der Teststrahlkampagne 2009, welche am Fermilab durchgeführt wurde.

T 52: CP-Verletzung im B-Meson-System

Zeit: Dienstag 16:45–19:00 Raum: VMP6 HS F

T 52.1 Di 16:45 VMP6 HS F

Untersuchung der CP-Verletzung im Kanal $B^0 \to D^-\pi^+$ am LHCb-Experiment — •Alex Birnkraut, Ulrich Eitschberger und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Am LHCb-Experiment werden unter anderem CP-verletzende Prozesse im System der neutralen B^0-Mesonen zeitaufgelöst gemessen. Untersucht man die zeitabhängigen Zerfallsraten der B^0- und $\overline{B}^0$-Mesonen findet man bei bestimmten CP-verletzenden Prozessen eine Asymmetrie in der Interferenz zwischen Mischung und Zerfall der neutralen B^0- und $\overline{B}^0$-Mesonen.
Bei der zeitaufgelösten Messung der Zerfallsmoden $B^0 \to D^\pm\pi^\mp$ und $\overline{B}^0 \to D^\mp\pi^\pm$ werden die Asymmetrien zwischen den Zerfällen initialer B^0 und $\overline{B}^0$ in den jeweils gleichen Endzustand gemessen. Dabei kann der CKM-Winkel γ mit geringen theoretischen Unsicherheiten bestimmt werden. Da der Zerfall $B^0 \to D^+\pi^-$ gegenüber dem Zerfall $B^0 \to D^-\pi^+$ stark Cabibbo-unterdrückt ist, wird nur ein geringes Maß an CP-Verletzung in der Interferenz aus Mischung und Zerfall erwartet. Daher stellt die Messung eine experimentelle Herausforderung dar: Asymmetrien in der Produktion, der Detektion und der Bestimmung des Anfangszustandes der B-Mesonen müssen sehr genau bekannt sein, um diese Effekte von einer CP-Asymmetrie zu separieren.
In diesem Vortrag wird der Stand der Analyse zur Messung der CP-Verletzung in dem Zerfallskanal $B^0 \to D^-\pi^+$ auf dem Run I Datensatz des LHCb-Experiments, dessen Größe einer integrierten Luminosität von $3\,\text{fb}^{-1}$ entspricht, vorgestellt.

T 52.2 Di 17:00 VMP6 HS F

Sensibility Study of $B \to \pi^0\pi^0$ for the Belle II Experiment — •Fernando Abudinen for the Belle II-Collaboration — Max-Planck-Institut für Physik, München

Within the Standard Model, the largest CP violation is expected in the decays of B-mesons. Because of the small branching fraction around 10^{-6} and the difficulty in reconstructing the B^0 decay vertex using π^0s, the measurement of the CP violation parameters for the channel $B \to \pi^0\pi^0$ is a highly challenging task. So far, the analysis at B-factories consisted in the measurement of the branching fraction $\mathcal{B}$ and the direct CP violation parameter A_{CP}. These have been used to determine ϕ_2, one of the angles of the Unitarity Triangle, via the isospin analysis of the whole $B \to \pi\pi$ system.
With an expected integrated luminosity of about 50 ab^{-1} at SuperKEKB and the capabilities of the new pixel vertex detector, the Belle II experiment will provide enough data to measure also the mixing-induced CP violation parameter S_{CP}. For this measurement the reconstruction of either $\pi^0 \to e^+e^-\gamma$ or converted photons from $\pi^0 \to \gamma\gamma$ is required. The obtained result would reduce the ambiguities in the ϕ_2 measurement.
Within the scope of this work the reconstruction of π^0s and converted photons is being developed in order to exploit maximally the new data set and to characterize the sensitivity of Belle II for this channel.

T 52.3 Di 17:15 VMP6 HS F

Messung von CP-Verletzung in $B^0 \to D^+D^-$ mit dem LHCb-Experiment — •Frank Meier, Margarete Schellenberg und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Im Standardmodell der Teilchenphysik beschreibt die CKM-Matrix die Transformation zwischen den Masseneigenzuständen und den Eigenzuständen der schwachen Wechselwirkung für die down-artigen Quarks. Die Unitarität dieser 3×3-Matrix führt zu Unitaritätsbedingungen, welche als Dreiecke in der komplexen Ebene interpretiert werden können. Der Winkel β eines dieser CKM-Unitaritätsdreiecke lässt sich unter anderem mithilfe des Zerfalls $B^0 \to D^+D^-$ messen. In diesem Zerfall tritt CP-Verletzung in der Interferenz zwischen direktem Zerfall und Zerfall nach Mischung in den Flavour-konjugierten Zustand auf. Da es sich in diesem Zerfall um einen Cabibbo-unterdrückten $b \to c\bar{c}d$ Übergang handelt, ist der Beitrag loopartiger Feynmandiagramme zur Übergangsamplitude gegenüber dem Treediagramm nicht unterdrückt. Somit ermöglicht die Bestimmung von CP-Verletzung in diesem Kanal eine Ergänzung der Messungen in $B^0 \to J/\psi\, K^0_S$, in dem der Übergang $b \to c\bar{c}s$ stattfindet. Um die statistische Genauigkeit zu erhöhen, werden in der Analyse des vollen Run I Datensatzes des LHCb-Experiments neue Flavour Tagging Algorithmen eingesetzt. Die Ergebnisse dieser Messung werden im Vortrag vorgestellt.

T 52.4 Di 17:30 VMP6 HS F

Messung der zeitabhängigen *CP*-Asymmetrie im Zerfall $B^0 \to D^{*\pm}D^{\mp}$ mit dem LHCb-Experiment — Frank Meier, •Margarete Schellenberg und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Ein wichtiges Ziel des LHCb-Experiments ist die präzise Vermessung der *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 $b \to c\bar{c}d$ und dem Zerfall nach B^0 - $\bar{B}^0$-Mischung auftritt. Über die *CP*-Asymmetrie lässt sich der CKM-Winkel β bestimmen. Im Gegensatz zu $b \to c\bar{c}s$-Zerfällen sind hier Beiträge höherer Ordnung nicht Cabibbo-unterdrückt, weshalb diese Messung sensitiv auf Effekte durch Physik jenseits des Standardmodells ist und somit bisherige Messungen ergänzen kann. Der Vortrag stellt den bisherigen Stand der Analyse vor, welche auf dem vom LHCb-Experiment in den Jahren 2011 und 2012 aufgenommenen Datensatz von $3\,\mathrm{fb}^{-1}$ basiert.

T 52.5 Di 17:45 VMP6 HS F

Messung der zeitabhängigen *CP*-Asymmetrie im Zerfall $B^0 \to J/\psi(ee)\,K^0_S$ mit dem LHCb-Experiment — Vanessa Müller, •Ramon Niet und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Durch Analyse von $B^0 \to J/\psi\,K^0_S$ Zerfällen lässt sich eine zeitabhängige *CP*-Asymmetrie messen, die in der Interferenz zwischen Mischung und Zerfall auftritt. Durch Messung der Asymmetrie erhält man Zugang zur Größe $\sin 2\beta$, wobei β einen der Winkel in einem Unitaritätsdreieck der CKM Matrix darstellt. Bisher wurden bei LHCb zur Messung dieses Parameters nur J/ψ Zerfälle in zwei Myonen herangezogen. Um die Sensitivität weiter zu steigern wird im Rahmen der vorgestellten Analyse die Rekonstruktion von Zerfällen in zwei Elektronen vorgenommen, die aufgrund der verstärkten radiativen Effekte im Vergleich zu Myonen, experimentell herausfordernder sind. Der Vortrag stellt den Stand der Analyse vor, die auf dem vom LHCb-Experiment aufgenommenen Run I Datensatz von $3\,\mathrm{fb}^{-1}$ beruht.

T 52.6 Di 18:00 VMP6 HS F

Messung des *CP*-Parameters $\sin(2\beta)$ im Zerfall von $B^0 \to \psi(2S)K^0_S$ mit dem LHCb-Experiment — •Vanessa Müller, Ramon Niet und Julian Wishahi — Experimentelle Physik 5, TU Dortmund

Die Messung der *CP*-Verletzung in der Interferenz zwischen B^0–$\overline{B^0}$-Mischung und $b \to c\bar{c}s$-Zerfällen 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. Neben diesem Zerfallskanal können weitere Charmonium-Resonanzen, wie des ψ(2S), genutzt werden. Das ψ(2S)-Meson lässt sich dabei besonders gut im Zerfall in zwei Myonen rekonstruieren. Besondere Herausforderungen stellen die korrekte Bestimmung des Produktionszustandes des *B*-Mesons oder auch die korrekte Beschreibung der Zerfallszeitakzeptanz sowie der Zerfallszeitauflösung dar.

In diesem Vortrag werden die Ergebnisse dieser Studien mit dem Run I Datensatz von LHCb vorgestellt und diskutiert.

T 52.7 Di 18:15 VMP6 HS F

Messung von *CP*-Verletzung in den Zerfällen $B^0_s \to D_sK$ und $B^0_s \to D_s\pi$ mit dem LHCb-Experiment — Alex Birnkraut, •Ulrich Eitschberger und Julian Wishahi für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Die zeitabhängige Messung der *CP*-verletzenden Observablen im Zerfallskanal $B^0_s \to D_sK$ ist sensitiv auf den CKM-Winkel γ. Aufgrund der ähnlichen Topologie bei gleichzeitig deutlich größerer Zerfallsbreite wird der Zerfall $B^0_s \to D_s\pi$ zur Optimierung der Selektion und zur Kontrolle verschiedener Effekte genutzt. In diesem Zerfallskanal stellt eine Untersuchung von *CP*-Verletzung in der Interferenz einen Nulltest des Standardmodells dar, da dieses keine *CP*-Verletzung für $B^0_s \to D_s\pi$ voraussagt. Zusätzlich ermöglicht die zeitabhängige Analyse von $B^0_s \to D_s\pi$ eine Präzisionsmessung der B^0_s-Mischungsfrequenz Δm_s.

Die zeitabhängige Analyse beider Zerfallskanäle, deren aktueller Stand im Vortrag vorgestellt wird, nutzt den gesamten Run I Datensatz des LHCb-Experiments.

T 52.8 Di 18:30 VMP6 HS F

Vorstudien zur Messung der zeitabhängigen CP-Verletzung in $B^0 \to K^0_S K^0_S K^0_S$ bei BelleII — •Paul Jäger, Michael Feindt, Pablo Goldenzweig und Martin Heck für die Belle II-Kollaboration — Karlsruher Institut für Technologie

Im Zuge der Entwicklung des Software-Frameworks für das Belle II-Experiment (BASF2) wird eine erste Analyse anhand von Monte-Carlo Ereignissen durchgeführt. Hierbei sollen Funktionalität und Leistung der neu entwickelten Tools getestet werden. Es wird der Zerfallskanal $B \to KsKsKs$ untersucht. Der Fokus liegt dabei auf der Rekonstruktion und Selektion von kurzlebigen Kaonen (Ks). Hierfür werden multivariate Klassifizierer trainiert (Boosted decision trees), deren trennende Variablen vorgestellt werden. Es soll die Verteilung der Zeit zwischen dem Zerfall der beiden B-Mesonen (ΔT) gefittet werden. Durch den Fit lassen sich die beiden Parameter der zeitabhängigen CP-Verletzung S_f und A_f bestimmen. Im Zuge dieses Vortrages werden die Struktur und Implementierung der Analyse erklärt, sowie aktuelle Ergebnisse vorgestellt.

T 52.9 Di 18:45 VMP6 HS F

Suche nach *T*-Verletzung im Zerfall $\bar{B}^0 \to \Lambda\bar{p}\pi^+$ mit den Run-I-Daten des LHCb-Detektors — •Christian Voss — Universität Rostock, Institut für Physik

Experimentell stellt die Messung der vom Standardmodell vorhergesagten Zeitumkehrasymmetrie eine große Herrausforderung dar.

Eine Möglichkeit besteht im Vergleich zweier Asymmetrien, die jeweils für das Teilchen als auch für das Antiteilchen bestimmt werden. Die Asymmetrien selbst werden dabei mit Hilfe eines Spatp roduktes der Form

$$\mathcal{O} = \boldsymbol{s}_\Lambda \cdot (\boldsymbol{p}_\Lambda \times \boldsymbol{p}_\pi)$$

berechnet, wobei $\boldsymbol{s}_\Lambda$ den Spin-Vektor und $\boldsymbol{p}_\Lambda$ den Impulsvektor des Λ-Baryons darstellen bzw. $\boldsymbol{p}_\pi$ den Impulsvektor des Pions. Der Sp in-Vektor des Λ-Baryons wird durch Ausnutzen der Paritätsverletzung im Λ-Zerfall bestimmt.

Der Zerfall $\bar{B}^0 \to \Lambda\bar{p}\pi^+$ wird mit Hilfe der LHC*b*-Daten rekonstruiert und die Anzahl der Signalereignisse durch einen Fit in vier unterschiedlichen Samples, entsprec hend des Vorzeichens des Spat-Produktes und des Flavour des *B*-Mesons, bestimmt und anschließend die Differenz der Asymmetrien berechnet. Theoretische Vorhersagen geben an, dass die Verletzung der *T*-Asymmetrie bis zu 10% beträgt. Die erwartete statistische Genauigkeit wird etwa in der selben Größenortnung erwartet.

Vorläufige Ergebnisse werden im Vortrag vorgestellt.

T 53: Halbleiterdetektoren III (Strahlenhärte)

Zeit: Dienstag 16:45–19:00 Raum: VMP8 HS

T 53.1 Di 16:45 VMP8 HS

3-Dimensional Charge Collection Efficiency measurements using volumetric tomographic reconstruction — •Daniel Dobos — CERN, Geneva, Switzerland

For a better understanding of the electrical field distribution of 3D semiconductor detectors and to allow efficiency based design improvements, a method to measure the 3D spatial charge collection efficiency of planar, 3D silicon and diamond sensors using 3D volumetric reconstruction techniques is possible. Simulation results and first measurements demonstrated the feasibility of this method and show that with soon available 10 times faster beam telescopes even small structures and efficiency differences will become measurable in few hours.

T 53.2 Di 17:00 VMP8 HS

Strahlenhärte von n-in-p Siliziumstreifensensoren für das CMS-Phase-II-Upgrade — Felix Bögelspacher, Alexander Dierlamm, •Marius Metzler, Thomas Müller, Martin Printz, Daniel Schell und Pia Steck — IEKP

Im Jahre 2024 soll das Phase-II-Upgrade des Large Hadron Collider (LHC) zum HL-LHC und damit auch des Compact Muon Solenoid Detektors (CMS) umgesetzt werden, welches mit einer Steigerung der Luminosität von $1{\cdot}10^{34}$ auf $5{\cdot}10^{34}$ $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ einhergehen wird. Dies

entspricht bei einer Laufzeit von 10 Jahren bei geschätzten 3000 fb^{-1} einer Fluenz von $1{\cdot}10^{15}$ $n_{eq}cm^{-2}$, die man etwa 20 cm Entfernung vom Zentrum erwartet. Dementsprechend muss die Widerstandsfähigkeit des Spurdetektors gegenüber Strahlung angepasst werden.

Dieser Vortrag wird ausschließlich Messungen von n-in-p-Streifensensoren beinhalten. Im Detail heißt das, dass verschiedene Testsensoren unterschiedlichen Designs auf ihre elektrischen Eigenschaften vor und nach Bestrahlung bis $1{\cdot}10^{15}$ $n_{eq}cm^{-2}$ sowie ihre Ladungssammlungseffizienz untersucht werden.

T 53.3 Di 17:15 VMP8 HS

Characterization of irradiated thin silicon sensors for the CMS phase II pixel upgrade — •Matteo Centis Vignali[1], Doris Eckstein[2], Thomas Eichhorn[2], Erika Garutti[1], Alexandra Junkes[1], and Georg Steinbrück[1] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]Deutsches Elektronen Synchrotron, DESY

The high-luminosity upgrade of the Large Hadron Collider, foreseen for 2025, necessitates the replacement of the tracker of the CMS experiment. The innermost layer of the new pixel detector will be exposed to severe radiation corresponding to a 1 MeV neutron equivalent fluence up to $\Phi_{eq} = 2 \cdot 10^{16}$ cm^{-2} and an ionizing dose of ≈ 10 MGy after an integrated luminosity of 3000 fb^{-1}. Silicon crystals grown with different methods and sensor designs are under investigation in order to optimize the sensors for such high fluences. Thin planar silicon sensors are good candidates to achieve this goal, since the degradation of the signal produced by traversing particles is less severe than for thicker devices.

Epitaxial pad diodes and strip sensors irradiated up to fluences of $\Phi_{eq} = 1.3 \cdot 10^{16}$ cm^{-2} have been characterized in laboratory measurements and beam tests at the DESY II facility. The active thickness of the strip sensors and pad diodes is 100 μm. In addition, strip sensors produced using other growth techniques with a thickness of 200 μm have been studied.

In this talk, the results obtained for p-bulk sensors are shown.

T 53.4 Di 17:30 VMP8 HS

X-ray irradiation effects of interface traps and trapped-oxide charge at the Si-SiO_2 interface of segmented silicon sensors — •Ioannis Kopsalis, Eckhart Fretwurst, Erika Garutti, Robert Klanner, and Joern Schwandt — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

The surface radiation damage of SiO_2 grown on high-ohmic Si, as used for the fabrication of segmented silicon sensors, has been investigated. Circular p- and n-MOSFETs, biased in accumulation and inversion at a field in the SiO_2 of about 500 kV/cm, have been irradiated by X-rays up to a dose of about 17 kGy(SiO_2) in different irradiation steps. Before and after each irradiation, the gate voltage has been cycled from inversion to accumulation conditions and back, and from the dependence of the drain-source current, on gate voltage, the threshold voltage of the MOSFET and the hole and electron mobility at the Si-SiO_2 interface determined.
From the threshold voltage, the effective oxide-charge density is calculated. Using the subthreshold-current technique the contribution of interface traps, in the lower and the upper part of the energy Si bandgap, and of fixed oxide-charge to the effective oxide-charge density has been estimated. Results on the dose dependence of the above quantities, the charging-up and discharging of border traps when changing the gate voltage, and the hole and electron mobilities at the Si-SiO_2 interface are presented.

T 53.5 Di 17:45 VMP8 HS

TSC measurements on proton-irradiated p-type Si-sensors — •Elena Donegani, Eckhart Fretwurst, Erika Garutti, and Alexandra Junkes — University of Hamburg

Thin n^+p Si sensors are potential candidates for coping with neutron equivalent fluences up to $2{\cdot}10^{16}$ n_{eq}/cm^2 and an ionizing dose in the order of a few MGy, which are expected e.g. for the HL-LHC upgrade. The aim of the present work is to provide experimental data on radiation-induced defects in order to: firstly, get a deeper understanding of the properties of hadron induced defects, and secondly develop a radiation damage model based on microscopic measurements.

Therefore, the outcomes of Thermally Stimulated Current measurements on 200 μm thick Float-Zone (FZ) and Magnetic Czochralski (MCz) diodes will be shown, as a results of irradiation with 23 MeV protons and isothermal annealing. The samples were irradiated in the fluence range $(0.3\text{-}1){\cdot}10^{14}$ n_{eq}/cm^2, so that the maximal temperature at which the TSC signal is still sharply distinguishable from the dark current is 200 K.

In particular, special focus will be given to the defect introduction rate and to the issue of boron removal in p-type silicon. Annealing studies allow to distinguish which defects mainly contribute to the leakage current and which to the space charge, and thus correlate microscopic defects properties with macroscopic sensor properties.

T 53.6 Di 18:00 VMP8 HS

Messungen des Leckstroms zur Bestimmung der effektiven Bandlücke und Schädigungskonstante stark bestrahlter Siliziumsensoren — •Moritz Wiehe[1], Tony Affolder[2], Gianluigi Casse[2], Paul Dervan[2], Susanne Kühn[1], Riccardo Mori[1], Ulrich Parzefall[1] und Sven Wonsak[2] — [1]Albert-Ludwigs-Universität Freiburg — [2]University of Liverpool

Der Leckstrom bestrahlter Siliziumsensoren führt zur Selbsterwärmung und verschlechtert das Signal-zu-Rausch-Verhältnis eines Detektors. Daher ist eine genaue Vorhersage der im Experiment zu erwartenden Höhe des Leckstroms für die Planung und den Betrieb eines Detektors erforderlich. Die Abhängigkeit des Leckstroms von der Sensortemperatur und der Bestrahlungsdosis wird parametrisiert durch die effektive Bandlücke $E_{g,eff}$ und die Schädigungskonstante, die sogenannte *current related damage rate* α. Im Vortrag werden Messungen zur Bestimmung dieser Parameter in Abhängigkeit der Bestrahlungsdosis vorgestellt. Es wurden Messungen des Leckstroms unter Variation der Biasspannung bei Sensortemperaturen von $-32°C$, $-27°C$ und $-23°C$ durchgeführt. Die oben genannten Parameter wurden so für 18 verschiedene n-in-p Siliziumstreifensensoren der Firmen Hamamatsu Photonics und Micron Semiconductor Ltd, welche mit einer Dosis von $2 \cdot 10^{14}$ bis $2 \cdot 10^{16}$ n_{eq}/cm^2 bestrahlt wurden, bestimmt.

T 53.7 Di 18:15 VMP8 HS

An edge-TCT setup for the investigation of radiation damaged silicon sensors — •Finn Feindt, Christian Scharf, Erika Garutti, and Robert Klanner — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

The aim of this work is to measure the electric field, drift velocity and charge collection of electrons and holes in radiation-damaged silicon strip sensors.

For this purpose the edge Transient Current Technique (TCT) is employed. In contrast to conventional TCT, this method requires light from a sub-ns pulsed, infrared laser to be focused to a μm-size spot and scanned across the polished edge of a strip sensor. Thus electron-hole pairs are generated at a known depth in the sensor. Electrons and holes drift in the electric field and induce transient currents on the sensor electrodes. The current wave forms are analyzed as a function of the applied voltage and the position of the laser focus in order to determine the electric field, the drift velocities and the charge collection.

In this talk the setup and the procedure for polishing the sensor edge are described, and first results, regarding the measurement of the laser light focus are presented.

T 53.8 Di 18:30 VMP8 HS

Module mit dünnen planaren Silizium-Sensoren für den ATLAS Pixel-Detektor am HL-LHC — •Natascha Savic, Anna Macchiolo, Richard Nisius und Stefano Terzo — Max-Planck-Institut für Physik, München

Um der höheren Detektor-Okkupanz und Strahlendosis in der nächsten Phase der Steigerung der Luminosität des LHC (HL-LHC) Rechnung zu tragen, wird das derzeitige ATLAS-Pixel-System bis zum Jahr 2025 vollständig ersetzt werden. Dazu sind neue weitaus strahlenresistentere Pixelsensoren nötig. Die zur Zeit verwendeten 200-250μm dicken Silizium-Sensoren können aufgrund steigender Dunkelströme, niedriger Sammeleffizienzen und hoher Depletionsspannungen dann nicht mehr effizient betrieben werden. Das am Max-Planck-Institut für Physik dazu entwickelte, neuartige Modulkonzept nutzt dünne planare n-in-p Siliziumsensoren in Verbindung mit dem ATLAS FE-I4 Auslesechip. Im Vergleich zu den zur Zeit benutzten Sensoren wird die Funktion der dünnen Siliziumsensoren mit Dicken von 50 bis 150μm nach intensiver Bestrahlung weniger beeinträchtigt. Die Leistungsfähigkeit der Pixeldetektoren in Bezug auf Ladungssammlung und Pixeleffizienz wird mithilfe von radioaktiven Quellen und Test-Strahlen untersucht und verglichen. Es werden Resultate von Pixelmodulen vor und nach Bestrahlung vorgestellt. Der Einfluss der Sensordicke, sowie neuartiger

Punch-Through Designs (Strukturen welche die Funktionsprüfung der Sensoren vor Verbindung mit dem Auslesechip ermöglichen) und aktiver Kanten, auf die Eigenschaften der Sensoren wird untersucht.

T 53.9 Di 18:45 VMP8 HS

Absorption of light, drift velocity, and trapping times in highly irradiated silicon pad sensors — •Christian Scharf, Robert Klanner, and Erika Garutti — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

The aim of this work is to obtain information on the drift velocities and trapping rates in radiation damaged silicon sensors as a function of electric field and dose. For highly irradiated silicon sensors the electric field under reverse bias takes the shape of a double junction with high field near the implants and a region of lower field in between. For this condition it is difficult to determine separately the electric field, the trapping and multiplication of charge carriers, and the drift velocity; all of which are functions of the irradiation and the position in the sensor. However, for forward bias the electric field and the trapping rates are expected to be independent of position. We analyze transient current measurements of forward biased silicon pad sensors irradiated with proton doses above 10^{15} n_{eq}/cm^2 . The transients are induced by charges produced by sub-ns laser light of wavelengths of 670 and 1060 nm. In the analysis we considered that radiation-induced defects in the silicon can result in a decrease of the light absorption length, resulting in an increase of the number of electron-hole pairs generated by infrared light. This effect influences the determination of the charge collection efficiency of highly irradiated silicon sensors using infrared laser pulses, which is a method frequently used. The analysis method and first results will be presented.

T 54: Seltene Zerfälle und BSM im Flavourbereich

Zeit: Dienstag 16:45–18:50 Raum: VMP8 SR 05

Gruppenbericht T 54.1 Di 16:45 VMP8 SR 05

Seltene Zerfälle am LHCb-Experiment — •Maximilian Schlupp und Johannes Albrecht für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Die Suche nach seltenen Zerfällen schwerer Quarks bietet die Möglichkeit eines indirekten Nachweises Neuer Physik. Durch neue Teilchen bewirkte Quantenkorrekturen können zu drastischen Abweichungen von der Standardmodellerwartung führen. Durch die Präzisionsmessung von beispielsweise der Zerfallsrate des seltenen Zerfalls $B_s^0 \to \mu^+\mu^-$ oder durch die Winkelanalyse von $B^0 \to K^{*0}\mu^+\mu^-$ Zerfällen kann der getestete Energiebereich über die Schwerpunktsenergie des LHC hinaus erweitert werden. Dies sind nur zwei Beispiele vielversprechender Tests um neue Phänomene in Quantenkorrekturen zu messen. Das LHCb-Experiment hat ein breites Programm im Bereich der Untersuchung von seltenen Zerfällen. Der Vortrag stellt selektierte und aktuelle Highlights dieses Bereichs vor.

T 54.2 Di 17:05 VMP8 SR 05

Vorstudien zur Messung des Verzweigungsverhältnisses des Kanals $B^+ \to \ell^+\nu_\ell\gamma$ bei Belle II — •Felix Metzner, Michael Feindt, Pablo Goldenzweig, Thomas Hauth, Martin Heck und Thomas Keck für die Belle II-Kollaboration — Karlsruher Institut für Technologie

Der Zerfall $B^+ \to \ell^+\nu_\ell\gamma$ wurde bereits auf dem vollen Belle Datensatz untersucht. Dabei konnte eine obere Grenze für das Verzweigungsverhältnis bestimmt werden. Nun wird die Analyse mit Hilfe der neuen Werkzeuge des Belle II Software-Pakets, beginnend bei der Rekombination der Teilchen, durchgeführt. Aufgrund des nicht detektierbaren Neutrinos wird dabei die Vollständige Ereignisinterpretation eingesetzt, um auf die fehlende Masse schließen zu können. Dieses Werkzeug rekombiniert die Tag-Seite des Ereignisses mit einem hierarchischem Ansatz. Da dieser Teil der Software deutlich weiterentwickelt wurde, ist eine Verbesserung der Rekombinationseffizienz gegenüber des Vorgänger zu erwarten.

In diesem Vortrag wird knapp das Vorgehen bei der Analyse des Zerfalls $B^+ \to \ell^+\nu_\ell\gamma$ vorgestellt. Weiterhin wird das Ergebnis der Gegenüberstellung der Effizienzen der Vollständigen Ereignisinterpretation präsentiert.

T 54.3 Di 17:20 VMP8 SR 05

Background studies of $B \to K^{(*)}\nu\bar{\nu}$ decays at Belle II — •James Kahn and Thomas Kuhr for the Belle II-Collaboration — Ludwig-Maximilians University Munich, Germany

The $B \to K^{(*)}\nu\bar{\nu}$ decays provide some of the cleanest 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 full 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. New techniques will be required to identify and simulate background events in sufficient volumes for statistical analysis.

T 54.4 Di 17:35 VMP8 SR 05

Suche nach den verbotenen Zerfällen $B^0 \to \Lambda_c^+\mu^-$ und $B_s^0 \to \Lambda_c^+\mu^-$ mit dem LHCb-Experiment — Johannes Albrecht, Laura Gavardi, Maximilian Schlupp und •Konstantin Schubert für die LHCb-Kollaboration — Experimentelle Physik 5, TU Dortmund

Viele Theorien jenseits des Standardmodells erlauben die Verletzung von Baryonzahl B und Leptonzahl L, verlangen aber die Erhaltung der Differenz $B - L$. Die Zerfälle $B^0 \to \Lambda_c^+\mu^-$ und $B_s^0 \to \Lambda_c^+\mu^-$ erfüllen diese Bedingungen und sind daher aussichtsreiche Kandidaten für die direkte Messung eines solchen im Standardmodell verbotenen Prozesses. Der Vortrag präsentiert den Stand der Suche nach diesen Zerfällen auf dem Datensatz des LHCb Experiments der Jahre 2011 und 2012. Es wird erläutert, wie Untergründe und Unsicherheiten die Sensitvität der Analyse beeinflussen. In diesem Kontext werden die zu erwartenden oberen Ausschlussgrenzen auf die Verzweigungsverhältnisse präsentiert und im Falle von $B^0 \to \Lambda_c^+\mu^-$ mit den Ergebnissen früherer Messungen verglichen.

T 54.5 Di 17:50 VMP8 SR 05

Measurement of the inclusive $B \to X_s\gamma$ branching fraction and spectral moments. — •Luis Pesantez and Jochen Dingfelder for the Belle-Collaboration — Physikalisches Institut, Universitaet Bonn

The Belle detector at the KEKB e^+e^- collider recorded 770 $\times 10^6$ $B\bar{B}$ pairs produced at the $\Upsilon(4S)$ resonance. In the analysis presented here, the rare radiative decay of $B \to X_s\gamma$ was investigated. The study of this decay is interesting as it probes QCD properties of B-mesons and the rate can be considerably enhanced due to new physics effects: the decay, forbidden at tree-level in the Standard Model of particle physics, is loop-mediated and new charged particles, such as charged Higgs bosons, would alter the rate. The current experimental world average of the branching fraction and the SM prediction are in good agreement. The measured branching fractions also severely constrain a scenario with a charged Higgs boson in the Two-Higgs-Doublet Model of type II, which is a candidate of the Higgs sector of the supersymmetric extension of the Standard Model. In this presentation the current status of the legacy Belle analysis of the $B \to X_s\gamma$ branching fraction is shown using an inclusive approach. In particular, the status of the measurement of the differential shape, spectral moments and the extraction of QCD parameters will be summarized.

T 54.6 Di 18:05 VMP8 SR 05

Analyse des seltenen Zerfalls $B \to h\nu\bar{\nu}$ mit dem Belle-Experiment. — •Johannes Grygier, Michael Feindt, Martin Heck und Pablo Goldenzweig für die Belle-Kollaboration — KIT, Karlsruhe

B-Zerfälle mittels flavoränderner neutraler Ströme sind, da im Standardmodell auf Baumgraphniveau verboten, ein interessanter Ort, um nach Effekten dieses Modell erweiternder Theorien zu suchen. Ein besonders interessantes Beispiel ist hierbei der konkrete Zerfall, in dem das B-Meson in genau ein leichtes Meson und ein Neutrino-

Antineutrino-Paar übergeht, da dieser Übergang keine elektromagnetischen oder hadronische Residualwchselwirkungen im Endzustand beinhaltet.

Da Neutrinos in Detektoren gängiger Hochenergieexperimente nicht nachgewiesen werden können, ist man auf die genaue Kenntnis der Kinematik des Ereignisses angewiesen. Hierzu lässt sich ausnutzen, dass an B-Fabriken wie dem japanische KEKB stets zwei B-Mesonen erzeugt werden. Ist ein B-Meson rekonstruiert, kann auf die Gegenwart des zweiten geschlussfolgert werden. Nur so kann eine annehmbare Unterdrückung des anfallenden Untergrundes gewährleistet werden.

Es werden Analyseprinzipien und auftretende Herausforderungen dargestellt.

T 54.7 Di 18:20 VMP8 SR 05

Die Suche nach $\Xi_b \to \Lambda K$ — •Harald Viemann — Universität Rostock, Institut für Physik

Der Zerfall $\Xi_b \to \Lambda K$ kann entweder über einen Pinguin-Graphen (b→s) oder Baum-Graphen (b→u) erfolgen. In den Endzuständen des Zerfalls sind zwei strange-quarks vorhanden, welche vertauschen können.

Die Interferenz dieser Graphen (Pauli-Interferenz) ist destruktiv, daher ist ein sehr kleines Verzweigungsverhältnis $\mathcal{B}(\Xi_b \to \Lambda K)$ zu erwarten. Aufgrund der Farbunterdrückung eines der Baum-Graphens ist dieses nicht exakt null.

Der Zerfall wird in den vom LHCb-Detektor am LHC aufgenommenen Daten gesucht. Die Vorstellung der Ergebnisse erfolgt im Vortrag.

T 54.8 Di 18:35 VMP8 SR 05

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

The Standard Model (SM) has been so far the most successful approach to explain the phenomena of particles physics both at low and high energies. Neutrino flavor oscillation experiments imply that neutrinos are massive particle ($m_\nu \geq 0$). Moreover, the SM can't answer some cosmology open questions *e.g.* the Dark Matter origin or the matter over anti-matter dominance in the universe. Extending SM minimally by adding a Majorana mass term and three singlet neutrinos may solve these problems. In terms of mass eigenstates one obtains in the νMSM the known three light neutrinos ν_i and three heavy, quasi-sterile neutrinos N_j. Because of the small admixture of the left-handed component, the heavy neutrinos couple to the $W^\pm$, Z bosons and also to the Higgs boson. As a result, lepton-number ($B^\mp \to M^\pm l_1^\mp l_2^\mp$) and lepton-flavour ($B^\mp \to M^\mp l_1^\mp l_2^\pm$, $l_1 \neq l_2$) violating semileptonic decays of B mesons may be induced. The heavy neutrino can be produced as an on-shell intermediate particle ($m_M \lesssim m_N \lesssim m_B$).
The LHCb experiment at LHC is one of the most promising current experiments investigating in particular rare B meson decays within SM and beyond it. A summary of recent LHCb results as well as studies leading to a new search for heavy Majorana neutrinos in LNV and LFV B meson rare decays using LHCb run II data @ 13 TeV will be presented.

T 55: Monte Carlo, Partonschauer, QCD (Theorie)

Zeit: Dienstag 16:45–19:00 Raum: VMP8 SR 105

T 55.1 Di 16:45 VMP8 SR 105

Monte Carlo solution of the DGLAP evolution equation and extraction of TMD densities — •Aleksandra Lelek[1], Hannes Jung[1], and Francesco Hautmann[2] — [1]DESY, Hamburg, Germany — [2]University of Oxford, Oxford, United Kingdom

The Sudakov form factor, with its simple physical interpretation as a probability of evolving from one scale to another without any resolvable branching, is a basic tool to solve the evolution equation with a Monte Carlo method.

We present results for the full quark and gluon parton densities obtained with uPDFevolv code. We demonstrate that this method gives an exact solution of the evolution equation by a comparison with the results from the QCDnum package. We also show that higher order splitting functions can be included in a straight forward manner. The MC methods provides a direct method to obtain transverse momentum dependent (TMD) parton densities.

T 55.2 Di 17:00 VMP8 SR 105

Parton Shower Matching for Electroweak Corrections — Michael Krämer, Alexander Mück, and •Lennart Oymanns — RWTH Aachen, Institut für Theoretische Teilchenphysik und Kosmologie

The POWHEG method is widely used to match next-to-leading order (NLO) QCD calculations with standard parton shower programs. It is also possible to use the POWHEG method to match electroweak (EW) corrections with parton showers. We present how the POWHEG method can be extended to handle EW corrections, including photon radiation, and we use it to investigate the Drell-Yan process ($pp \to \mu^+\mu^-$). Our implementation is compared to an existing implementation in the POWHEGBOX and to NLO calculations for QCD and EW corrections.

T 55.3 Di 17:15 VMP8 SR 105

Automation of soft-gluon resummation in Sherpa — •Piero Ferrarese and Steffen Schumann — II. Physikalisches Institut Georg-August-Universitaet Goettingen

We present a fully automated NLL resummation of soft-gluons in global event-shape distributions at hadron colliders, for generic QCD processes. In general, for non-additive variables, the single logarithmic piece of the resummed distribution involves integrals that are not analytically solvable. We present a new algorithm to evaluate such integral, based on Monte Carlo methods. For this purpose we employ the parton-shower formalism, as implemented in the SHERPA event generator, to efficiently generate points in the multiple emission phase space. We discuss the general layout of our approach and present exemplary results.

T 55.4 Di 17:30 VMP8 SR 105

Fast evaluation of theoretical uncertainties with Sherpa and MCgrid — •Enrico Bothmann[1], Marek Schönherr[2], and Steffen Schumann[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Physik-Institut, Universität Zürich

The determination of theoretical error estimates and PDF/α_s-fits requires fast evaluations of cross sections for varied QCD input parameters. These include PDFs, the strong coupling constant α_S and the renormalization and factorization scales. Beyond leading order QCD, a full dedicated calculation for each set of parameters is often too time-consuming, certainly when performing PDF-fits. In this talk we discuss two methods to overcome this issue for any QCD NLO calculation: The novel event-reweighting feature in Sherpa and the automated generation of interpolations grids using the recently introduced MCgrid interface. For the Sherpa event-reweighting we present the newly added support for the all-order PDF dependencies of parton shower emissions. Building on that we discuss the sensitivity of high precision observables to those dependencies.

T 55.5 Di 17:45 VMP8 SR 105

Validation of aMC@NLO & Herwig++ for Processes Involving Top Quarks — •Daniel Rauch and Judith Katzy — DESY, Notkestraße 85, 22607 Hamburg

Measurements of top-associated Higgs production are among the flagship analyses of the second run of the LHC with the process $pp \to t\bar{t}H$ giving access to the Yukawa coupling of the Higgs particle to the top quark. The process $pp \to t\bar{t}b\bar{b}$ forms an irreducible background not only to these measurements but also to other searches investigating charged Higgs and SUSY models. From a theoretical perspective processes with such a large number of massive particles and different mass scales are quite challenging and typically suffer both from large theory uncertainties as well as modelling uncertainties regarding the treatment of masses and the splitting of the gluon into pairs of heavy quarks.

In this talk the Monte Carlo event generation with aMC@NLO matched at next-to-leading order to the Herwig++ parton shower will be studied for processes involving top quarks that are relevant in measurements of top-associated Higgs production in the second run of the LHC. Following up on the findings from Run 1 different radiation and scale settings will be evaluated and compared to results obtained dur-

ing the 2015 data taking period at a center-of-mass energy of 13 TeV.

T 55.6 Di 18:00 VMP8 SR 105

FeynCalc 9 — •Vladyslav Shtabovenko[1], Rolf Mertig[2], and Frederik Orellana[3] — [1]Technische Universität München, Physik-Department T30f, James-Franck-Str. 1, 85747 Garching, Germany — [2]GluonVision GmbH, Bötzowstr. 10, 10407 Berlin, Germany — [3]Technical University of Denmark, Anker Engelundsvej 1, Building 101A, 2800 Kgs. Lyngby, Denmark

We present the new version 9 of the Mathematica package FeynCalc, a useful tool for symbolic evaluation of Feynman diagrams and algebraic calculations in QFT. This talk will provide examples for using FeynCalc in heavy quarkonium physics, focussing on matching calculations between QCD and non-relativistic QCD (NRQCD), a well established effective field theory of QCD that is used to describe production and decay of heavy quarkonia. We will show that despite of being a high energy physics tool, FeynCalc is also well suitable for situations, where in the matching the manifest Lorentz covariance of QCD must be broken, such that one has to explicitly distinguish between temporal and spatial components of Lorentz tensors. Such calculations are important for obtaining higher order relativistic corrections to the NRQCD cross-sections and decay rates where the covariant projector approach is not always applicable.

T 55.7 Di 18:15 VMP8 SR 105

NLO event generation with the $(MC)^3$ sampling algorithm — •Rene Poncelet[1], Steffen Schumann[2], and Kevin Kröninger[3] — [1]Institut für Theoretische Teilchenphysik und Kosmologie, RWTH Aachen — [2]II. Physikalisches Institut, Universität Göttingen — [3]Experimentelle Physik IV, TU Dortmund

For precise predictions in high energy physics perturbative calculations within numerical approaches like Monte Carlo event generation are the state of the art. The sampling from complicated phase spaces arising in higher order calculations need to be handled. Multi-Channel Importance Sampling methods are the commonly used algorithms for phase space sampling, but suffer from inefficiencies for complicated target functions. The new sampling method Multi-Channel Markov Chain Monte Carlo $(MC)^3$ is a promising alternative regarding sampling efficiency. In this talk, the generalisation of the $(MC)^3$ implementation in Sherpa to next-to-leading order event generation as well as the validity and performance measurement of the $(MC)^3$ sampling algorithm is discussed. Also, the study on the influence of parameters steering the sampling with $(MC)^3$ will be outlined. It will be shown that $(MC)^3$ can produce samples of equally weighted events with statistical properties comparable to unweighted importance sampling in only a fraction of the time.

T 55.8 Di 18:30 VMP8 SR 105

Towards the automatized evaluation of Feynman integrals with differential equations — •Christoph Meyer and Peter Uwer — HU Berlin, Berlin, Germany

In the past years the method of differential equations has proven itself to be a powerful tool for the computation of multi-loop Feynman integrals. This method relies on the choice of a basis of master integrals in which the dependence on the dimensional regulator factorizes. We will present an algorithm which automatizes the transformation to such a basis, starting from a given reduction basis. The algorithm only requires some mild assumptions about the basis. It applies to problems with multiple scales of which we will present some examples.

T 55.9 Di 18:45 VMP8 SR 105

Automation of calculations in Soft-Collinear Effective Theory — Guido Bell[2], •Rudi Rahn[1], and Jim Talbert[1] — [1]Rudolf Peierls Centre for Theoretical Physics, University of Oxford, United Kingdom — [2]Theoretische Physik 1, Universität Siegen, Germany

In this talk we will focus on the evaluation of 2-loop dijet soft functions, which are crucial for NNLL resummation in SCET, and an algorithmic approach, suitable for automation and numerical treatment of a wide range of soft functions will be presented. We will show an implementation of this algorithm using the publicly available program SecDec, and various results for e+e- and hadron collider soft functions derived with it.

T 56: Beyond the Standard Model (Theorie)

Zeit: Dienstag 16:45–19:00 Raum: VMP8 SR 106

T 56.1 Di 16:45 VMP8 SR 106

Constraining Composite Higgs Models with direct searches — Christoph Niehoff, •Peter Stangl, and David Straub — Excellence Cluster Universe, TUM, Garching, Germany

Composite Higgs Models offer a unified effective description of models with new strong interactions or extra dimensions and are thus of high phenomenological interest. They can naturally account for a light Higgs Boson compatible with LHC data and at the same time are able to give a solution to the hierarchy problem without invoking supersymmetry. In this talk I will present result from a comprehensive analysis of composite Higgs models, where I will focus on constraints due to direct searches.

T 56.2 Di 17:00 VMP8 SR 106

Indirect Constraints on Composite Higgs Models — •Christoph Niehoff, Peter Stangl, and David Straub — Excellence Cluster Universe, München

Models in which the Higgs boson is implemented as a composite pseudo Nambu-Goldstone boson of a new strongly interaction sector provide an elegant solution to the hierarchy problem and the origin of electroweak symmetry breaking. In this talk we present ways to constrain these kinds of models indirectly using flavour observables as well as Higgs physics.

T 56.3 Di 17:15 VMP8 SR 106

Lepton flavour violation in RS models with a brane- or nearly brane-localized Higgs — Martin Beneke[1], •Paul Moch[1,2], and Jürgen Rohrwild[3] — [1]Physik-Department T31, Technische Universität München, James-Franck-Straße 1, 85748 Garching — [2]Theoretische Physik 1, Universität Siegen, Walter-Flex-Straße 3 , 57068 Siegen — [3]Rudolf Peierls Centre for Theoretical Physics, University of Oxford, 1 Keble Road, Oxford OX1 3NP

We perform a comprehensive study of charged lepton flavour violation in Randall-Sundrum (RS) models in a fully 5D quantum-field-theoretical framework. Our calculation provides the first complete result for the flavour-violating electromagnetic dipole operator in Randall-Sundrum models. We study the typical range for the branching fractions of $\mu \to e\gamma$, $\mu \to 3e$, $\mu N \to eN$ as well as $\tau \to \mu\gamma$, $\tau \to 3\mu$ by a numerical scan in both the minimal and the custodial RS model. The combination of $\mu \to e\gamma$ and $\mu N \to eN$ currently provides the most stringent constraint on the parameter space of the model. A typical lower limit on the KK scale T is around 2 TeV in the minimal model (up to 4 TeV in the bulk Higgs case with large Yukawa couplings), and around 4 TeV in the custodially protected model, which corresponds to a mass of about 10 TeV for the first KK excitations, far beyond the lower limit from the non-observation of direct production at the LHC.

T 56.4 Di 17:30 VMP8 SR 106

Unparticle physics constraints from the hydrogen atom — •Michael Florian Wondrak[1,2], Piero Nicolini[1,2], and Marcus Bleicher[1,2] — [1]Frankfurt Institute for Advanced Studies (FIAS), Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität Frankfurt am Main, Frankfurt am Main, Germany

Unparticle stuff has been proposed as an extension of the Standard Model of particle physics by including scale invariant fields. In the framework of effective field theory, it describes the low-energy limit of a so-called Banks-Zaks sector which exhibits scale invariance below an energy scale $\Lambda_{\mathcal{U}}$. Unparticle fields are characterized by a non-integer canonical scaling dimension $d_{\mathcal{U}}$, which leads to unusual properties like resembling a fractional number of (un)particles. The existence of unparticle stuff may be detected experimentally through the interaction with conventional matter.

After a review on the unparticle theory and the static potential due to virtual unparticle exchange, we focus on its impact on hydrogen atom energy levels. We obtain the energy shift of the ground state by

using Rayleigh-Schrödinger perturbation theory and compare it with experimental data. In this way, bounds on the energy scale $\Lambda_{\mathcal{U}}$ as a function of $d_{\mathcal{U}}$ are derived.

Finally, we offer a comparison with existing constraints in literature like the lepton magnetic anomaly. For some parameter regimes, the hydrogen bound provides competitive results.

T 56.5 Di 17:45 VMP8 SR 106

A Simplified Model of Top-Flavoured Dark Matter — •Simon Kast and Monika Blanke — Karlsruher Institut für Technologie, Karlsruhe, Germany

We present the phenomenology of a new physics simplified model of top-flavoured dark matter. The dark matter particle is the lightest Dirac fermion of a new flavour-triplet coupling to the SM up-triplet via a new scalar mediator. The coupling is left general, following Dark Minimal Flavour Violation introduced in arXiv:1405.6709, and therefore is a new source of flavour violation. We study the impact of constraints from both flavour experiments, relic abundance and direct detection constraints, as well as collider bounds.

T 56.6 Di 18:00 VMP8 SR 106

Low Scale Unification @ LHC — Pavel Fileviez Perez, •Sebastian Ohmer, and Hiren H. Patel — Max-Planck-Institut fuer Kernphysik

I will introduce new particles called "leptobaryons" and investigate low scale unification of the Standard Model gauge couplings in four dimensions. Finally, I will discuss how the LHC can search for the leptobaryons and point out the implications for dark matter. This talk is based on:

P. Fileviez Perez, S. Ohmer and H. H. Patel, "Minimal Theory for Lepto-Baryons", Phys.Lett. B735 (2014) 283-287, [arXiv: 1403.8029]

P. Fileviez Perez and S. Ohmer, "Low Scale Unification of Gauge Interactions", Phys.Rev. D90 (2014) 3, 037701, [arXiv: 1405.1199]

S. Ohmer and H. H. Patel, "Leptobaryons as Majorana Dark Matter", Phys.Rev. D92 (2015) 5, 055020, [arXiv: 1506.00954]

T 56.7 Di 18:15 VMP8 SR 106

One-Loop Corrections to the Fermion Masses and Flavour Symmetries — Walter Grimus[1], Patrick Ludl[2], and •Maximilian Löschner[1] — [1]Particle Physics Group, University of Vienna — [2]SHEP, University of South Hampton

Extensions of the Standard Model which explain non-vanishing neutrino masses and some of the peculiar features of the lepton mixing matrix by flavour symmetries always lead to a proliferation of scalars in the model. Then, the relation between Yukawa couplings and fermions in general involves several vacuum expectation values. It is therefore expedient to devise a renormalization procedure which is adapted to this situation.

In this talk, we will present first results of an ongoing PhD project on one-loop corrections to fermion masses in a toy model featuring an arbitrary number of Majorana or Dirac fermions and scalar fields, testing the stability of tree level predictions and keeping focus on the renormalization of the vacuum expectation values. This can serve as a preliminary study of the radiative generation of the neutrino masses in explicit physical models, like the so called Scotogenic Model which will also be discussed in this talk.

T 56.8 Di 18:30 VMP8 SR 106

Minimal conformal model — •Alexander Helmboldt, Pascal Humbert, Manfred Lindner, and Juri Smirnov — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The gauge hierarchy problem is one of the crucial drawbacks of the standard model of particle physics (SM) and thus has triggered model building over the last decades. Its most famous solution is the introduction of low-scale supersymmetry. However, without any significant signs of supersymmetric particles at the LHC to date, it makes sense to devise alternative mechanisms to remedy the hierarchy problem. One such mechanism is based on classically scale-invariant extensions of the SM, in which both the electroweak symmetry and the (anomalous) scale symmetry are broken radiatively via the Coleman-Weinberg mechanism.

Apart from giving an introduction to classically scale-invariant models, the talk will present our results on obtaining a theoretically consistent minimal extension of the SM, which reproduces the correct low-scale phenomenology.

T 56.9 Di 18:45 VMP8 SR 106

Exceptional Dark Matter — •Jakob Schwichtenberg — Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology, Engesserstraße 7, D-76131 Karlsruhe, Germany

We discuss fermionic dark matter candidates in non-supersymmetric E_6 Grand Unification. The exceptional group E_6 is perfectly suited for such a study, because of its unique status among the viable groups and because of the fact that we do not need to add anything by hand: dark matter candidates are contained in the fundamental representation of E_6 which contains at the same time the standard model fermions. The stability of the candidates is guaranteed by a remnant discrete symmetry that originates when the E_6 gauge symmetry is broken spontaneously. By restricting to the lowest-dimensional Higgs representations that couple to fermions and minimal fine-tuning, we end up with a viable candidate that can be produced with the correct relic abundance and could be detected in the near future.

T 57: Detektorsysteme II

Zeit: Dienstag 16:45–19:00 Raum: VMP8 SR 205

T 57.1 Di 16:45 VMP8 SR 205

Untersuchung der Einflüsse von UV-Strahlung auf szintillierende Fasern — •Nina Klemme, Robert Ekelhof, Janine Müller und Mirco Deckenhoff für die LHCb-Kollaboration — Technische Universität Dortmund

Für das Jahr 2018 ist ein Upgrade des LHCb-Detektors geplant, wobei die Trackingstationen durch einen Detektor aus szintillierenden Fasern mit Silizium-Photomultiplier-Auslese ersetzt werden.

Während der Verarbeitung der Fasern zum fertigen Detektor werden diese durch unterschiedliche Quellen der UV-Strahlung ausgesetzt. Um zum Beispiel die Lichtleitung messen zu können, werden die Fasern mit UV-LED's angeregt. Außerdem ist Tageslicht eine schwer zu vermeidende UV-Quelle.

In diesem Vortrag werden die Einflüsse von UV-Strahlung auf die Fasern vorgestellt. Es wird darauf eingegangen, welchen Einfluss die Stärke dieser Bestrahlung auf die Lichtleitung der Fasern hat und ob es mit der Zeit zu einer Ausheilung der Schäden kommt.

T 57.2 Di 17:00 VMP8 SR 205

Entwicklung und Test eines auf szintillierenden Fasern basierenden Spurdetektors für das LHCb-Experiment — •Simon Nieswand, Roman Greim, Waclaw Karpinski, Thomas Kirn, Stefan Schael, Arndt Schultz van Dratzig, Georg Schwering und Michael Wlochal — I. Physikalisches Institut B, RWTH Aachen University

Am Large Hadron Collider am CERN untersuchen Wissenschaftler mithilfe komplexer Detektorsysteme die Vorhersagen des Standardmodells und suchen nach Anzeichen neuer physikalischer Phänomene. Eines dieser Systeme ist das LHCb-Experiment, welches gezielt für die Untersuchung seltener Zerfälle in der B-Physik konzipiert wurde.
Aufgrund der Erhöhung der Strahlenergie und der Luminosität des LHCs nach dem Long Shutdown 2 in 2018/19, müssen Teile des Detektors ausgetauscht und verbessert werden. Zu diesem Zweck wird derzeit ein neues, modulares Tracking-System entwickelt, welches auf szintillierenden Fasern ($\varnothing 250\,\mu$m) basiert, die durch Silizium-Photomultiplier ausgelesen werden. Insgesamt werden für das Tracking-System über 1100 sechslagige Fasermatten an mehreren Standorten produziert.
In diesem Vortrag werden die Teststände für die Qualitätskontrolle der Fasermatten vorgestellt und Ergebnisse präsentiert. Zu den überprüften Eigenschaften gehören beispielsweise Ortsauflösung, Effizienz und Lichtausbeute, zu deren Messung unter anderem Strahlentests am CERN durchgeführt wurden.

T 57.3 Di 17:15 VMP8 SR 205

Radiation tolerance tests of scintillating fibres — •Laura Gavardi and Johannes Albrecht for the LHCb-Collaboration —

TU Dortmund

An upgrade of the LHCb detector is planned during the shutdown which will take place from mid 2018 to the end of 2019. The proposed upgrade for the tracking system is a detector composed of scintillating fibres read out by silicon photomultipliers. The tracking detector will be working in an environment exposed to radiation, so that the resistance of the fibres to radiation is an important quality, which needs to be investigated. In this talk tests of scintillating fibres tolerance to radiation will be presented.

T 57.4 Di 17:30 VMP8 SR 205

Qualitätskontrolle von Detektoren aus szintillierenden Fasern für das LHCb-Upgrade — •Janine Müller, Robert Ekelhof, Mirco Deckenhoff, Thomas Soestwöhner, Julian Wishahi, Kevin Heinicke und Timon Schmelzer — Technische Universität Dortmund

Im Jahr 2018 ist ein Upgrade des LHCb-Detektors geplant. Die Trackingstationen werden dabei durch einen Detektor aus szintillierenden Fasern mit Silizium-Photomultiplier-Auslese ersetzt. Um die gewünschte Ortsauflösung von unter 100 μm zu erreichen, werden Fasern mit einem Durchmesser von 250 μm präzise in sechs Lagen positioniert und zu 2,5 m langen Matten verklebt.

In diesem Vortrag wird insbesondere die Qualitätskontrolle von Fasern und Fasermatten diskutiert. Dazu werden Verfahren gezeigt, welche die Qualität der Fasermatten während der Produktion überwachen und im Nachhinein bestimmen.

Ein wichtiger Einfluss auf die Qualität der Fasermatte ist die Positionierung der szintillierenden Faser. Diese wird zum Beispiel durch ihren schwankenden Durchmesser beeinflusst, weshalb auch eine Qualitätskontrolle der einzelnen Fasern von Bedeutung ist. Außerdem kann zu viel Kleber zwischen den Faserlagen oder andere äußeren Umstände die Qualität der Fasermatten beeinflussen.

T 57.5 Di 17:45 VMP8 SR 205

Produktion von Detektoren aus szintillierenden Fasern für das LHCb-Upgrade — •Thomas Soestwöhner, Janine Müller und Robert Ekelhof — Technische Universität Dortmund

Im Zuge des Upgrades des LHCb-Detektors im Jahr 2018 werden die Trackingstationen durch einen Detektor aus szintillierenden Fasern mit Silizium-Photomultiplier-Auslese ersetzt. Szintillierende Fasern mit einem Durchmesser von 250 μm werden präzise in sechs Lagen positioniert und zu 2,5 m langen Matten verklebt.
Damit die gewünschte Ortsauflösung von unter 100 μm erreicht wird, müssen die Fasern sehr genau positioniert und verklebt werden, was zu besonderen Anforderungen an den Herstellungsprozess der Fasermatten führt. Um die Qualität der Matten zu gewährleisten ist eine präzise Vorgehensweise bei der Produktion erforderlich, da verschiedene Einflüsse die Qualität der Faser und der Matte beeinflussen.
In diesem Vortrag wird auf die Anforderungen an die Produktionsmaschinen und ihre Vorgänger sowie auf die Besonderheiten beim Fertigungsprozess eingegangen.

T 57.6 Di 18:00 VMP8 SR 205

Test beam results of LHCb Scintillating Fibre tracker prototypes — Sebastian Bachmann, Albert Comerma, David Gerick, Stephanie Hansmann-Menzemer, Matthieu Kecke, Blake Leverington, José Mazorra de Cos, •Dominik Mitzel, Max Neuner, Ulrich Uwer, and Xiaoxue Han for the LHCb-Collaboration — Physikalisches Institut, Universität Heidelberg

During the Long Shutdown 2 of the LHC, the LHCb detector will undergo a major upgrade to meet the challenges of running at a higher luminosity. The current Inner and Outer Tracking system will not be sufficient to deal with the envisaged increased detector occupancy and higher radiation levels and will be replaced by a single tracking detector based on 0.250 mm diameter plastic scintillating fibres. The fibres are wound to multilayer ribbons 2.4 m long and read out by 128 channel silicon photomultiplier arrays. The Scintillating Fibre (SciFi) tracker will cover a total active area of 360 m^2, arranged in 12 layers. The performances of prototype modules having 6 and 8 layers of fibre have been tested at the SPS at CERN. This talk will focus on basic properties of the prototype modules such as spatial resolution, single hit efficiency and light yield measured during the test beam campaigns in 2015.

T 57.7 Di 18:15 VMP8 SR 205

Messung und Simulation von Eigenschaften szintillierender Fasern — •Holger Stevens, Jan Broll, Mirco Deckenhoff, Robert Eckelhof, Janine Müller, Patrick Reda, Thomas Soestwöhner und Julian Surmann für die LHCb-Kollaboration — Technische Universität Dortmund

Im Jahr 2018/19 wird ein Upgrade des LHCb-Experimentes durchgeführt. Nach diesem soll eine höhere instantante Luminosität genutzt werden, dazu werden Detektorsysteme erneuert bzw. ausgestauscht. Es wird unter anderem einen Tracker aus szintillierenden Fasern, den sogenannten SciFi-Tracker, geben. Die dafür verwendeten Fasern haben einen Durchmesser von 250 μm, wodurch die nötige Ortsauflösung von unter 100 μm erreicht wird.
Für die Optimierung des Detektors ist es notwendig die Faser präzise beschreiben zu können. Mit Simulationen ist es möglich Szenarien zu Untersuchen, welche im Labor nur schlecht oder gar nicht realisierbar sind. Des weiteren helfen Simulationen bei der Interpretation von Messergebnissen. Zudem liefern Messungen wichtige Informationen, damit die Simulation noch präziser werden kann.
Der Vortrag gibt eine Übersicht über Messungen und Simulationen in Hinblick auf die Lichtleitungseigenschaften der Faser.

T 57.8 Di 18:30 VMP8 SR 205

Entwicklung von Szintillationsdetektoren mit SiPM-Auslese — •Simon Weingarten, Oliver Pooth, Andreas Künsken, Lars Weinstock, Thomas Radermacher, Günter Flügge und Achim Stahl — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Der Vortrag beschreibt die Untersuchung von schnellen Plastikszintillatoren ausgelesen mit Silizium-Photomultipliern (SiPM). Drei Prototypen mit einer Szintillatorfläche von jeweils 30 cm × 30 cm, teilweise mit integrierten wellenlängenschiebenden Fasern, wurden am COSY-Beschleuniger im Forschungszentrum Jülich mit 2.95 GeV Protonen ortsaufgelöst vermessen. Präsentiert wird der Vergleich der unterschiedlichen Prototypdesigns hinsichtlich der Signalhöhe (Homogenität auf der Detektorfläche), der Nachweiswahrscheinlichkeit sowie der Zeitauflösung. Darüber hinaus wird ein Ausblick auf die Entwicklung von Szintillationsdetektoren mit SiPM-Auslese zur Detektion von schnellen Neutronen gegeben.

T 57.9 Di 18:45 VMP8 SR 205

Advancements of Floating Strip Micromegas Detectors for Medical Imaging Applications — •Felix Klitzner[1], Otmar Biebel[1], Jonathan Bortfeldt[1], Bernhard Flierl[1], Lorena Magallanes[2,3], Katia Parodi[2,4], and Bernd Voss[5] — [1]LS Schaile, LMU München — [2]LS Parodi, LMU München — [3]Universitätsklinikum Heidelberg — [4]Heidelberger Ionenstrahl Therapiezentrum — [5]Gesellschaft für Schwerionenforschung Darmstadt

Floating strip Micromegas have proven to be high-rate capable tracking detectors with excellent spatial and temporal resolution for particle fluxes up to 7 MHz/cm^2. To further increase the high-rate capability a Ne:CF_4 86:14 vol.% gas mixture has been used as detector gas. We present results from measurements with a seven detector system constisting of six low material budget floating strip Micromegas, a GEM detector and a scintillator based particle range telescope. The gaseous and the scintillation detectors were read out with APV25 frontend boards, allowing for single strip readout with pulse height and timing information. A two-dimensional readout anode for floating strip Micromegas has been tested for the first time. The Micromegas detectors were operated with minimal additional drift field, which significantly improves the timing resolution and also the spatial resolution for inclined tracks. We discuss the detector performance in high-rate carbon and proton beams at the Heidelberg Ion Beam Therapy Center (HIT) and present radiographies of phantoms, aquired with the system.

T 58: Elektroschwache Wechselwirkung (Experiment) I

Zeit: Dienstag 16:45–18:30 Raum: VMP8 SR 206

T 58.1 Di 16:45 VMP8 SR 206

Measurement of Tau Polarization in Z Boson Decays at ATLAS — •Benedict Winter, William Davey, and Jochen Dingfelder — Physikalisches Institut, Universität Bonn

Decays of the Z boson in the Standard Model violate parity, leading to a net polarization of the decay products. Z boson decays to pairs of tau leptons provide a unique opportunity to measure the tau polarization by using the kinematics of the subsequent tau decays, hence testing the Standard Model predictions. They also provide a unique opportunity to pioneer experimental techniques that assess the tau helicity and may be used in searches for new particles and to study the properties of the Higgs boson.

In this talk the status of the first measurement of the tau polarization in $Z \to \tau\tau$ decays at a hadronic collider is presented. The analysis is based on the 20.3 fb^{-1} collected by the ATLAS experiment at a center-of-mass energy of $\sqrt{s} = 8$ TeV. The tau polarization is measured in events in which one tau decays leptonically and the other decays hadronically by using the kinematics of the hadronic decay. A main focus is set on the determination of the systematic uncertainties and the limit setting procedure.

T 58.2 Di 17:00 VMP8 SR 206

Measurement of the weak mixing angle from polarization of τ leptons produced in Z decays at CMS — •Vladimir Cherepanov, Günter Flügge, Bastian Kargoll, Wolfgang Lohmann, Alexander Nerhkorn, Ian .M Nugent, Claudia Pistone, Achim Stahl, and Alexander Zotz — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Measurements of the τ - lepton polarization and its forward-backward asymmetry at the Z^0 resonance have been performed at LEP. The precision reached was limited by the statistical uncertainty. The LHC provides the opportunity to improve the precision and test the SM of electroweak interaction. An additional challenge at the LHC is the unknown center of mass energy of tau lepton pairs. We present an analysis on the full kinematic reconstruction of the process $Z \to \tau\tau \to a_1\nu$ $\mu\nu\nu$ and a measurement of the τ - lepton polarization. The result is used to determine the electroweak mixing angle $\sin^2\theta_W$.

T 58.3 Di 17:15 VMP8 SR 206

Measurement of W and Z production in pp collisions at $\sqrt{s}$ =2.76 TeV with the ATLAS detector — •Ksenia Gasnikova — DESY, Notkestrasse 85, 22607 Hamburg, Deutschland

Probing W and Z production cross-section in pp collisions for a range of center of mass energies from 2.76 to 13 TeV provides additional constraints for the parton densities functions. This talk presents the measurement of W and Z cross-section at $\sqrt{s}$=2.76 TeV in 2013 data in electron and muon decay channels. Based on integrated luminosity $4pb^{-1}$ collected in 2013 there are around 13k selected W events and 1k Z events and this leads to precision of the cross-section measurement at a few percent level.

T 58.4 Di 17:30 VMP8 SR 206

Messung der W-Boson-Paarproduktion in pp-Kollisionen am ATLAS-Experiment — •Philip Sommer, Christian Weiser und Karl Jakobs — Albert-Ludwigs-Universität Freiburg

Die Paarproduktion von W-Bosonen in pp-Kollisionen erfolgt in führender Ordnung durch t-Kanal-Streuung von qq-Anfangszuständen oder durch s-Kanal-Streuung über den Austausch von Z/γ^*-Bosonen. Die SU(2)×U(1) Eichstruktur der elektroschwachen Wechselwirkung gewährleistet die Unitarität beider Diagramme. Die Messung der W-Paarproduktion ist somit ein wichtiger Test des Standardmodells, insbesondere ermöglicht sie die Berechnung von Ausschlussgrenzen auf anomale trilineare Eichkopplungen.

Der Nachweis der W-Bosonen erfolgt über den leptonischen Zerfall in ein Elektron oder Myon und das entsprechende Neutrino. Zur Unterdrückung von Untergrund aus top-Produktion wurden in der Vergangenheit nur Ereignisse ohne hadronische Jetaktivität für Messungen selektiert. Neuere theoretische Entwicklungen legen jedoch nahe, dass deren Beschreibung bei der Interpretation der Ergebnisse von hoher Relevanz ist. Vorgestellt werden Studien zur Messung der W-Boson-Paarproduktion in Verbindung mit einem hadronischen Jet. Darüber hinaus werden die bisher erzielten Ergebnisse, denen Daten einer integrierten Luminosität von 20.3 fb^{-1} zugrunde liegen, die im Jahr 2012 vom ATLAS-Experiment bei einer Schwerpunktsenergie von 8 TeV aufgezeichnet wurden, diskutiert.

T 58.5 Di 17:45 VMP8 SR 206

Bestimmung der Masse des W-Bosons mit den Daten des ATLAS Experiments — •Verena Herget, Giovanni Siragusa und Raimund Ströhmer — Universität Würzburg

Die Messung der Masse des W-Bosons ist ein zentraler Bestandteil von Präzisionstests des Standardmodells. Mögliche Abweichungen von den Erwartungen wären ein wichtiger indirekter Hinweis auf Physik jenseits des Standardmodells. Die freien Parameter des Standardmodells sind mit der Bestimmung der Masse des Higgs-Bosons, des W-Bosons und des Top-Quarks überbestimmt, sodass die Konformität des Standardmodells mit diesen Messungen überprüft werden kann. Aus diesem Grund müssen bestmögliche Ergebnisse in der Unsicherheit der Messung der Masse und der Zerfallsbreite erzielt werden. Die Auswertung der Daten muss dadurch sehr sorgfältig erfolgen und setzt ein detailliertes Verständnis der Modellierung der Ereignis- und Hintergrundsignaturen in den Daten sowie in Monte Carlo Ereignissen voraus. Wichtig ist hierbei unter anderem die Kalibrierung der Leptonen und des hadronischen Rückstoßes, was mit Hilfe der Standardkerze des Z-Bosons, zerfallend in zwei Leptonen, erfolgt.

In diesem Vortrag sollen einige Auswertestrategien der Messung der W-Masse vorgestellt werden und ein Einblick in mögliche Aspekte der Messung bei 8 TeV gegeben werden.

T 58.6 Di 18:00 VMP8 SR 206

Cross section measurement of Z boson pair production with the ATLAS at $\sqrt{s}$=13 TeV: Background determination and correction for detector effects — •Maurice Becker and Stefan Tapprogge — Institute of Physics, Mainz, Germany

One of the predictions that the electroweak sector of the Standard Model gives, is the production of two Z bosons. This process is not only a background contribution of many analysis that are done at the LHC, a measurement of the cross section of the process can also used for constraints on the theoretical modeling of the process and used to search for phenomena beyond the Standard Model (e.g. anomalous triple gauge couplings).
An overview of the first ZZ cross section measurement with 3.3 fb^{-1} of data that were taken with the ATLAS detector in 2015 at $\sqrt{s}$=13 TeV is presented. The measurement is done requiring two on shell Z bosons using only leptonic final states with $\ell = e, \mu$ due to the low background contribution in this decay channel. The focus is set on the determination of background that arises from mis-identified electrons or muons from secondary decay vertices. Since this background is difficult to model, a data driven approach is chosen. Furthermore the corrections for detector effects are presented which are used to extract the measured cross section in the chosen fiducial region.

T 58.7 Di 18:15 VMP8 SR 206

Measurement of the tau polarization in $Z \to \tau\tau$ decays with the ATLAS detector — Philip Bechtle, Klaus Desch, •Lara Schildgen, and Peter Wagner — University of Bonn

This talk summarizes the status of the tau polarization analysis which represents the first measurement of the tau polarization in $Z \to \tau\tau$ decays at a hadron collider. In addition to the measurement of the tau polarization, the first ATLAS measurement of the effective Weinberg angle in third generation lepton coupling will be performed.

The presented analysis focuses on the decay process $Z \to \tau_{\text{lep}}\tau_{\text{had}}$ in which the polarization of the hadronically decaying tau lepton is estimated from the energy asymmetry of the charged and neutral decay products.

The presentation emphasizes the understanding of polarization-sensitive observables using sideband and control distributions from data. The main focus is placed on the event selection and the background estimation including data driven methods for the estimation of multijet and W+jets backgrounds. Furthermore, the extraction of a systematic uncertainty on the shape of the data driven estimate of the W+jets background will be presented.

The presented analysis is based on data collected with the ATLAS detector in 2012 at a center of mass energy of $\sqrt{s} = 8$ TeV with an integrated luminosity of 20.3 fb^{-1}.

T 59: Top Quark III (tt+X)

Zeit: Dienstag 16:45–19:00 Raum: VMP9 HS

T 59.1 Di 16:45 VMP9 HS

Cross Section Measurement of the Bottom-Quark-Pair Associated Top-Quark-Pair Production in the Semi-Leptonic Channel with the CMS Experiment. — •Fabian Heidemann, Martin Erdmann, and Robert Fischer — III. Physikalisches Institut A, RWTH Aachen University

We present a cross section measurement of the top-quark-pair-production with two bottom quarks which is the dominant background process to top-quark-pair associated Higgs Boson production. The semi-leptonic channel of top-quark decays is used due to its combination of a relatively large branching ratio and small QCD contamination. The analysis method relies on Standard Model Monte Carlo simulations of all relevant physics processes. Template distributions are created with Boosted Decision Tree classifiers on the simulated data. Subsequently, the composition of these templates is fitted to the data distribution to obtain the signal strength relative to the Standard Model prediction. A Bayesian interference method is used to perform the fit, in which systematic uncertainties are incorporated as nuisance parameters.

T 59.2 Di 17:00 VMP9 HS

Top-Quark Rekonstruktion mittels der Methode *Buckets of tops* im ATLAS Experiment — •Mathis Kolb, Christoph Anders und André Schöning — Physikalisches Institut, Universität Heidelberg, Deutschland

Die Methode *Buckets of tops* zur Rekonstruktion hadronisch zerfallender Top-Quark Paare, wie in JHEP 08 (2013) 086 vorgeschlagen, wird vorgestellt. Die Methode eignet sich insbesondere für moderate transversale Impulse der Top-Quarks im Bereich $p_T = 100 - 400$ GeV. So kann die Lücke zwischen traditionellen Methoden der Top-Quark Rekonstruktion und auf Substruktur großer R-Jets basierenden Methoden geschlossen werden. Es werden anti-k_T (R = 0.4) Jets in drei *Buckets* aufgeteilt. Diese entsprechen den beiden Top-Quarks und der weiteren hadronischen Aktivität.

Die Leistungsfähigkeit und Anwendungsmöglichkeiten der Methode innerhalb des ATLAS Experiments werden diskutiert. Dies wird anhand der Untersuchung der assoziierten Produktion eines Higgs Bosons mit einem Top-Quark Paar ($t\bar{t}H \rightarrow bq\bar{q}\bar{b}q\bar{q}\bar{b}\bar{b}$) verdeutlicht. Für den Endzustand mit mindestens vier b-Jets kann die obige Methode direkt auf diesen Kanal angewendet werden. Der Vortrag wird sich mit Monte Carlo (MC) Studien zur Effizienz des Algorithmus und einem entsprechenden Daten–MC Vergleich befassen. In dieser Studie werden die Rekonstruktionseffizienz, die Fähigkeit zur Unterdrückung des Untergrunds, sowie die Abhängigkeit von Pile-up untersucht.

T 59.3 Di 17:15 VMP9 HS

Suche nach *ttW*- und *ttZ*-Ereignissen im trileptonischen Kanal bei 13 TeV am ATLAS-Detektor — Boris Lemmer, Maria Moreno Llácer, Arnulf Quadt, •Nils-Arne Rosien und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Die Produktion von Top-Quark-Paaren in Assoziation mit einem W-Boson (ttW) oder Z-Boson (ttZ) ist von besonderem Interesse in der Top-Quark-Physik. Insbesondere durch den Prozess ttZ wird es das erste Mal möglich sein, die Kopplung des Z-Bosons an das Top-Quark zu vermessen, lange bevor Top-Quark-Paare an Elektron-Positron-Collidern wie dem ILC oder CLIC über die elektroschwache Wechselwirkung erzeugt werden können. Dies ermöglicht es zum Beispiel, den schwachen Isospin des Top-Quarks zu vermessen. Außerdem sind ttW und ttZ wichtige Untergründe in vielen anderen Analysen, wie z.B. ttH und einigen SUSY-Suchen. Momentan liegt bei der Analyse von ttW und ttZ das Hauptaugenmerk auf dem trileptonischen Kanal, für den die höchste Signifikanz erwartet wird. In diesem Vortrag werden Studien für diesen Kanal gezeigt.

T 59.4 Di 17:30 VMP9 HS

MC Validierung für $t\bar{t}Z$ Messungen bei $\sqrt{s} = 13$ TeV mit ATLAS — •Konstantin Lehmann, Boris Lemmer, María Moreno Llácer, Arnulf Quadt und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Obwohl das Top-Quark seit zwei Jahrzehnten entdeckt ist, sind einige der vom Standardmodell vorhergesagten Eigenschaften nicht experimentell bestätigt. Um die dritte Komponente des Isospins zu bestimmen, ist die assoziierte Produktion eines Top-Quarkpaares und eines Z-Bosons ($t\bar{t}Z$) geeignet. Dieser Prozess ist jedoch stark gegenüber der reinen $t\bar{t}$-Produktion unterdrückt und hat zusätzlich weitere relevante Untergrundprozesse. Daher muss zunächst eine effiziente Trennung von Signal und Untergrund etabliert und eine Wirkungsquerschnittmessung durchgeführt werden, bevor kinematische Variablen untersucht werden.

Um statistische Methoden zur Trennung von Signal und Untergrund (z.B. Neuronale Netze) zu verwenden, müssen verlässliche Monte-Carlo-Simulationen der jeweiligen Prozesse vorliegen. In diesem Vortrag wird die Validierung mehrerer Simulationen vorgestellt, die für die Analyse der $t\bar{t}Z$-Produktion mit dem ATLAS-Detektor genutzt werden sollen. Abgesehen von unterschiedlichen Monte-Carlo-Generatoren werden verschiedene Partonenverteilungsfunktionen sowie Schwerpunktsenergien von 8 und 13 TeV verglichen.

T 59.5 Di 17:45 VMP9 HS

Messung des Wirkungsquerschnittes der $t\bar{t}Z$-Produktion im 4-Leptonen-Endzustand mit dem ATLAS-Experiment — Katharina Bierwagen[1], Volker Büscher[1], Markus Cristinziani[2], Carsten Meyer[1], •Alexandra Schulte[1], Kaven Yau[2] und Evan Machefer[2] — [1]Johannes Gutenberg-Universität Mainz — [2]Physikalisches Institut, Universität Bonn

Bisher wurde die Top-Z-Kopplung nicht direkt gemessen. Ein experimenteller Zugang ist erstmals mit der Messung des Wirkungsquerschnittes der $t\bar{t}Z$-Produktion möglich. Die Top-Z-Kopplung verändert sich in Modellen jenseits des Standardmodells. Somit kann neue Physik jenseits des SM entdeckt werden.

Eine erste Messung des Wirkungsquerschnittes erlaubte der aufgezeichnete Datensatz von etwa $20\,\mathrm{fb}^{-1}$ aus dem Jahre 2012 bei 8 TeV. Mit dem aktuellen Datensatz von $3{,}3\,\mathrm{fb}^{-1}$ und einer Schwerpunktsenergie von 13 TeV lassen sich bereits vergleichbare Sensitivitäten erreichen wie mit dem Datensatz von 2012.

In diesem Vortrag wird der aktuelle Stand der $t\bar{t}Z$-Analyse im 4-Leptonen-Endzustand vorgestellt. Charakteristisch für den 4-Leptonen-Kanal sind niedrige Raten bei einem sehr guten Signal-zu-Untergrund-Verhältnis.

T 59.6 Di 18:00 VMP9 HS

Suche nach $t\bar{t}Z$ Ereignissen im dileptonischen Zerfallskanal bei 13 TeV mit ATLAS — Boris Lemmer, María Moreno Llácer, •Tobias Orthen, Arnulf Quadt, Nils Arne Rosien und Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

Für das Verständnis des Standardmodells der Teilchenphysik spielen die Eigenschaften des Top-Quarks eine besondere Rolle. Die genaue Vermessung seiner Wechselwirkungen mit anderen Teilchen trägt u.a. wesentlich zu den Bereichen der Higgs Physik bei und beeinflusst theoretische Modelle für die Physik maßgeblich, die über das Standardmodell der Teilchenphysik hinausgehen, weil das Top-Quark das schwerste bekannte Teilchen ist. Die Untersuchung von $t\bar{t}Z$ Ereignissen ist wichtig, um die Kopplung des Top-Quarks an das Z-Boson zu beschreiben. Dabei ist der dileptonische Kanal, bei dem das Z-Boson in zwei Leptonen zerfällt, besonders herausfordernd, da hierbei sowohl das Top- und das Antitop-Quark hadronisch zerfallen, was Schwierigkeiten bei der Trennung von Signal und Untergrund zur Folge hat. Damit eine Trennung dennoch gelingen kann, werden multivariate statistische Methoden eingesetzt. Weiterhin lassen sich durch die genaue Kenntnis der tZ-Kopplungsstärke Rückschlüsse auf die dritte Komponente des schwachen Isospins des Top-Quarks ziehen. Dieser Parameter ist wichtig in der elektroschwachen Wechselwirung als Bestätigung dafür, dass das Top-Quark wirklich der schwache Isospinpartner des Bottom-Quarks ist.

T 59.7 Di 18:15 VMP9 HS

Measurement of the $t\bar{t}\gamma$ cross section using dilepton events from the ATLAS experiment at 8 TeV — Nello Bruscino, Markus Cristinziani, Mazuza Ghneimat, •Sebastian Heer, Vadim Kostyukhin, Liza Mijović, Andrea Sciandra, and Kaven Yau Wong — Physikalisches Institut of University of Bonn

The cross section of $t\bar{t}\gamma$ production in $p\bar{p}$ collisions is predicted by the

Standard Model and has to be measured by experiment. The measurement presented here is done using $t\bar{t}\gamma$ events in the dilepton channel. Dileptonic events were not used for the $t\bar{t}\gamma$ process in general yet, because of the small branching fraction. On the other hand, systematic uncertainties are expected to be smaller than in the lepton plus jets channel, due to an excellent signal-to-background ratio.
The analysis uses events from the eμ-channel only, because of the very high signal-to-background ratio, which is not blurred by background processes involving the Z boson. The most dominant background consists of photons radiated by hadrons, e.g. in $t\bar{t}$ events. The analysis uses a simple cut-and-count method. To get the optimal set of requirements for the measurement, the event selection was optimized by minimizing the relative uncertainty on the expected cross section.
The measurement of the cross section is done using the requirements obtained by the optimization. Due to the high signal-to-background ratio the total uncertainties is only 12%.

T 59.8 Di 18:30 VMP9 HS

Production of $t\bar{t}\gamma$ in pp collision at $\sqrt{s} = 8$ TeV with the ATLAS experiment — •Sara Ghasemi, Naim Bora Atlay, Ivor Fleck, Yichen Li, and John Meshreki — Universität Siegen, Department für Physik, D-57068 Siegen, Germany

The pair production of Top quarks with an associated photon is of particular interest, as it provides the opportunity to study the electroweak couplings of the Top quark. In this presentation, the study toward cross-section measurements of $t\bar{t}\gamma$ in the single lepton channel is described.

In this analysis, a template fit is used to estimated the fraction of signal events in the observed data. The major background contribution in the $t\bar{t}\gamma$ process comes from hadrons misidentified as photons. Templates of absolute track isolation are extracted for signal photons and hadrons faking a photon, separately. While the background template is extracted from data, a Monte Carlo simulated sample is used for the signal template. The background due to electrons misidentified as photons is also estimated from data. Other backgrounds containing a prompt photo are mostly estimated from Monte Carlo while the QCD + γ contribution is estimated using data.

T 59.9 Di 18:45 VMP9 HS

Event Reconstruction in *ttZ* Events — Boris Lemmer, Maria Moreno Llacer, Arnulf Quadt, Elizaveta Shabalina und •Knut Zoch — II. Physikalisches Institut, Georg-August-Universität Göttingen

Obwohl für das 1995 entdeckte Top-Quark bisher alle gemessenen Eigenschaften mit den Vorhersagen des Standardmodells übereinstimmen, steht der Nachweis des schwachen Isospins noch aus, der das Top-Quark als Isospin-Partner des Bottom-Quarks qualifiziert. Ereignisse, in denen neben einem Top-Quark-Paar auch ein Z-Boson entsteht (sog. ttZ-Produktion), liefern einen direkten Zugang zur Kopplungsstärke des Z-Bosons zu Quarks und lassen damit auch eine Berechnung der dritten Komponente dieses Isospins zu.

Zur Untersuchung von ttZ-Ereignissen muss zunächst eine effiziente Ereignisrekonstruktion etabliert werden. Die Software KLFitter wurde im Bereich der Top-Quark-Paarproduktion bereits in einer Vielzahl von Analysen erfolgreich eingesetzt, um mittels eines kinematischen Likelihood-Fits die Top-Quarks und ihre Zerfallsprodukte mit hoher Effizienz zu rekonstruieren. In diesem Vortrag werden die Implementierung von KLFitter für eine ttZ-Topologie diskutiert und Rekonstruktionseffizienzen studiert.

T 60: Niederenergie-Neutrinophysik I

Zeit: Dienstag 16:45–19:10 Raum: VMP9 SR 07

Gruppenbericht T 60.1 Di 16:45 VMP9 SR 07

SOX: Search for Sterile Neutrinos with Borexino — •Mikko Meyer for the BOREXINO-Collaboration — Institut für Experimentalphysik, Universität Hamburg

Several observed anomalies in the neutrino sector could be explained by a 4th (sterile) neutrino with a squared mass difference in the order of $1eV^2$ to the other three standard neutrinos. This hypothesis can be tested with an artificial kCi antineutrino (Ce-144/Pr-144) source deployed near or inside a large low background detector like Borexino. The SOX project (short baseline neutrino oscillation with Borexino) aims for the detection of sterile neutrinos and offers the almost unique possibility to observe the characteristic antineutrino oscillation pattern within the detector. The talk will summarize this concept and will show the sensitivities for the possible phases of the experiment.

T 60.2 Di 17:05 VMP9 SR 07

Study of systematics for 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 radioactive electron (anti-)neutrino sources underneath the Borexino detector. Oscillations will be observed via a reduction of the detected interaction rate of the electron(anti-)neutrinos and an oscillatory pattern as a function of the neutrino energy and travelled distance.

The talk will give an overview of the experiment with the focus on the systematics and their impact on the sensitivity for a 100kCi ^{144}Ce source.

The work is supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 60.3 Di 17:20 VMP9 SR 07

Performance of a high-precision calorimeter for the measurement of the antineutrino-source strength in the SOX experiment — •Konrad Altenmüller for the BOREXINO-Collaboration — Technische Universität München

A calorimeter was developed to measure the thermal power and thus the antineutrino-generation rate of a ^{144}Ce – ^{144}Pr antineutrino-source with $< 1\%$ overall accuracy for the SOX experiment. SOX is searching for neutrino oscillations at short baselines with the Borexino detector to investigate the existence of eV-scale sterile neutrinos. The calorimeter design is based on a copper heat exchanger with integrated water lines for the heat extraction, mounted around the source. A high precision measurement is possible thanks to an elaborate thermal insulation.

In this talk, the design of the calorimeter is reviewed and results of calibration measurements are presented. The thermal insulation of the system was examined and heat losses were quantified. The methods to reconstruct the source power and the decay rate from measurements are described.

This work is supported by the DFG cluster of excellence "Origin and Structure of the Universe"

T 60.4 Di 17:35 VMP9 SR 07

Efficiency of the Borexino Muon Veto — •Dominik Jeschke — Technische Universität München — Borexino Collaboration

The Borexino detector is situated at the LNGS under the Gran Sasso massiv aiming for the detection of solar neutrinos. For these analyses, cosmic muons impose an important background, directly and through the production of cosmic radionuclides in the scintillator. For this reason, a very efficient identification of cosmic muons passing through the detector is crucial.

In this talk, the development of the efficiency of muon identification at Borexino will be analyzed. The angular distribution of muons as well as their seasonal modulation will further be illustrated.

Gruppenbericht T 60.5 Di 17:50 VMP9 SR 07

The Jiangmen Underground Neutrino Observatory — •Julia Sawatzki — Technische Universität München, Physik Department E15, James-Franck-Straße 1, 85748 Garching

The Jiangmen Underground Neutrino Observatory (JUNO) is a next-generation medium-baseline reactor neutrino experiment located in southern China, close to Kaiping. The construction of the 700 m deep underground facility already started and the experiment is scheduled to start data-taking in 2020, and is expected to operate for at least 20 years. The 20 kt liquid scintillator detector will detect low-energy neutrinos with an unprecedented energy resolution of 3% (at 1 MeV).

The primary experimental goal is the determination of the neutrino mass hierarchy at 3σ significance from the measurement of the reactor neutrino energy spectrum. Two nuclear power plants: Yangjiang and Taishan are located at a distance of $\sim$ 53 km from the detector. Moreover, JUNO will measure the solar neutrino mixing parameters and the atmospheric neutrino squared-mass splitting with a precision $< 1\%$. In addition, supernova neutrinos, geo-neutrinos, sterile neutrinos as well as solar and atmospheric neutrinos can be studied. This talk will review the status of the project and highlight important scientific objectives.

T 60.6 Di 18:10 VMP9 SR 07

Development of Intelligent Photomultipliers for the JUNO Detector — •Florian Lenz, Marta Meloni, Michael Soiron, Achim Stahl, Jochen Steinmann, and Christopher Wiebusch — III. Physikalisches Institut B, RWTH Aachen University, 52056 Aachen, Germany

The JUNO experiment will be a 20kt liquid scintillator neutrino detector near Kaiping, China, 50km from two nuclear power plants. Its main goal is the determination of the neutrino mass hierarchy from a precise measurement of the energy spectrum of neutrinos. Due to the detector size it is not possible to digitize the signal outside the detector cavern. Therefore FPGAs with a low-level reconstruction combined with a fast adc mounted on the base will convert the PMTs into intelligent sensors. Advantages and disadvantages of this design will be discussed and first measurements will be shown.

T 60.7 Di 18:25 VMP9 SR 07

Präzisionsmessungen der Abschwächlänge für den JUNO-Detektor — •Sabrina Prummer[1], Dominikus Hellgartner[1], Lothar Oberauer[1], Julia Sawatzki[1] und Andreas Ulrich[2] — [1]Technische Universität München E15, James-Franck-Straße, 85748 Garching — [2]Technische Universität München E12, James-Franck-Straße, 85748 Garching

Das geplante JUNO-Experiment ist ein 20 kt Flüssigszintillatordetektor. Das primäre Ziel des Experiments ist die Bestimmung der Neutrino-Massen-Hierarchie durch eine Präzisionsmessung der Reaktor(antielektron)-Neutrino-Überlebenswahrscheinlichkeit. Geplant ist ein kugelförmiger Detektor mit ca 30 m Durchmesser. Dies setzt hohe Anforderungen an die optischen Eigenschaften des Szintillators, speziell an die Abschwächlänge. Das Lösungsmittel LAB wurde mit verschiedenen Aluminiumoxiden aufgereinigt und die optischen Abschwächlängen verglichen. Die Abschwächlänge wurde mit einem UV/Vis-Spektrometer in handelsüblichen 10 cm Küvetten gemessen. Aufgrund des kurzen Lichtwegs sind die resultierenden Fehler sehr groß. Um diese zu verringern und präzise Aussagen treffen zu können, wurde ein neues Spektrometer-Experiment konzipiert und aufgebaut, welches Lichtwege von bis zu 2.9 m ermöglicht. Damit sind präzise Messungen für die Abschwächlänge möglich. Das Ziel ist die für JUNO angepeilte Abschwächlänge von mehr als 22 m (@430nm) mit einem relativen Fehler von maximal 5% zu bestimmen.Unterstützt vom DFG Cluster of Excellence "Origin and Structure of the Universe" und vom Maier-Leibniz-Laboratorium.

T 60.8 Di 18:40 VMP9 SR 07

Non linearities in the light yield of liquid scintillators — •Tobias Drohmann, Lothar Oberauer, Corbinian Oppenheimer, Sabrina Prummer, Julia Sawatzki, Stefan Schönert, and Vincenz Zimmer — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

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.

Currently there is an experiment in preparation at the Technical University Munich to measure the non linearity in the light yield of low energy electron events with a low threshold of $\sim$10 keV. A photomultiplier tube (PMT) is 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, is used to determine the deposited energy in the scintillator by measuring the remaining energy of the Compton scattered γ-ray. The talk will present the status of this experiment.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe', the Maier-Leibnitz-Laboratorium (MLL) in Garching and the DFG JUNO-Forschergruppe.

T 60.9 Di 18:55 VMP9 SR 07

A PMT Mass Testing Facility for the JUNO Experiment — •Alexander Tietzsch[1], Isabell Alsheimer[1], Bosse Bein[2], Daniel Bick[2], David Blum[1], Joachim Ebert[2], Caren Hagner[2], Tobias Lachenmaier[1], Henning Rebber[2], Lisa Steppat[2], Tobias Sterr[1], and Björn Wonsak[2] — [1]Physikalisches Institut, Universität Tübingen — [2]Institut für Experimentalphysik, Universität Hamburg

The JUNO (Jiangmen Underground Neutrino Observatory) experiment will be one of the big neutrino oscillation experiments starting in the next years. The main goal of JUNO is the determination of the neutrino mass hierarchy. To detect the sub-dominant effects in the oscillation pattern which depend on the mass hierarchy, the JUNO detector is planned with almost 20 kt fiducial volume, high light yield and energy resolution of better than 3%. In order to reach this, roughly 17000 newly developed high QE PMTs for the central detector, and additionally 2000 for the veto will be used. Each PMT has to be tested and characterized before it will be mounted in the experiment. This talk will give an overview on our plans and strategy for the mass test of all PMTs, and on the current status of the experimental test setup and next steps. The testing facility will be developed in a cooperation between the Physical Institutes in Tübingen and Hamburg within the JUNO collaboration. This work is supported by the Deutsche Forschungsgemeinschaft.

T 61: Neutrinoastronomie III

Zeit: Dienstag 16:45–19:05 Raum: VMP9 SR 08

Gruppenbericht T 61.1 Di 16:45 VMP9 SR 08

Recent results from the IceCube Neutrino Observatory — •Sebastian Schoenen for the IceCube-Collaboration — 3. Physikalisches Institut B, RWTH Aachen

The IceCube Neutrino Observatory is a cubic-kilometer Cherenkov telescope buried deep in the glacial ice at the geographic South Pole. It is a multi-purpose detector covering a broad physics program in high-energy neutrino astronomy and particle physics. Already the data from IceCube's first few years of operation have revealed an excess of high-energy neutrino events in multiple detection channels from a few tens of TeV up to a few PeV. The flux observed at these energies is incompatible with a purely atmospheric origin and thus confirmed the existence of a high-energy extraterrestrial neutrino flux. However, the astrophysical sources of this flux still remain unresolved. In this talk we will provide an overview about recent IceCube results in the field of neutrino astrophysics.

T 61.2 Di 17:05 VMP9 SR 08

Optimization of the IceCube neutrino sample by improving the data processing chain — •Juliane van Scherpenberg, Kai Krings, Stefan Coenders, and Andrea Turcati for the IceCube-Collaboration — Technische Universität München

The IceCube Neutrino Observatory found evidence for astrophysical neutrinos. However, their sources are still unknown. In order to raise the probability of detecting these sources, the data processing chain can still be optimized with regard to more efficient event selection and background retention.

For a selection of neutrino-induced muon events studies were made on the effect of applying a new coincident-event splitting algorithm at low processing levels. Furthermore the impact of using a different numerical minimizer in the low-level likelihood reconstructions was investigated. The results of these studies - including arising changes at higher levels of reconstruction - are going to be presented in this talk.

T 61.3 Di 17:20 VMP9 SR 08

Unfolding Measurement of the Atmospheric Muon Neutrino Spectrum using IceCube — •Mathis Börner, Tim Ruhe, Maxi-

milian Meier, Philipp Schlunder, Thorben Menne, and Tomasz Fuchs for the IceCube-Collaboration — Dept. of Physics, Technical University of Dortmund, 44227 Dortmund, Germany

IceCube is a cubic kilometer neutrino observatory located at the geographic South Pole. With its huge volume, the detector is well suited for measurements of the atmospheric muon neutrino energy spectrum. Over the last years, several unfolding analyses for single years were able to provide model independent measurements for the northern hemisphere in an energy region between 200 GeV and 3.2 PeV. In this talk, the extension of the analyses to four additional years of data is presented. With this significant enlargement of the data basis, it is possible to reanalyze the full northern hemisphere with smaller statistical errors. Moreover, the spectrum can be unfolded in several small zenith bands. Measurements of the energy spectrum for different zenith regions provide further information on the composition and the shape of the flux.

T 61.4 Di 17:35 VMP9 SR 08

Suche nach Tau-Neutrino-Ereignissen in IceCube — •Maximilian Meier, Mathis Börner, Thorben Menne, Philipp Schlunder, Tim Ruhe, Tomasz Fuchs und Alexander Sandrock für die IceCube-Kollaboration — Faktultät Physik, TU Dortmund, 44227 Dortmund, Deutschland

Die IceCube Kollaboration hat einen hochenergetischen, diffusen, astrophysikalischen Neutrinofluss nachgewiesen. Aufgrund von Neutrinooszillationen wird ein astrophysikalischer Fluss von Tau-Neutrinos vorhergesagt. Bisher wurden allerdings noch keine Tau-Neutrino-Signaturen im IceCube Detektor identifiziert. In diesem Vortrag werden erwartete Ereignisraten für verschiedene Tau-Signaturen und ein daraus resultierendes Analysekonzept vorgestellt. Die Selektion der Ereignisse soll dabei mit Hilfe von maschinellen Lernmethoden stattfinden. Dazu werden neben den typischen Ereignistopologien auch die Spannungszeitreihen der einzelnen DOMs herangezogen.

T 61.5 Di 17:50 VMP9 SR 08

KM3NeT/ARCA sensitivity to a diffuse cosmic neutrino flux — •Dominik Stransky for the ANTARES-KM3NeT-Erlangen-Collaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

KM3NeT is a neutrino telescope being built in the Mediterranean Sea. In December 2015, a big step in the first construction phase has been achieved with the succesful deployment of the first detection unit. In a second phase, the full KM3NeT/ARCA detector, comprising 2 detector blocks with an instrumented volume of 1 cubic kilometre, will be built to investigate high-energy cosmic neutrinos. The high-energy cosmic neutrino flux must be distinguished against a background of atmospheric neutrinos and down-going tracks originating from atmospheric muons. Using Monte Carlo simulations, dedicated track and shower reconstruction algorithms have been developed allowing for a high precision in the determination of the kinematic event variables. For showers, the obtained energy resolution amounts to roughly 10% and the median angular resolution is less than 2 degrees, while in the track channel the angular and energy resolution is below 0.2 degress on average and about 0.27 in the logarithm of the energy, respectively. The reconstruction algorithms also provide reconstruction parameters that help to efficiently discriminate signal from background.

In this talk, an analysis dedicated to the sensitivity of KM3NeT/ARCA to a diffuse cosmic neutrino flux will be presented, incorporating a spectral fitting method, thus also being sensitive to the spectral shape of such a flux.

T 61.6 Di 18:05 VMP9 SR 08

Die Kalibration des Neutrinoteleskops KM3NeT — •Jonas Reubelt für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

Der Aufbau des Neutrinoteleskops KM3NeT hat im Dezember 2015 mit der Installation der ersten Detektorstruktur (Detection Unit) vor der Mittelmeerküste von Sizilien begonnen. Eine Detection Unit besteht aus 18 Optischen Modulen, die mit einem Abstand von jeweils 36 m mit speziellen Kabeln zu einer vertikalen Struktur verbunden sind. Ein Optisches Modul ist mit 31 Photodetektoren bestückt und weist eine annähernd isotrope Sensitivität auf. Obwohl die Größe und somit die Sensitivität des Detektors durch das Hinzufügen von vielen weiteren Detection Units (mehrere 100) noch drastisch steigen wird, ist der Detektor in der derzeitigen Ausbaustufe bereits in der Lage atmosphärische Myonen und Neutrinos nachzuweisen. Hierzu bedarf es einer aufwendigen Kalibration der benutzten Hardware und Prozesse. Methoden und Ergebnisse der Kalibration werden im Vortrag vorgestellt.

T 61.7 Di 18:20 VMP9 SR 08

IceCube results from point-like source searches using seven years of through-going muon data — •Stefan Coenders and Elisa Resconi for the IceCube-Collaboration — Technische Universität München, Boltzmannstr. 2, 85748 Garching

The IceCube Neutrino Observatory located at the geographic South Pole was designed to study and discover high-energy neutrinos coming from both galactic and extragalactic sources. Track-like events induced by charged-current muon-neutrino interactions close to the IceCube detector give an angular resolution better than 1 degree above TeV energies. Within seven years of detector livetime, IceCube selects more than 700,000 events over the full sky, plus an additional component of almost 1000 events that are identified to be starting in the detector in the southern sky. Using this event sample, IceCube is sensitive to a steady neutrino flux substantially below $E^2\,\partial\phi\,/\,\partial E = 10^{-12}\,\mathrm{TeV\,cm^{-2}\,s^{-1}}$ in the northern sky for neutrino energies above 10 TeV. We report about the results in this search for steady point-like neutrino sources.

T 61.8 Di 18:35 VMP9 SR 08

Selektion atmosphärischer Myonneutrinos mit DeepCore — •Philipp Schlunder für die IceCube-Kollaboration — TU Dortmund

Der Fluss atmosphärischer Myonneutrinos ist für den Energiebereich von wenigen bis einigen Hundert GeV bisher noch nicht mit IceCube gemessen worden. Um eine hochauflösende Messung zu gewährleisten ist zunächst die Selektion eines reinen Datensatzes bestehend aus neutrinoinduzierten Myonen notwendig. In diesem Vortrag werden erste Ergebnisse einer solchen Selektion auf dem Weg zum rekonstruierten Fluss gezeigt.

T 61.9 Di 18:50 VMP9 SR 08

Studying the cosmic-ray shadows of the Sun and the Moon with the IceCube neutrino telescope — •Fabian Bos and Julia Becker-Tjus for the IceCube-Collaboration — Ruhr-Universität Bochum

Cosmic rays are energetic charged particles from outer space that continuously impinge on Earth from all directions. As cosmic rays are blocked by the Sun and the Moon, a deficit in the number of cosmic rays is observed at Earth from the direction of these celestial bodies. The study of these cosmic-ray shadows has been traditionally used to characterize the angular resolution and absolute pointing of cosmic-ray detectors. We report on a five-year observation of the cosmic-ray Moon and Sun shadows detected with different configurations of the IceCube neutrino telescope, located at the South Pole. The cosmic-ray Moon shadow was observed with high statistical significance ($> 6\sigma$) in previous analyses of IceCube data, before the detector completion in December 2010. We present first results from the Sun and Moon shadow analyses with data from the completed detector. A dependence of the Sun shadow on solar activity is expected as particles propagating in the Sun's vicinity are influenced by its magnetic field. This opens the possibility for future analyses to probe different coronal magnetic field models.

T 62: Suche nach dunkler Materie III

Zeit: Dienstag 16:45–19:05 Raum: VMP9 SR 28

Gruppenbericht T 62.1 Di 16:45 VMP9 SR 28

Application of Neganov-Trofimov-Luke amplified cryogenic light-detectors for rare event search experiments — •M. Willers, X. Defay, F. Hitzler, E. Mondragon, A. Münster, J.-C. Lanfranchi, A. Langenkämper, L. Oberauer, C. Oppenheimer, W. Potzel, S. Schönert, S. Wawoczny, and A. Zöller — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

Ultra-low background experiments based on the so-called phonon-light technique (e.g., direct dark matter search experiments such as CRESST and EURECA or future experiments searching for the neutrino-less double beta decay such as CUPID) rely heavily on the sensitivity of the cryogenic light-detector at low light energies. The Neganov-Trofimov-Luke effect (NTLE) offers a promising way to increase the sensitivity of cryogenic light detectors by drifting photon induced electron-hole pairs in an electric field, thereby amplifying the heat signal in the cryogenic detector. In this contribution we present an overview and results of the current status of our detector development efforts as well as potential applications and planned future developments.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching) and by the BMBF.

T 62.2 Di 17:05 VMP9 SR 28

Artificial neural network based pulse-shape analysis for cryogenic detectors operated in CRESST-II — •Andreas Zöller for the CRESST-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

In this talk we report on results of a pulse-shape analysis of cryogenic detectors based on artificial neural networks. To train the neural network a large amount of pulses with known properties are necessary. Therefore, a data-driven simulation used to generate these sets will be explained. The presented analysis shows an excellent discrimination performance even down to the energy threshold. The method is applied to several detectors, among them is the module with the lowest threshold (307eV) operated in CRESST-II phase 2. The performed blind analysis of this module confirms the substantially enhanced sensitivity for light dark matter published in 2015. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching) and by the BMBF.

T 62.3 Di 17:20 VMP9 SR 28

Absolute und relative Reflektivitätsmessungen von reflektierenden und szintillierenden Folien für das CRESST Experiment — •A. Langenkämper, X. Defay, F. Hitzler, J.- C. Lanfranchi, E. Mondragon, A. Münster, C. Oppenheimer, W. Potzel, S. Schönert, H. Steiger, A. Ulrich, S. Wawoczny, M. Willers und A. Zöller — Physik-Department und Excellence Cluster Universe, Technische Universität München, D-85747 Garching

Im CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) Experiment wird nach Kernrückstößen, welche durch elastische Streuung von Dunkler Materie hervorgerufen werden, gesucht. Die auf wenige zehn mK gekühlten Detektoren bestehen aus einem szintillierenden $CaWO_4$ Kristall sowie einem separaten Lichtdetektor und sind von einem reflektierenden und szintillierendem Gehäuse umschlossen. Die dafür verwendete Folie sowie vergleichbare Folien wurden in dieser Arbeit hinsichtlich ihrer Reflektivität charakterisiert. Die Ergebnisse der wellenlängen- als auch winkelabhängigen absoluten Reflektivitätsmessung bei Raumtemperatur werden vorgestellt. Zudem wurde die relative Reflektivität bei einer Temperatur von 20K untersucht. Diese Arbeit wurde unterstützt von dem DFG Exzellenzcluster "Origin and Structure of the Universe", der Helmholtz Alliance for Astroparticle Physics, dem Maier-Leibnitz-Laboratorium (Garching) und dem BMBF.

T 62.4 Di 17:35 VMP9 SR 28

Quenching Faktor Messungen mit dem CRESST/EURECA Neutronenstreuexperiment — •S. Wawoczny[1], X. Defay[1], F. Hitzler[1], J.-C. Lanfrachi[1], A. Langenkämper[1], A. Münster[1], E. Mondragon[1], C. Oppenheimer[1], W. Potzel[1], S. Schönert[1], H. Steiger[1], R. Strauss[2], M. Willers[1] und A. Zöller[1] — [1]Physik Department E15 und Excellence Cluster Universe, Technische Universität München, 85748 Garching — [2]Max-Planck-Institut für Physik, Föhringer Ring 6, 80805 München

Quenching Faktoren (QF) beschreiben die Abschwächung der Lichtausbeute von Kernrückstößen relativ zu Elektronrückstößen in Szintillatoren. Für Experimente zur Suche nach Dunkler Materie wie CRESST und das geplante EURECA, die szintillierende Tieftemperaturdetektoren einsetzen, ist eine genaue Kenntnis der QF der verschiedenen Targetkerne essentiell zur Untergrundunterdrückung. Mit dem CRESST-Neutronenstreuexperiment am Maier-Leibnitz-Laboratorium in Garching können QF schwerer Kerne insitu bei mK-Temperaturen gemessen werden. Dazu wird ein spezielles Kryodetektormodul mit monoenergetischen Neutronen (11 MeV, mit Beschleuniger erzeugt) bestrahlt. Dieses wurde hinsichtlich Lichtausbeute und Energieauflösung im Lichtkanal optimiert um nun besonders die Energieabhängigkeit der QF einzeln untersuchen zu können. Es werden der experimentelle Aufbau und Ergebnisse einer ersten Strahlzeit vorgestellt. Diese Arbeit wurde unterstützt von dem DFG Exzellenzcluster "Origin and Structure of the Universe", der Helmholtz Alliance for Astroparticle Phyiscs, dem Maier-Leibnitz-Laboratorium (Garching) und dem BMBF.

T 62.5 Di 17:50 VMP9 SR 28

Characterization of scintillation properties of high-purity $CAWO_4$ crystals for the CRESST experiment — •C. Oppenheimer, X. Defay, T. Drohmann, A. Erb, R. Hampf, J.-C. Lanfranchi, A. Langenkämpfer, A. Münster, E. Mondragon, L. Oberauer, W. Potzel, S. Schönert, H. Steiger, H.H. Trinh Thi, A. Ulrich, S. Wawoczny, M. Willers, V. Zimmer, and A. Zöller — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85748 Garching

In the scope of the dark matter search experiment CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) the Technische Universität München (TUM) produces high purity $CaWO_4$ single crystals. CRESST uses these scintillating crystals as targets to directly search for dark matter particles. An important factor for the event detection and discrimination is the light-output of the crystals. This light-output shows a crystal dependent non-linear behaviour at low energies, which affects the discrimination capabilities of the detector. To investigate this behaviour and the dependency on the growth parameters, a Compton scattering experiment will be conducted. The experimental setup and first results will be presented. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching) and by the BMBF.

T 62.6 Di 18:05 VMP9 SR 28

Production of $CaWO_4$ crystals for direct dark matter search with CRESST — •Andrea Münster for the CRESST-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85748 Garching, Germany

The direct dark matter search experiment CRESST (Cryogenic Rare Event Search with Superconducting Thermometers) uses scintillating $CaWO_4$ single crystals as targets for possible recoils of dark matter particles. Since several years these $CaWO_4$ crystals are produced directly at the Technische Universität München (TUM) including the $CaWO_4$ powder production from the raw materials $CaCO_3$ and WO_3, the $CaWO_4$ crystal growth via the Czochralski method as well as the aftergrowth treatment of the crystals. In the recently finished CRESST-II Phase 2 (2013-2015), 4 TUM-grown crystals were installed in the main cryostat for the first time. Showing one of the best radiopurities of all installed crystals combined with an excellent detector performance the analysis of the crystal TUM40 resulted in the best sensitivity for low-mass dark matter particles in 2014. For the upcoming CRESST-III phase 2 we aim for a further improvement in radiopurity by a factor of 100. First results of a chemical purification of the raw materials as well as future plans to reduce the intrinsic background via recrystallization will be presented. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe", by the Helmholtz Alliance for Astroparticle Physics, by the Maier-Leibnitz-Laboratorium (Garching) and by the BMBF.

T 62.7 Di 18:20 VMP9 SR 28

The CRESST-III iStick Veto: Stable operation of multiple transition edge sensors in one readout circuit — •Johannes Rothe for the CRESST-Collaboration — Max-Planck-Institut f. Physik (Werner-Heisenberg-Institut) — Ludwig-Maximilians-Universität München

To enable complete rejection of holder-related events in the upcoming CRESST-III dark matter search experiment, the scintillating target crystals are held by calcium tungstate sticks (iSticks) instrumented with tungsten transition edge sensors (TESs). Since the iStick signals are used exclusively for vetoing, it is sufficient to register if an event happened in any stick, without knowing which one. This allows the operation of all iSticks in a single readout circuit, requiring just one SQUID magnetometer. The talk will describe the effect of bias current heating and corresponding hysteresis phenomena known in single-TES circuits, and the resulting conditions for stability in multiple-TES circuits. The fundamentally different behaviour of parallel and series circuits and resulting design choices will be explored.

T 62.8 Di 18:35 VMP9 SR 28

The CRESST-III Detector Module — •Marc Wüstrich for the CRESST-Collaboration — Max-Planck-Institut f. Physik (Werner-Heisenberg-Institut)

The direct dark matter experiment CRESST uses scintillating calorimeters to detected WIMP induced nuclear scattering in $CaWO_4$ single crystals. Equipped with transition edge sensors (TESs), these detectors can achieve detection thresholds well below 1keV. The last physics run of CRESST-II proved the high potential of the experiment especially for small WIMP masses and triggered the development of a new detector module using much smaller $CaWO_4$ main absorbers. The upcoming CRESST-III run will mainly be equipped with these newly developed modules, which combine a fully scintillating detector housing with an improved detection threshold (<100keV). While many features of the new module were adapted from previous module designs in an improved way, also new features are implemented like instrumented sticks (iSticks) holding the crystals and optimized TES structures for phonon and light detectors. First tests above ground validated the improved performance of these detector modules and promise to explore new regions in the WIMP parameter space in the next CRESST-III run.

T 62.9 Di 18:50 VMP9 SR 28

Konzeptstudien zur Entwicklung von voll-szintillierenden Detekormodulen im Rahmen des EURECA Experiments — •H. Steiger[1], X. Defay[1], F. Hitzler[1], H. Kluck[3], J.-C. Lanfranchi[1], A. Langenkämper[1], E. Mondragon[1], A. Münster[1], C. Oppenheimer[1], W. Potzel[1], S. Schönert[1], R. Strauss[2], S. Wawoczny[1], M. Willers[1] und A. Zöller[1] — [1]Physik Department und Excellence Cluster Universe, Technische Universität München, D-85748 Garching — [2]Max-Planck-Institut für Physik, D-80805 München — [3]HEPHY, A-1050 Wien

Im Rahmen des EURECA Experiments (European Underground Rare Event Calorimeter Array) werden Konzeptstudien für voll-szintilierende Tieftemperatur-Detektormodule zur direkten Suche nach dunkler Materie entwickelt. In diesem Vortrag werden verschiedene Detektorkonzepte vorgestellt welche speziell für die Suche nach leichten bzw. schweren WIMPs optimiert wurden und deren Anforderung an die Ausleseelektronik diskutiert. Es werden erste Ergebnisse von Monte-Carlo-Simulationen zur Abschätzung des intrinsischen γ-Untergrunds durch den Detektorhalter sowie der aktuelle Stand der Prototypenentwicklung vorgestellt.

Diese Arbeit wurde unterstützt von dem DFG Exzellenzcluster "Origin and Structure of the Universe", der Helmholtz Alliance for Astroparticle Phyiscs, dem Maier-Leibnitz-Laboratorium (Garching) und dem BMBF.

T 63: Kosmische Strahlung III

Zeit: Dienstag 16:45–19:05 Raum: VMP9 SR 29

Gruppenbericht T 63.1 Di 16:45 VMP9 SR 29

The rise in the positron fraction: Distance limits on positron point sources from cosmic ray arrival directions and diffuse gamma-rays — •Iris Gebauer and Rosemarie Bentele — Karlsruhe Institute of Technologie, Karlsruhe, Germany

The rise in the positron fraction as observed by AMS and previously by PAMELA, cannot be explained by the standard paradigm of cosmic ray transport in which positrons are produced by cosmic-ray-gas interactions in the interstellar medium. Possible explanations are pulsars, which produce energetic electron-positron pairs in their rotating magnetic fields, or the annihilation of dark matter.

Here we assume that these positrons originate from a single close-by point source, producing equal amounts of electrons and positrons. The propagation and energy losses of these electrons and positrons are calculated numerically using the DRAGON code, the source properties are optimized to best describe the AMS data. Using the FERMI-LAT limits on a possible dipole anisotropy in electron and positron arrival directions, we put a limit on the minimum distance of such a point source. The energy losses that these energetic electrons and positrons suffer on their way through the galaxy create gamma ray photons through bremsstrahlung an Inverse Compton scattering. Using the measurement of diffuse gamma rays from Fermi-LAT we put a limit on the maximum distance of such a point source. We find that a single electron positron point source powerful enough to explain the locally observed positron fraction must reside between 225 pc and 3.7 kpc distance from the sun and compare to known pulsars.

T 63.2 Di 17:05 VMP9 SR 29

Cosmic ray anisotropy searches with AMS-02 — •Stefan Zeissler, Iris Gebauer, and Ricarda Trumpf — 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 this 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 the measurement of an 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 choices lead to difficulties in the reconstruction of a marginal signal with a big 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 63.3 Di 17:20 VMP9 SR 29

Towards an antiproton measurement with AMS-02 — •Andreas Bachlechner — RWTH Aachen University

AMS-02 is a high-precision multi-purpose particle detector. It has been onboard the International Space Station since May 2011.

The antiproton measurement is an important part of the AMS-02 physics program. An excess above the expected spectrum due to interactions of cosmic rays with the interstellar matter can hint at exotic sources like dark matter annihilation. The antiproton-to-proton ratio and the antiproton flux itself may also improve the understanding of the origin and propagation of cosmic rays.

Due to the very small abundance of antiprotons in the cosmic radiation of about 10^{-5} compared to protons a very precise particle identification is crucial. The main backgrounds are other singly charged particles like protons, electrons, and pions produced within the detector material itself. At lower energies the time-of-flight system and the ring-imaging Cherenkov detector seperate light particles from protons. The electromagnetic calorimeter and the transition radiation detector redundantly suppress the electron background. The reconstruction of

the charge sign by the magnetic spectrometer is limited by its resolution and has to be taken into account carefully.

The methods to identify antiprotons in the cosmic-ray measurement of AMS-02 in different energy regions will be presented. The ways to handle the uncertainties to the antiproton-to-proton ratio considering the various challenges will be discussed.

T 63.4 Di 17:35 VMP9 SR 29

Search for Positron Anisotropies in Cosmic Rays with AMS — •Fabian Machate — 1. Physikalisches Institut B, RWTH Aachen University

The Alpha Magnetic Spectrometer (AMS-02) on the International Space Station has observed a significant excess of cosmic ray positrons over the background expected from secondary production at energies above 10 GeV. Nearby pulsars and annihilating dark matter particles as a primary source of electrons and positrons have been discussed as an explanation. A possible way of distinguishing between pulsar and dark matter origin is the measurement of dipole anisotropies in the positron flux or the positron to electron ratio. Any anisotropy will be reduced by diffusion in galactic magnetic fields to below the percent level.

AMS-02 is the leading space-based experiment for cosmic ray detection and well suited for this search. A new analysis procedure for anisotropies using an event sample with large acceptance will be presented. It relies on the ability of the Transition Radiation Detector (TRD) to separate positrons from the proton background.

T 63.5 Di 17:50 VMP9 SR 29

The Pierre Auger Fluorescence Detector: Cross-Checking the Absolute Calibration Using a Drone — •Lenka Tomankova for the Pierre-Auger-Collaboration — Institute for Nuclear Physics (IKP), Karlsruhe Institute of Technology (KIT), 76021 Karlsruhe, Germany

The Pierre Auger Observatory combines the air shower fluorescence and surface array methods to study ultra-high energy cosmic rays. As the energy scale of the experiment is derived from calorimetric measurements by the fluorescence telescopes, their accurate calibration is of primary importance to all Auger data. We discuss a novel calibration method based on a remotely flown drone equipped with a specially designed light source that mimics a snapshot of an air shower traversing the atmosphere. Several drone measurement campaigns have been performed to study the properties of the Auger fluorescence telescopes and to derive an end-to-end calibration. We give an overview of the measurements and present the basic analysis chain as well as the first results of an independent cross-check of the Auger energy scale.

T 63.6 Di 18:05 VMP9 SR 29

Simulation and analysis of surface scintillator signals at the Pierre Auger Observatory — •David Schmidt, Darko Veberic, and Markus Roth for the Pierre-Auger-Collaboration — Karlsruhe Institute of Technology, Karlsruhe, Germany

To improve reconstruction of cosmic ray primary mass, the Pierre Auger Observatory is upgrading its surface detectors by installing a scintillator on top of each existing water Cherenkov tank. The different responses of the coupled detectors to the components of extensive air showers facilitates estimation of the number of muons reaching Earth's surface, which is correlated with primary mass. Geant4 and the Offline framework are used to simulate the detectors' responses, construct signal traces for individual particle components, and calculate total expected signals. This enables assessment of proposed reconstruction algorithms. An overview of the simulations and selected algorithms is presented here.

T 63.7 Di 18:20 VMP9 SR 29

Reconstruction of charge number of heavy cosmic rays using Cherenkov Light — •Robert Stein, Attila Abramowski, and Dieter Horns — Universität Hamburg, Hamburg, Germany

Between impact with the upper atmosphere and decay into a charged particle shower, heavy cosmic ray elements such as Iron emit Cherenkov Light at an angle determined by the Refractive Index of the air and the energy per nucleon. This direct Cherenkov Light forms a characteristic circular light distribution on the Earth's surface with an intensity proportional to the square of the cosmic ray charge. A new method has been developed to reconstruct this charge number. The expected performance for various existing and planned installations will be presented.

T 63.8 Di 18:35 VMP9 SR 29

Charakterisierung von 64 Channel SiPM Arrays für das SiECA Projekt — •Max Renschler[2], Jörg Bayer[3], Francesca Bisconti[1], Andreas Ebersold[4], Andreas Haungs[1], Thomas Huber[2], Tobias Jammer[3], Michael Karus[1], Matthias Kleifges[4], William Painter[1], Andrea Santangelo[3], Harald Schieler[1] und Andreas Weindl[1] für die JEM-EUSO-Kollaboration — [1]Institut für Kernphysik (IKP) , KIT — [2]Institut für experimentelle Kernphysik (IEKP), KIT — [3]Institut für Astronomie und Astrophysik, Universität Tübingen — [4]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

Um an Stelle von herkömmlichen Multianoden-Photomultipliern eine alternative Detektionsmethode von ultrahochenergetischer kosmischer Strahlung (UHECR) mit Silicon Photomultipliern (SiPMs) zu testen, wird derzeit das 'Silicon Elementary Cell Add-on' (SiECA) entwickelt, das die Detektion von UHECR mit SiPMs im Rahmen des 'Extreme Universe Space Observatory' (EUSO) Pathfinder Experiments 'EUSO-Super Pressure Ballon' untersuchen soll. In diesem Zusammenhang werden 64 Channel SiPM Arrays der neusten Generation von Hamamatsu untersucht und charakterisiert. Die Motivation und die Idee sowie der aktuelle Stand von SiECA werden vorgestellt und die Ergebnisse der Charakterisierung der neusten 64 Channel SiPM Arrays von Hamamatsu diskutiert.

T 63.9 Di 18:50 VMP9 SR 29

Silicon PM readout in SiECA — •Tobias Jammer for the JEM-EUSO-Collaboration — Physikalisches Institut, Universit Tübingen

The goal of SiECA, the SiPM Elementary Cell Addon to the EUSO Super Pressure Balloon pathfinder experiment, is to evaluate the feasibility of a Silicon PM camera in an EUSO-like setting. Therefore an additional standalone Elementary Cell will be mounted next to the MAPMT camera to test the UHECR camera prototype in a live environment. This talk will focus on the readout of the Silicon PMs for SiECA and the integration of the addon with the main apparatus.

T 64: Neutrinos, Dunkle Materie und Luftschauer

Zeit: Dienstag 16:45–19:10 Raum: VMP9 SR 30

Gruppenbericht T 64.1 Di 16:45 VMP9 SR 30

Sterile neutrino search in the STEREO Experiment — Christian Buck, Manfred Lindner, and •Christian Roca — MPIK

In neutrino oscillations, a canonical understanding has been established during the last decades after the measurement of the mixing angles θ_{12}, θ_{23}, θ_{13} via solar, atmospheric and, most recently, reactor neutrinos. However, the re-evaluation of the reactor neutrino theoretical flux has forced a re-analysis of most reactor neutrino measurements at short distances. This has led to an unexpected experimental deficit of neutrinos with respect to the theory that needs to be accommodated, commonly known as the "reactor neutrino anomaly". This deficit can be interpreted as the existence of a light sterile neutrino state into which reactor neutrinos oscillate at very short distances. The STEREO experiment aims to find an evidence of such oscillations.

The ILL research reactor in Grenoble (France) operates at a power of 58MW and provides a large flux of electron antineutrinos with an energy range of a few MeV. These neutrinos will be detected in a 2000 liter organic liquid scintillator detector doped with Gadolinium and consisting of 6 cells stacked along the direction of the core. Given the proximity of the detector, neutrinos will only travel a few meters until they interact with the scintillator. The detector will be placed about 10 m from the reactor core, allowing STEREO to be sensitive to oscillations into the above mentioned neutrino sterile state. The project presents a high potential for a discovery that would impact deeply the paradigms of neutrino oscillations and in consequence the current understanding of particle physics and cosmology.

Gruppenbericht T 64.2 Di 17:05 VMP9 SR 30

The OPERA Experiment: Discovery of ν_τ Appearance in

the CNGS ν_μ Beam — •Annika Hollnagel for the OPERA-Hamburg-Collaboration — Universität Hamburg, Institut für Experimentalphysik

The long-baseline neutrino oscillation experiment OPERA has been designed for the direct observation of ν_τ appearance in the CNGS ν_μ beam.

The OPERA detector is located at the LNGS underground laboratory, with a distance of 730 km from the neutrino source at CERN. It is a hybrid apparatus built of about 150000 Emulsion Cloud Chamber modules providing micrometric resolution and Electronic Detector elements for online readout, interaction location, and the measurement of particle charge and momentum.

While CNGS beam data taking lasted from 2008 to 2012, the neutrino oscillation analysis is still ongoing: With the observation of a 5th τ neutrino event in an enlarged data sample, the experiment was recently able to report the discovery of $\nu_\mu \to \nu_\tau$ oscillations at a significance larger than 5σ.

T 64.3 Di 17:25 VMP9 SR 30

Neutrino-argon interactions in the T2K near detector — •Lukas Koch, Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen

The T2K near detector employs three large, argon-filled TPCs with a total fiducial volume of about 10 m^3 at ambient pressure. These TPCs have been exposed to the intense T2K muon-neutrino beam since the start of the experiment. The beam has a mean neutrino energy of 600 MeV and so far, data corresponding to over $6 \cdot 10^{20}$ ($4 \cdot 10^{20}$) protons on target was recorded in neutrino (anti-neutrino) mode.

We expect about 600 charged current neutrino-argon interactions in the data. That enables us to do the world's first neutrino-Argon cross section measurement in gaseous argon, thus making an important contribution to constraining nuclear interaction models for future neutrino oscillation measurements. This talk will describe the physics goals and present the current status of the analysis.

T 64.4 Di 17:40 VMP9 SR 30

Calibration and neutron detection efficiency in Double Chooz — •Helena Almazan, Christian Buck, Julia Haser, and Manfred Lindner for the Double Chooz-Collaboration — MPIK, Heidelberg

As an intense and pure source of low energy electron antineutrinos, nuclear reactors are one of the most powerful tools to analyse the neutrino oscillations. The Double Chooz experiment aims for a precise determination of the neutrino mixing angle θ_{13} with the new data from the near detector. In order to reach this precision, a high and accurately known detection efficiency of the inverse beta decay (IBD) signal – the antineutrino interaction – is required.

Several methods are available for detector calibration. Cosmic muons and spallation neutron captures are some examples of natural sources that are used. Furthermore, signals created by artificial sources contribute to the calibration with well defined classes of events. LED Light Injection systems in the Inner Detector and the Inner Veto are used to measure PMT gains and time responses. Radioactive sources deployed inside the detector are used to determine the energy scale and the detector stability. The ^{252}Cf source plays an important role in the detector calibration. In the spontaneous fissions of this isotope neutrons are produced with high multiplicity. An analysis of the neutron interactions in the scintillator can be used to estimate the detection efficiency of the delayed coincidence signal of the IBD reaction. New results from recent calibration campaigns will be presented, providing a crucial input for reactor antineutrino analysis with two detectors.

T 64.5 Di 17:55 VMP9 SR 30

ν_τ-physics with the SHiP experiment — •Daniel Bick, Stefan Bieschke, Joachim Ebert, Caren Hagner, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHiP stands for Search for Hidden Particles and is a recently proposed new general-purpose fixed target facility at the SPS at CERN. The main aim is the search for hidden particles predicted by different models capable of explaining dark matter, neutrino masses or the origin of baryon asymmetry in the Universe. Furthermore, a huge number of (τ-)neutrinos will be produced at such a facility making it an ideal place for ν_τ-physics and thus giving the opportunity for a measurement of the τ-neutrino cross-sections or a first-time experimental evidence of the anti-τ-neutrino.

This talk will give an overview of the neutrino experiment at the SHiP experiment. An emphasis is given to the reconstruction of muons from interactions in the neutrino target using a magnetic spectrometer.

T 64.6 Di 18:10 VMP9 SR 30

Study of the optical properties of the DF2000MA daylight film used in the XENON1T muon veto water tank — •Diego Ramírez — Institut für Physik, Johannes Gutenberg-Universität Mainz

XENON1T is the 3rd stage of a series of experiments performed by the XENON collaboration for the direct detection of dark matter candidates, such as WIMPs. Its projected spin-independent WIMP-nucleon elastic scattering cross-section entails an improvement of two orders of magnitude with respect to Xenon100 and requires, for a fiducial mass of the detector of about 1 ton liquid xenon, a similar reduction in background. In order to minimize the neutron background induced by cosmic ray muons, the XENON1T TPC is placed in the center of a 750 m^3 water tank acting as an active Cherenkov muon veto, the walls of which are clad with the high reflective DF2000MA foil by 3M.

The improved setup and results of a dedicated study of the reflective properties of the foil is presented, as well as a measurement of its possible wavelength shifting (WLS) properties. The analysis yields a specular reflectance of $\approx$ 100% for wavelengths larger than 400 nm, while $\approx$ 90% of the incoming light with wavelengths smaller than 370 nm is absorbed by the foil. The emission spectra of the WLS are dependent on the absorbed wavelength and show Gaussian shapes, with highest intensities at mean values of $\approx$ 450 nm emission wavelength.

T 64.7 Di 18:25 VMP9 SR 30

Status of the 2D Bayesian analysis of XENON100 data — •Stefan Schindler for the XENON-Collaboration — JGU, Staudingerweg 7, 55128 Mainz

The XENON100 experiment is located in the underground laboratory at LNGS in Italy. Since Dark Matter particles will only interact very rare with normal matter, an environment with ultra low background, which is shielded from cosmic radiation is needed. The analysis for XENON100 data was performed with the profile likelihood method (a frequentist approach) and still provides one of the most sensitive exclusion limits to WIMP Dark Matter.

Bayesian inference takes a different approach towards probability. Here, probability is interpreted as a degree of believe. In the Bayesian approach a prior probability density function (pdf) is defined, which represents the state of knowledge in a parameter of interest. After looking at the data, the knowledge is updated, which results in a posterior pdf. All inferences of the problem are obtained following Bayes'theorem. We present the status of an unbinned 2D approach, using Bayesian inference. Going away from a spatial averaged treatment of the signal in the detector, postion dependence is introduced. The progress to reconstruct mass and cross-section of an interacting WMIP for a given set of mock-data is shown and compared to the spatial averaged case.

T 64.8 Di 18:40 VMP9 SR 30

Mounic Footprint of Simulated Extensive Air Showers — •Mona Erfani[1,2], Markus Risse[1,2], and Alexey Yushkov[1,2] — [1]University of Siegen — [2]for the Pierre Auger Observatory

The muon component of extensive air showers produced by the ultra-high energy cosmic rays (E$\sim 10^{18}$ eV) is a subject of numerous studies related to the determination of the primary mass composition or to the properties of the hadronic interactions at the energies beyond the reach of LHC. In our work we investigate the nature of the fluctuations of the muon density at the ground and consider other characteristics of the muon footprint using CORSIKA simulations with no thinning applied to the muon component.

This work was supported by the BMBF Verbundforschung Astroteilchenphysik.

T 64.9 Di 18:55 VMP9 SR 30

Geant4-Simulationen des SLAC T-510-Experiments zur Messung elektromagnetischer Strahlung von Teilchenschauern — •Anne Zilles für die SLAC T-510-Kollaboration — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie, Deutschland

In den letzten Jahrzehnten hat sich die Radiodetektion von ausgedehnten Luftschauern als Methode zur Messung von ultrahochenergetischer kosmischer Strahlen etabliert. Die Analyse der gemessenen Daten baut

dabei auf der zugrunde liegenden Theorie der Radiostrahlung auf. Im Jahr 2014 führten wir ein Experiment unter kontrollierten Laborbedingungen am SLAC durch, mit dem wir die Strahlung im MHz-Bereich einer geladenen Teilchenkaskade gemessen haben. Dabei wurde ein Magnetfeld mit einer Stärke von bis zu 1000 G induziert. Parallel entwickelten wir eine detaillierte Simulation des Experiments, um das Radiosignal unter Verwendung von zwei modernen Formalismen für die Berechnung der elektromagnetischen Strahlung von Teilchenkaskaden vorherzusagen. Der Vortrag gibt Einblick in die Details der Simulation und präsentiert einen Vergleich der Simulationsergebnisse der beiden Formalismen mit den Messdaten. Dieser zeigt, dass die Simulationen quantitativ mit den Messungen innerhalb der Systematik übereinstimmen und eine qualitativ sehr gute Beschreibung geben.

T 65: Gammaastronomie III

Zeit: Dienstag 16:45–19:05 Raum: VMP11 HS

Gruppenbericht T 65.1 Di 16:45 VMP11 HS

FACT - More than Four Years of Reliable Operation with SiPMs in an IACT Camera — •Jens Buss and Fabian Temme for the FACT-Collaboration — Experimentelle Physik 5b, TU Dortmund, Deutschland

The First G-APD Cherenkov Telescope (FACT) is pioneering the application of solid state photo detectors for imaging atmospheric Cherenkov telescopes. Since October 2011, the FACT collaboration has successfully been showing the reliability of silicon photo multipliers (SiPMs) for earth-bound gamma-ray astronomy. Though being situated on the Canary Island of La Palma, FACT is operated remotely from Europe. Due to the robustness of SiPMs, even observations during strong moon light are possible without any need of UV-filters or a reduced voltage. Moreover, no indication for any aging of the used SiPMs has occurred so far. In consequence, this technology allowed to increase FACT's duty cycle beyond that of current generation IACTs, in order to collect a dense data sample from Active Galactic Nuclei. As a result, FACT is an ideal instrument to monitor bright and variable TeV Blazars on the northern sky. A quick-look analysis is reporting flux variations with low latency. Hence, several flare alerts were sent to partners in the Multiwavelength Community. In addition, the Monte Carlo simulations of the system were improved and show a good understanding of the SiPM's properties. The simulations fit the measured data even on proton shower level. The status and lessons learned from the experience of more than four years operation of the First G-APD Cherenkov Telescope will be presented.

T 65.2 Di 17:05 VMP11 HS

Prototyp eines SiPM Kollimator Clusters für die MAGIC-Teleskope — •Christian Jung für die MAGIC-Kollaboration — TU Dortmund, Dortmund, Deutschland

Die MAGIC-Teleskope sind zwei bildgebende Tscherenkow-Teleskope, die von der MAGIC-Kollaboration auf der kanarischen Insel La Palma betrieben werden. Beide Teleskope verwenden eine Kamera mit 1039 Photomultipliern (PMTs). An den Ecken der Kamera befinden sich freie Plätze, an denen alternative Photodetektoren getestet werden können. Momentan sind dort zwei Testcluster mit Silizium-Photomultiplier (SiPMs) eingesetzt. Sowohl bei den PMTs als auch bei den beiden Testclustern werden Winston Cones als Lichtleiter verwendet.

In einer Kollaboration zwischen der TU Dortmund, der Universität Würzburg und der Max-Planck-Gesellschaft werden Kollimatoren als Alternativen zu den Winston Cones untersucht, denn durch die Weiterentwicklung der SiPMs sind die Winston Cones nicht mehr zwingend erforderlich. Für die Kollimatoren wurden mehrere Ansätze entwickelt, simuliert und verglichen.

In diesem Vortrag werden der aktuelle Stand des Testclusters und die Ergebnisse der Simulationen vorgestellt.

T 65.3 Di 17:20 VMP11 HS

Status of the H.E.S.S. I Camera Upgrade — •Iryna Lypova[1] and for the H.E.S.S. collaboration[2] — [1]DESY, Platanenallee 6, D-15738 Zeuthen, Germany — [2]https://www.mpi-hd.mpg.de/hfm/HESS/

The High Energy Stereoscopic System (H.E.S.S.) is an array of one big and four small size Cherenkov telescopes located in Namibia. In July 2015 the camera electronics of one of the small telescopes (CT1) was renewed. The upgrade of three more (CT2-4) telescopes is planned to happen in 2016. The main goals of the upgrade is to reduce the dead time of the small telescopes, decrease the influence of night sky background light and hence improve the sensitivity of the system. For better understanding of the performance of the new camera, Monte-Carlo simulations are necessary. For their production, the CORSIKA and sim_telarray codes were used. During the talk, an overview of the CT1-4 cameras upgrade and the status of the new simulations production will be presented.

T 65.4 Di 17:35 VMP11 HS

Long-term studies of Markarian 421 from 2007 to 2009 — •Sonja Schröder[1], Ann-Kristin Overkemping[1], Marina Manganaro[2], and Diego Tescaro[3] for the MAGIC-Collaboration — [1]TU Dortmund, Dortmund, Deutschland — [2]IAC La Laguna, Teneriffa, Spanien — [3]INFN, Padova, Italien

The MAGIC experiment consists of two Imaging Air shower Cherenkov Telescopes to detect and study gamma-rays from galactic and extragalactic sources. Blazars are a special type of extragalactic sources hosting an Active Galactic Nucleus (AGN) with a jet directed towards earth. The AGN Mrk 421 is one of the strongest and brightest known blazars suitable for very high-energy (VHE) observations. This talk gives an overview over long-term variability and correlation studies of the blazar Mrk 421. For this study a VHE dataset collected by MAGIC-I covering the extensive timespan from February 2007 to June 2009 was examined together with data of different wavelengths from other telescopes. These kind of studies could allow for an increase of knowledge about the possible emission processes inside Mrk 421.

T 65.5 Di 17:50 VMP11 HS

Ein Framework zur Prozessierung von Transient-Benachrichtigungen für H.E.S.S. — •Clemens Hoischen und H.E.S.S. Kollaboration — Universität Potsdam, Potsdam, Deutschland

Die Beobachtung von kurz andauernden astrophysikalischen Ereignissen (Transients) in nahezu allen Wellenlängen ist ein wichtiger Zweig der heutigen Astrophysik. So versucht auch das H.E.S.S. Experiment beispielsweise Gammastrahlungsausbrüche (GRBs) in TeV-Gammastrahlung zu detektieren. In den kommenden Jahren startet der Betrieb von mehreren Experimenten mit großem Detektionspotential für Transients (GAIA, PTF, LSST). Dadurch wird sich die Rate an interessanten beobachtbaren Phänomenen vervielfachen. Um den Übergang zu dieser neuen Ära der Transient-Astrophysik zu ermöglichen wird für das H.E.S.S. Experiment ein Softwarekonzept entwickelt, welches modular und flexibel ist, um den Übergang von wenigen Benachrichtigungen pro Monat zu mehreren Millionen pro Nacht zu ermöglichen. Die Bausteine dieses neuen Systems und ihre Verbindungen werden vorgestellt. Ein Vergleich zum bestehenden System in H.E.S.S. wird gezogen, sowie ein Ausblick auf mögliche Erweiterungen gegeben.

T 65.6 Di 18:05 VMP11 HS

The influence of night sky background on calibration and analysis in H.E.S.S. — •Eva Leser[1] and H.E.S.S. Collaboration[2] — [1]Potsdam University — [2]https://www.mpi-hd.mpg.de/hfm/HESS/

In some regions of the galactic plane, background light by stars (night sky background) poses a severe challenge for the detection of gamma-ray sources. Thorough tests are needed to ensure a good quality of the data analysis, especially in regions with both a strong and inhomogeneous background. Investigation of the influence on calibration and data analysis is started at an early stage in data processing. Different cleaning levels were tested and the event loss rate was evaluated. It is shown that for regions with strong and inhomogeneous night sky background and a powerful source an increased cleaning level is beneficial.

T 65.7 Di 18:20 VMP11 HS

Application of the Ctools Analysis Framework to H.E.S.S. data — •Maria Haupt[1], for the H.E.S.S. collaboration[2]

und Jürgen Knödlseder[3,4] — [1]DESY, Platanenallee 6, D-15738 Zeuthen, Germany — [2]https://www.mpi-hd.mpg.de/hfm/HESS/ — [3]Université de Toulouse; UPS-OMP; IRAP; Toulouse, France — [4]CNRS; IRAP; 9 Av. colonel Roche, BP 44346, F-31028 Toulouse Cedex 4, France

The data of the currently operating gamma-ray telescopes is mostly analysed with an increasingly diverse set of instrument-specific analysis tools. The instrument independent framework GammaLib is currently developed for the analysis of the high-level data products of the upcoming Cherenkov Telescope Array (CTA). It will be provided as open source software for any kind of gamma-ray data from existing telescopes. Based on GammaLib, a set of analysis executables were created (ctools). These powerful tools provide the opportunity of simultaneous multi-instrument analyses which will be in particular helpful during the HESS upgrade. The ctools software also provides support for studying extended gamma-ray sources. To test the ctools framework on HESS data, we made cross-checks on well-established sources like the Crab Nebula or the Galactic center with good agreements of the results from the HESS internal analysis framework and the ctools framework. An overview of the instrument performance and future plans will be given.

T 65.8 Di 18:35 VMP11 HS

Simulationsbasierte Analyse der Systemperformance nach dem Kamera-Upgrade von H.E.S.S. — •Constantin Steppa[1] und for the H.E.S.S. collaboration[2] — [1]DESY, Platanenallee 6, 15738 Zeuthen — [2]https://www.mpi-hd.mpg.de/hfm/HESS/

Seit über zehn Jahren liefert das High Energy Stereoscopic System mit seinen vier 12m-Cherenkov-Teleskopen einen wichtigen Beitrag zur Gamma-Astronomie. Im Jahr 2012 wurde dem System ein 28m-Teleskop hinzugefügt, was es ermöglicht kosmische Gamma-Photonen mit einer höheren Rate und bei noch niedrigeren Energien zu messen. Momentan arbeitet die H.E.S.S. Kollaboration an einem Upgrade der Kameras der vier 12m-Teleskope mit dem Ziel, neben dem Austausch der gealterten Elektronik, die Energieschwelle der Teleskope zu reduzieren und die Rate an koinzident erfassten Bildern zusammen mit dem 28m-Teleskop zu erhöhen. Ein wichtiges Kriterium dabei ist die Reduzierung der Auslesezeit der Kameras, die bei der Datenerfassung die Totzeit der Kameras bestimmt. Anhand von Simulationen wurde der Einfluss der Totzeit auf die Performance des Gesamtsystems untersucht sowie ein durch das Upgrade mögliches neues Bildbereinigungsverfahren getestet. Das Ergebnis eines Vergleichs der Systemperformance vor und nach dem Upgrade wird vorgestellt.

T 65.9 Di 18:50 VMP11 HS

Phase measuring deflectometry: An improved setup for measuring CTA mirror facets — •Andreas Specovius, Christopher van Eldik, Andre Wörnlein, and Alexander Ziegler — Erlangen Centre for Astroparticle Physics (ECAP)

The future Cherenkov Telescope Array (CTA) will consist of up to 100 single telescopes with a total reflecting surface of $\sim$10.000 m^2 made of numerous mirror facets. Characterizing the surface properties of these facets is quite challenging concerning time and logistics. An efficient way to reliably reconstruct the surface of specular free-forms is Phase Measuring Deflectometry (PMD). PMD is routinely used to characterize the focal distance and point spread function of spherical CTA prototype mirrors. To address the possibility to measure the surface properties of aspherical mirrors, a new PMD setup has recently been built. First experience with this setup is reported.

T 66: Higgs-Boson (exotische Zerfälle)

Zeit: Mittwoch 16:45–18:00 Raum: VMP5 HS A

T 66.1 Mi 16:45 VMP5 HS A

Suche nach Leptonenzahl verletzenden Higgszerfällen — •Daniel Troendle, Peter Schleper, Adrian Perieanu, Benedikt Vormwald, Annika Vanhoefer, Malte Hoffmann, Oliver Rieger, Lucas Schneider und Johann Dittmer — Universität Hamburg, Institut für Experimentalphysik

Nach der Entdeckung des Higgsbosons von den beiden Experimenten ATLAS und CMS im Jahr 2012, ist die genaue Vermessung dieses neuen Bosons eine der wichtigsten Aufgaben der experimentellen Teilchenphysik. Trotzdem gibt es noch viele offene Fragen, die das Standardmodell (SM) der Teilchenphysik noch nicht beantworten kann. Eine mögliche Erweiterung stellen sogenannte 2-Higgs-Dublett-Modelle (2HDM) dar, die zum Teil neue, im SM nicht erlaubte, Zerfälle des Higgsbosons vorhersagen. Die Ergebnisse der Suchen nach Leptonenzahl verletzenden Higgszerfällen ($H \rightarrow \mu\tau, e\tau, e\mu$) mit dem CMS Experiment bei einer Schwerpunktsenergie von 8 TeV werden diskutiert.

T 66.2 Mi 17:00 VMP5 HS A

Suche nach unsichtbaren Zerfällen des Higgs-Bosons mit dem ATLAS-Detektor — Volker Büscher, Frank Fiedler, Christian Schmitt und •Johannes Balz — Institut für Physik, Johannes Gutenberg-Universität Mainz

Nach der Entdeckung des Higgs-Bosons im Jahr 2012 am LHC ist eine der großen Aufgaben am ATLAS-Detektor die Untersuchung der Eigenschaften des Higgs-Bosons und die Suche nach möglichen Unterschieden zu den Vorhersagen des Standardmodells.

In diesem Vortrag geht es um die Suche nach direkten, unsichtbaren Zerfällen des Higgs-Bosons, die nur mit Modellen jenseits des Standardmodells beschrieben werden können. Bisher wurde dies nur in den Higgs-Produktionskanälen Vektor-Bosonen-Fusion und Assoziierte Produktion untersucht. In dem am LHC dominanten Produktionskanal Gluon-Fusion werden unsichtbare Higgs-Boson-Zerfälle nur sichtbar, wenn im Anfangszustand zusätzliche Abstrahlungen stattfinden. Diese unterscheiden sich von den Abstrahlungen im dominanten Untergrundprozess $Z \rightarrow \nu\nu$, wodurch eine Untergrundunterdrückung möglich ist.

Im Vortrag wird der aktuelle Stand der Analyse bei einer Schwerpunktsenergie von $\sqrt{s}$=13 TeV vorgestellt.

T 66.3 Mi 17:15 VMP5 HS A

Suche nach schweren Higgs–Teilchen in Endzuständen mit Z($\mu^+\mu^-$)– und h($b\bar{b}$)–Bosonen — •Johann Dittmer, Malte Hoffmann, Adrian Perieanu, Jan Oliver Rieger, Peter Schleper, Daniel Troendle, Annika Vanhoefer und Benedikt Vormwald — Universitaet Hamburg

Mit der Entdeckung des Higgsbosons durch die CMS– und ATLAS–Kollaborationen am LHC wird das Standardmodell (SM) der Teilchenphysik um ein wichtiges Teilchen erweitert, allerdings können damit noch nicht alle Phänomene erklärt werden. Supersymmetrische Modelle (SUSY) jenseits des SM sind mögliche Erweiterungen. Im minimalen supersymmetrischen Standardmodell existieren vier weitere Higgs–artige Bosonen, ein schweres skalares Boson H^0, ein pseudoskalares Boson A^0 und zwei geladene Bosonen $H^\pm$.

Die vorgestellte Analyse untersucht allgemein die Produktion eines Z– und eines Higgsboson, wobei das Z–Boson in zwei Myonen und das Higgsboson in zwei Bottomquarks zerfällt. Außerdem wird der Untergrund mit ähnlicher Signatur, wie zum Beispiel Z($\mu^+\mu^-$)Z($b\bar{b}$), untersucht. Zusammen mit allgemeinen Ereignisobservablen werden auch Winkelverteilungen der Zerfallsprodukte des Z– und Higgsbosons analysiert. Die unterschiedlichen Spins der Bosonen können benutzt werden, um das Signal anzureichern.

T 66.4 Mi 17:30 VMP5 HS A

Suche nach einem schweren, pseudoskalaren Higgs-Boson A im Zerfallskanal $A \rightarrow Zh$ mit dem ATLAS-Experiment — •Hannah Arnold und Christian Weiser — Albert-Ludwigs-Universität, Freiburg

Nach der Entdeckung eines Higgs-Bosons am LHC im Jahre 2012 verbleibt die wichtige Frage zu beantworten, ob es sich bei dem entdeckten Teilchen um das im Standardmodell (SM) vorhergesagte Higgs-Boson handelt, oder ob es zu einem erweiterten skalaren Sektor gehört. Eine mögliche Erweiterung des SM Brout-Englert-Higgs-Mechanismus stellen Zwei-Higgs-Duplett-Modelle (2HDM) dar, in denen ein zweites komplexes Duplett postuliert wird. Dies führt zur Vorhersage von fünf Higgs-Bosonen, unter Anderem von einem schweren, pseudoskalaren Higgs-Boson A. Das am LHC entdeckte, SM-ähnliche Higgs-Boson mit einer Masse von 125 GeV wird in 2HDM mit dem leichten, CP-geraden Higgs-Boson h identifiziert. In diesem Vortrag wird die Suche

nach einem solchen Higgs-Boson A, welches in ein Z-Boson und ein SM-ähnliches Higgs-Boson h zerfällt, vorgestellt. Bei dieser mit dem ATLAS-Experiment bei einer Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ durchgeführten Analyse werden Zerfälle des Z-Bosons in ein Lepton- oder Neutrinopaar, sowie des h-Bosons in ein b-Quark-Paar betrachtet. Gegenüber der in Run 1 durchgeführten Analyse, kann infolge der erhöhten Schwerpunktsenergie der untersuchte Bereich zu höheren Massen des A-Bosons ausgedehnt werden. Dies erfordert auch den Einsatz von Techniken, die speziell für *geboostete* Systeme entwickelt wurden, wie die Rekonstruktion von großen Jets.

T 66.5 Mi 17:45 VMP5 HS A

Suche nach dem Higgs Boson in $H \to \mu^+\mu^-$ – Zerfällen mit dem ATLAS Experiment am LHC — •Friedrich Hönig — Ludwig-Maximilians-Universität München

Es wird eine Suche nach dem Standard-Modell Higgs-Boson in $H \to \mu^+\mu^-$ Zerfällen mit dem ATLAS-Experiment am LHC vorgestellt. Hierfür wurden Messdaten von Proton-Proton-Kollisionen bei einer Schwerpunktsenergie von $\sqrt{s} = 13\,\text{TeV}$ untersucht. Die gut rekonstruierten Myon-Spuren und die vollständig rekonstruierbare Kinematik der Ereignisse dieses Zerfallskanals ermöglichen eine sehr gute Massenauflösung des Higgs-Bosons. Herausforderungen sind das geringe Verzweigungsverhältnis im Standard-Modell (SM) und die Unterdrückung des dominanten Z/γ^*-Untergrundes. Mögliche Erweiterungen des SM lassen eine höhere Ereignisrate erwarten.

T 67: Higgs-Boson (assoziierte Produktion) III

Zeit: Mittwoch 16:45–19:00 Raum: VMP5 HS B1

T 67.1 Mi 16:45 VMP5 HS B1

Study of MVA variables for signal and background separation for the $t\bar{t}H$ process during Run II with the ATLAS experiment — Matteo Mantoani, Maria Moreno Llacer, •Ishan Pokharel, Arnulf Quadt, and Elizaveta Shabalina — II. Physikalisches Institut, Georg-August-Universität Göttingen

After the discovery of the Higgs boson in 2012, the validation of the properties of this new particle as predicted by the Standard Model has taken a very important stance in physics. The associated production of the Higgs boson with a top and anti-top pair, namely the $t\bar{t}H$ process provides a direct measurement of the Yukawa coupling between the Higgs boson and the top quark. This analysis focuses on the search for the $t\bar{t}H$ process in the $H \to b\bar{b}$ decay mode. The main background to this process is the $t\bar{t}$ production with jets and $t\bar{t}b\bar{b}$ being the irreducible background. With the cross section of production of the $t\bar{t}H$ process being four orders of magnitude smaller than that of $t\bar{t}$, sophisticated multivariate analysis (MVA) methods are needed in order to separate signal from overwhelming background. This analysis focuses on choosing MVA variables based on object kinematic properties and event shape information of the $t\bar{t}H$ events that allow to separate signal-like events from background. This work will be directly used in the search for the $t\bar{t}H$ signal with the Run II data at the ATLAS detector.

T 67.2 Mi 17:00 VMP5 HS B1

Reconstruction of $t\bar{t}H$ ($H \to bb$) Events using Deep Neural Networks with the CMS Detector — •Marcel Rieger, Martin Erdmann, Benjamin Fischer, Robert Fischer, Fabian Heidemann, Thorben Quast, and Yannik Rath — III. Physikalisches Institut A, RWTH Aachen University

The measurement of Higgs boson production in association with top-quark pairs ($t\bar{t}H$) is an important goal of Run 2 of the LHC as it allows for a direct measurement of the underlying Yukawa coupling. Due to the complex final state, however, the analysis of semi-leptonic $t\bar{t}H$ events with the Higgs boson decaying into a pair of bottom-quarks is challenging.

A promising method for tackling jet parton associations are Deep Neural Networks (DNN). While being a widely spread machine learning algorithm in modern industry, DNNs are on the way to becoming established in high energy physics.

We present a study on the reconstruction of the final state using DNNs, comparing to Boosted Decision Trees (BDT) as benchmark scenario. This is accomplished by generating permutations of simulated events and comparing them with truth information to extract reconstruction efficiencies.

T 67.3 Mi 17:15 VMP5 HS B1

Categorization of the Processes Contributing to ttH(H→bb) Using Deep Neural Networks with the CMS Experiment — •Yannik Rath, Martin Erdmann, Benjamin Fischer, Robert Fischer, Fabian Heidemann, Thorben Quast, and Marcel Rieger — III. Physikalisches Institut A, RWTH Aachen University

In ttH(H→bb) analyses, event categorization is introduced to simultaneously constrain signal and background processes. A common procedure is to categorize events according to both their jet and b-tag multiplicities.

The separation power of this approach is limited by the b-tagging efficiency. Especially ttH(H→bb) events with their high b-tag multiplicities suffer from migrations to background categories.

In this presentation, we explore deep neural networks (DNNs) as a method of categorizing events according to their jet multiplicity and a DNN event class hypothesis. DNNs have the advantage of being able to learn discriminating features from low level variables, e.g. kinematic properties, and are naturally suited for multiclass classification problems. We compare the ttH signal separation achieved with the DNN method with that of a common categorization approach.

T 67.4 Mi 17:30 VMP5 HS B1

Lorentzinvariante Observablen für die Messung des Standardmodell-$H\to b\bar{b}$-Zerfalls mit ATLAS — Götz Gaycken, •Stephan Hageböck, Vadim Kostyukhin, Tatjana Lenz, Elisabeth Schopf, Eckhard von Toerne und Norbert Wermes — Physikalisches Institut, Universität Bonn

Seitdem im Jahr 2012 das Higgs-Boson von ATLAS und CMS entdeckt wurde, konnte nicht nachgewiesen werden, dass es in b-Quarks zerfällt. Das Standardmodell sagt bei einer Masse von 125 GeV ein Verzweigungsverhältnis von 58% vorher. Obwohl $H \to b\bar{b}$ damit der wahrscheinlichste Zerfall ist, ist er wegen des enormen b-Jet Untergrundes am LHC schwierig zu messen.

In diesem Vortrag wird eine ATLAS-Analyse vorgestellt, die sich auf die Higgs-Produktion in Assoziation mit leptonisch zerfallenden W- oder Z-Bosonen beschränkt. Mit den Daten des Jahres 2012 wird diskutiert, wie Boosted Decision Trees und lorentzinvariante Variablen verwendet werden können, um die systematischen Unsicherheiten bei der Suche nach $H \to b\bar{b}$-Zerfällen zu reduzieren.

T 67.5 Mi 17:45 VMP5 HS B1

Kinematic Reconstruction of the Higgs Mass at the ILC — •Aliakbar Ebrahimi[1,2] and Jenny List[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The International Linear Collider (ILC) is a future e^+e^- collider with center-of-mass energies of 200 to 500 GeV, upgradeable to 1 TeV. The aim of the ILC comprises precision measurements of known and possible new particles in the clean experimental conditions of a lepton collider.

A well established method to reach ultimate precision on the Higgs mass is to measure the recoil of the Higgs against a Z boson in $e^+e^- \to ZH$ with $Z \to \mu^+\mu^-$ at center-of-mass energy of 250 GeV. In order to reach the level of $10 - 20\,\text{MeV}$ precision, a substantial amount of running time (more than 5 years) needs to be spent at this rather low center-of-mass energy.

An important question is to understand whether this is the only method to reach this level of precision, or whether alternatives applicable at higher center-of-mass energies exist. Therefore, we investigate the potential of direct kinematic reconstruction of Higgs decays using the dominant hadronic decays of the Higgs bosons, in particular $H \to b\bar{b}$. The study is based on full simulation of one of the two proposed detectors for the ILC, the International Large Detector (ILD), at center-of-mass energies of 350 and 500 GeV.

T 67.6 Mi 18:00 VMP5 HS B1

Studien zur Suche nach tH-Ereignissen mit $H \to \gamma\gamma$ bei einer

Schwerpunktsenergie von 13 TeV mit dem ATLAS-Detektor — Johannes Erdmann, Claus Gössling, Kevin Kröninger und •Isabel Nitsche — TU Dortmund, Experimentelle Physik IV

Die elektroschwache Produktion eines einzelnen Top-Quarks, welches ein Higgs-Boson abstrahlt (tH), ermöglicht die direkte Messung der Yukawa-Kopplung Y_t des Top-Quarks. Das Higgs-Boson in tH-Ereignissen kann jedoch ebenfalls vom W-Boson in der t-Kanal Produktion abgestrahlt werden. Im Standardmodell (SM) interferieren diese beiden Prozesse destruktiv, weshalb tH-Produktion einen geringen Wirkungsquerschnitt besitzt. Diese Interferenz ermöglicht es jedoch, im Gegensatz zu anderen Prozessen, wie z.B. $t\bar{t}H$-Produktion, bei welcher ebenfalls eine direkte Messung von Y_t möglich ist, das relative Vorzeichen von Y_t zur Kopplung des Higgs-Bosons an das W-Boson zu messen. Bisherige Suchen hatten aufgrund der niedrigen Anzahl an erwarteten Ereignissen keine ausreichende Sensitivität zur Beobachtung von tH-Ereignissen.

Eine Analysestrategie für die Suche nach tH-Produktion bei einer Schwerpunktsenergie von 13 TeV wird für den $H \to \gamma\gamma$-Zerfallskanal präsentiert. Es wird eine leptonische und eine hadronische Ereignisselektion vorgestellt und die erwartete Sensitivität wird diskutiert. Desweiteren wird die erwartete Sensitivität für einen Prozess mit Physik jenseits des SM betrachtet, welcher den gleichen Endzustand wie tH-Produktion besitzt. Bei diesem Prozess handelt es sich um die Produktion eines einzelnen Vectorlike Quarks T mit $T \to tH$ und $H \to \gamma\gamma$.

T 67.7 Mi 18:15 VMP5 HS B1

Untersuchung der assoziierten Produktion von Higgs-Bosonen mit Einzel-Top-Quarks am CMS-Experiment — Thorsten Chwalek, •Simon Fink, Benedikt Maier und Thomas Müller — Institut für Experimentelle Kernphysik (IEKP), KIT

Das Top-Quark besitzt durch seine hohe Masse die stärkste im Standardmodell vorhergesagte Kopplung an das Higgs-Boson. Physik jenseits des Standardmodells wäre allerdings in der Lage diese deutlich zu beeinflussen.

In Ereignissen mit einem Einzel-Top-Quark und einem assoziiert produzierten Higgs-Boson würden sich Abweichungen von der vorhergesagten Kopplung durch einen Anstieg des Produktionswirkungsquerschnittes bemerkbar machen.

Einer bei einer niedrigeren Schwerpunktsenergie von 8 TeV durchgeführten Analyse war es bisher noch nicht möglich eine abschließende Aussage über die Natur der Top-Higgs-Yukawa-Kopplung zu liefern. In diesem Vortrag werden die Ergebnisse einer Kombination verschiedener Higgs-Boson-Zerfallskanäle bei 8 TeV in diesem seltenen Higgs-Boson-Produktionskanal präsentiert. Weiterhin wird zusätzlich ein erster Einblick in die Analyse eines in ein Bottom-Quark-Antiquark-Paar zerfallenden Higgs-Bosons bei 13 TeV gegeben.

T 67.8 Mi 18:30 VMP5 HS B1

Search for Higgs Boson Production in Final States with b-Quarks with the LHC Run II data — •Rostyslav Shevchenko — DESY, Hamburg, Germany

The discovery of a 125 GeV Higgs boson in July 2012 was a huge milestone for particle physics. While the properties of this particle agree with the predictions of the Standard Model at the current precision of measurements, it could well be only the first member of an extended Higgs sector. Different theoretical models, such as Supersymmetry and Compositeness, require additional Higgs bosons. This work focuses on the search for such Higgs bosons in final states with b-quarks, corresponding to the strongest decay channel in minimal supersymmetric extension of the SM (MSSM) within the allowed parameter space. The status of first studies with data of the CMS experiment collected at a center-of-mass energy of 13 TeV is presented.

T 67.9 Mi 18:45 VMP5 HS B1

Heavy Resonance Searches With Run 2 ATLAS-Data Using $H \to b\bar{b}$ Final States — •Elisabeth Schopf, Götz Gaycken, Stephan Hageböck, Ruth Jacobs, Vadim Kostyukhin, Tatjana Lenz, Eckhard von Toerne, and Norbert Wermes — Physikalisches Institut, Nussallee 12, 53115 Bonn

After an upgrade phase of two years the LHC restarted its operation in spring of 2015. In this Run 2 the protons have a collision energy of 13 TeV instead of 8 TeV in Run 1. This new energy regime allows for searches for so far undiscovered heavy particles. These heavy particles could decay into final states including the Higgs boson. The Higgs boson was successfully discovered by the ATLAS and CMS experiment in 2012 and may now be used as a tool for new physics searches.

This presentation will focus on heavy resonance searches using $H \to b\bar{b}$ final states. Since the Higgs decay into bottom quarks is the predominant decay channel of the Higgs boson it is a promising final state. I will introduce analysis techniques and multivariate methods that can be used to improve the sensitivity of the search. This presentation will also give an outlook for the standard model $H \to b\bar{b}$ search because a significant signal could not be established in Run 1 and will be probed again in Run 2.

T 68: Suche nach Supersymmetrie III (Hadronische, Tau, Photon Endzustände)

Zeit: Mittwoch 16:45–19:00 Raum: VMP5 HS B2

T 68.1 Mi 16:45 VMP5 HS B2

Search for supersymmetry in dileptonic final states with jets and missing transverse energy with the JZB method at CMS — Lutz Feld, Jan-Frederik Schulte, and •Marius Teroerde — I. Physikalisches Institut B, RWTH Aachen University

Supersymmetry (SUSY) is a popular extension of the Standard Model of particle physics, as it would solve a variety of problems in modern physics. In the model considered in the presented analysis, a possible final state contains jets as well as the stable lightest supersymmetric particle (LSP), which is produced together with a leptonically decaying Z boson. Thus, the signal is characterized by two same-flavour opposite-sign leptons, missing transverse energy (MET) and the presence of two or more jets.

An important background for this search is the Drell-Yan process with additional jets, as it has a similar event topology. In contrast to SUSY events, Drell-Yan events only contain instrumental MET. Therefore, the variable "jet-Z balance" (JZB), which takes the transverse momentum of the Z boson and the hadronic recoil into account, is distributed differently for Drell-Yan and SUSY events. This allows the definition of a signal depleted control region which is used to predict the Drell-Yan background.

The JZB method was successfully used in several analyses at $\sqrt{s} = 7-8\,\text{TeV}$. This talk shows the current progress towards its application on the dataset collected at $\sqrt{s} = 13\,\text{TeV}$.

T 68.2 Mi 17:00 VMP5 HS B2

Search for electroweak production of supersymmetric particles with photonic final states at CMS — Lutz Feld, •Johannes Lange, and Johannes Schulz — 1. Physikalisches Institut B, RWTH Aachen University

Supersymmetry (SUSY) is a prominent extension of the standard model of particle physics, providing possible solutions to the hierarchy problem, unification of the coupling constants and the existence of dark matter. In the context of gauge mediated SUSY breaking the next-to-lightest SUSY particle (NLSP) is the lightest neutralino, while the gravitino is the lightest SUSY particle. For a bino-like mixture, the NLSP predominantly decays to a photon and a gravitino, the latter leaving the detector undetected.

This analysis focuses on final states containing at least one photon, missing transverse energy and low hadronic activity, thus increasing the sensitivity to electroweak gaugino production and complementing searches requiring the presence of jets. The main background contributions are estimated using a template fit of the background simulations to the data in a control region.

The search has already been carried out using a special *parked data set* recorded by the CMS detector at $\sqrt{s} = 8\,\text{TeV}$ and an integrated luminosity of $7.4\,\text{fb}^{-1}$. We present the current status of the analysis for the LHC RunII at $\sqrt{s} = 13\,\text{TeV}$.

T 68.3 Mi 17:15 VMP5 HS B2

Search for physics beyond the Standard Model with photons, missing transverse energy and hadronic activity — Christian Autermann, Lutz Feld, and •Maximilian Knut Kiesel — 1. 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 via the strong interaction, the jets in the decay cascade lead to a large amount of hadronic activity.

This search uses data recorded with the CMS detector at a center-of-mass energy of 13˜TeV. At least one high energetic photon, hadronic activity and missing transverse energy are required. In this presentation, signal scenarios for physics beyond the Standard Model and data-driven background estimation methods are discussed.

T 68.4 Mi 17:30 VMP5 HS B2

Reconstruction and Identification of Boosted Tau Pair Topologies in ATLAS — •David Kirchmeier — IKTP, TU Dresden, Germany

Decays that involve a pair of tau leptons in the final state are important channels for the search for heavy resonances, which are predicted by theories that go beyond the Standard Model of particle physics. With the restart of LHC in 2015 higher energies and particle masses will be accessible for these processes. Thus, in particular the understanding of highly boosted tau pairs in the high energy region is essential for the search for new physics. With the current approach of tau reconstruction it is not possible to reconstruct di-tau topologies with low spatial separation, corresponding to a di-tau $p_{\mathrm{T}} \gtrsim 500\,\mathrm{GeV}$. A dedicated di-tau reconstruction algorithm has been developed, extending the accessible di-tau p_{T} up to 1200 GeV. Additionally, a multi-variate di-tau identification algorithm is under development which is able to suppress the background of QCD jets with high efficiency.

T 68.5 Mi 17:45 VMP5 HS B2

Performance of Different Searches for Supersymmetry with Tau Leptons at the ATLAS Experiment — Philip Bechtle, Klaus Desch, •Philipp König, Oliver Ricken, Steffen Schaepe, and Martin Schultens — University of Bonn

The Standard Model (SM) of particle physics is a successful approach to explain the building blocks of matter and the universe but still incomplete. Run-II of the Large Hadron Collider (LHC) is a bargain to discover physics beyond the SM. Supersymmetry (SUSY) is one of the most promising models of physics beyond the SM amongst many others.

The search for tau leptons in the final state is very interesting, since their heavy mass makes their SUSY partners preferred particles in the decay chain. In addition, only a few SM processes can produce multiple tau leptons and large missing transverse energy in the final state. While in Run-I the search for SUSY was mainly focussed on mechanisms for soft supersymmetry breaking such as GMSB, the search in Run-II is aiming for Simplified Model Spectra (SMS).

In this talk the motivation and performance of different analyses with two or more tau leptons in the final state with the ATLAS detector will be presented. Aspects like acceptance and efficiency, particularly for the SMS, will be addressed. The presented analyses will be compared and strengths of each analysis will be stressed as well as any differences. The parametrization of the SMS will be tested for the dependence of the efficiency on intrinsic mass relations, to suggest possible extensions of the SMS.

T 68.6 Mi 18:00 VMP5 HS B2

Messungen der Trigger-Effizienzen mit dem ATLAS-Detektor für Suche nach Supersymmetrie in Ereignissen mit Tau-Leptonen im Endzustand — Federica Legger und •Marina Steimle — Ludwig-Maximilians-Universität München

Die elektroschwache Produktion von supersymmetrischen Teilchen ist ein vielversprechender Kandidat für die Entdeckung von Supersymmetrie am LHC.

In der hier vorgestellten Analyse wird ein sogenanntes Simplified Model angenommen, bei dem die leichtesten Charginos und die zweitleichtesten Neutralinos elektroschwach produziert werden. Diese zerfallen über ein Stau oder Tau-Sneutrino in das leichteste Neutralino, welches zugleich auch das leichteste supersymmetrische Teilchen ist und somit stabil. Zusätzlich dazu entstehen mindestens zwei Tau-Leptonen, die unterschiedlich geladen sind. Um derartige Ereignisse zu selektieren, wird ein Trigger, der zwei hadronisch zerfallende Taus pro Ereignis fordert, verwendet.

In diesem Vortrag geht es im besonderen darum, die Effizienz dieses Triggers für die in 2015 mit dem ATLAS-Detektor aufgenommen Daten von Proton-Proton-Kollisionen zu messen. Dazu wird die Trigger-Effizienz in Daten mit einer Tag-and-Probe-Methode bestimmt und das Ergebnis mit Monte-Carlo-Simulationen verglichen.

T 68.7 Mi 18:15 VMP5 HS B2

Latest Developments in the Search for Supersymmetry with Tau Leptons at the ATLAS Experiment — Philip Bechtle, Klaus Desch, Philipp König, •Oliver Ricken, Steffen Schaepe, and Martin Schultens — University of Bonn

The upgraded Large Hadron Collider (LHC) and ATLAS experiment provide a new and unique discovery potential for physics beyond the Standardmodel (SM). One of the most promising extensions to the successful yet incomplete SM is Supersymmetry (SUSY).
While in proton-proton collisions production through the strong interaction is favoured, it is due to the nature of SUSY itself that tau leptons and their distinct detector signatures are expected to be rather abundant. These two aspects make up the foundation and motivation of this new physics search.
This talk addresses the ongoing searches for hadronic di-tau final states in different models of SUSY as pursued by the ATLAS collaboration. In contrast to the Run-I analyses this study focuses on Simplified Models (SMS) of SUSY. After introducing the SMS searched for, the analysis strategy and design are presented. Finally, the expected sensitivity in this first 13 TeV analysis is shown and discussed.

T 68.8 Mi 18:30 VMP5 HS B2

Suche nach skalaren Quarks im Endzustand mit Jets und fehlender Transversalenergie mit dem ATLAS-Experiment — Katharina Bierwagen, Volker Büscher, •Katharina Jakobi, Manuel Lornatus, Jan Schäffer, Andreas Reiss und Pedro Urrejola — Universität Mainz

Der Nachweis neuer Physik jenseits des Standardmodells ist eines der wichtigsten Ziele des ATLAS-Experiments am Large Hadron Collider am CERN. Die in diesem Vortrag präsentierte Analyse wurde für die Suche nach supersymmetrischen Quarks $\tilde{q}$, die in ein Quark q und ein Neutralino $\tilde{\chi}_1^0$ zerfallen, $\tilde{q} \to q + \tilde{\chi}_1^0$, für verschiedene Quarkflavour entwickelt, beispielsweise für $\tilde{t} \to c + \tilde{\chi}_1^0$ oder $\tilde{b} \to b + \tilde{\chi}_1^0$. Bei einem Endzustand mit zwei Quark-Jets und fehlender Transversalenergie stellt der hohe hadronische Untergrund eine Herausforderung dar. Zur Extraktion des Signals werden die Unterschiede in den Formen der Verteilungen von Signal und Untergrund in verschiedenen diskriminierenden Variablen ausgenutzt. Da die Analyse eine möglichst lockere Selektion verwendet, ist sie vergleichsweise modellunabhängig und komplementär zu bereits existierenden Analysen. Durch die Betrachtung von Systemen mit hoch-energetischen Abstrahlungen im Anfangszustand liegt der Schwerpunkt auf Modellen mit kleinem Δm zwischen $\tilde{q}$ und $\tilde{\chi}_1^0$. Der aktuelle Stand dieser Analyse mit dem Datensatz von 2015 und einer Schwerpunktsenergie von 13 TeV wird in diesem Vortrag vorgestellt.

T 68.9 Mi 18:45 VMP5 HS B2

ATLAS SUSY Search in 0-Lepton Channel — •Manfredi Ronzani — Albert-Ludwigs-Universität Freiburg, Germany

Many extensions of the Standard Model (SM) include heavy coloured particles, such as the squarks and gluinos of supersymmetric (SUSY) theories, which could be accessible at the Large Hadron Collider (LHC) and detected by ATLAS. Large number of R-parity-conserving models predict squarks and gluinos produced in pairs and decaying through $\tilde{q} \to q\tilde{\chi}_1^0$ and $\tilde{g} \to q\bar{q}\tilde{\chi}_1^0$, or via intermediate production of charginos as $\tilde{q} \to q\tilde{\chi}^{\pm}$ and $\tilde{g} \to q\bar{q}\tilde{\chi}^{\pm}$, with subsequent chargino decay to $W^{\pm}\tilde{\chi}_1^0$. The neutralino $\tilde{\chi}_1^0$ is assumed to be the Lightest Supersimmetric Particle (LSP) and escape undetected, resulting in large missing transverse momentum which, in addition to the jets resulting from the quark decays, form the final states investigated in the 0-Lepton SUSY analysis.

This talk presents the latest results of the ATLAS 0-Lepton SUSY analysis using data recorded in 2015 by the ATLAS experiment in $\sqrt{s}$ =13 TeV proton-proton collision during the LHC Run2.

T 69: Neutrinomasse III

Zeit: Mittwoch 16:45–19:05 Raum: VMP5 SR 0079

Gruppenbericht T 69.1 Mi 16:45 VMP5 SR 0079

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

The **E**lectron **C**apture ^{163}**Ho** experiment, **ECHo**, has the goal to probe the electron neutrino mass on a sub-eV level via the analysis of the calorimetrically measured **e**lectron **c**apture spectrum (**EC**) of ^{163}Ho.

For this metallic magnetic calorimeters will be used. The performance achieved by a first prototype of MMC with embedded ^{163}Ho already shows that the desired values of an energy resolution of $\Delta E_{FWHM} <$ 3 eV and a signal risetime of $\tau < 1$ μs for ECHo can be reached.

Recently the energy available for the decay $Q_{EC} = 2833(30_{stat})(15_{sys})$ eV/c^2 has been precisely determind by ECHo. Given this Q_{EC}-value we expect a sensitivity on the electron neutrino mass below 10 eV in the first phase of the ECHo experiment, ECHo-1k. In this phase a high purity ^{163}Ho source with a total activity of 1 kBq will be measured by about 100 detectors operated in a dedicated cryogenic platform in a reduced background environment. The results from this experiment will define parameters to scale the experiment to the next phase of ECHo-1M. There the total activity of the source will be 1 MBq and it will be measured by using 10^5 detectors. We present the current status of the ECHo experiment.

T 69.2 Mi 17:05 VMP5 SR 0079

The thermal properties of the windowless gaseous tritium source of the KATRIN experiment. — •Moritz Hackenjos for the KATRIN-Collaboration — Institut für Technische Physik KIT

The Karlsruhe Tritium Neutrino (KATRIN) Experiment aims to determine the neutrino mass with an unreached sensitivity of 200 meV/c^2 (90% C.L.) by the investigation of the endpoint energy-region of the tritium β-spectrum in a direct and model-independent way. Molecular Tritium gas with purity 95% is injected continuously in the center of the Windowless Gaseous Tritium Source (WGTS) of KATRIN and pumped off at both ends. The beta electrons are guided by a strong magnetic field to the spectrometers and are analyzed there energetically.

The statistical and systematic uncertainties of the $m_{\overline{\nu}_e}$ measurement are closely related to the thermal and gas dynamic performance and stability of this source. In order to keep the source pressure profile stable at 0.1% level, injection pressure and temperature of the beam tube need to be stabilized. The beam tube itself will be operated at 30 K to reduce systematic uncertainties like Doppler Effect.

To restrict systematic effects the thermal homogeneity and stability fluctuations therefore have to be lower than 30 mK. This talk will provide an insight of the thermal and gas dynamic properties of the WGTS with a construction overview and planed commissioning measurements.

T 69.3 Mi 17:20 VMP5 SR 0079

Simulation of differential electron spectra in the KATRIN WGTS — •Norman Haussmann for the KATRIN-Collaboration — Bergische Universität Wuppertal

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

In order to extract the neutrino mass the Windowless Gaseous Tritium Source (WGTS) properties of KATRIN need to be known to a high precision. For this reason several monitoring systems are installed. One of them, situated in the transport section, is the Forward Beam Monitor (FBM). The FBM is capable of recording the electron rate (10^6 e/s · mm^2) and the differential electron spectra with a high energy resolution and precision.

The electrons in the WGTS 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.

Changes in the column density are expected to have a great influence on lower energetic electrons and thereby change the spectrum and count rate at the FBM-detector. Monte-Carlo simulations have been performed to understand the influences of varying column densities and temperature fluctuations on the expected count rate and spectra by tracking the emitted electrons. The results will be shown in this talk.

T 69.4 Mi 17:35 VMP5 SR 0079

Tritium source-related systematic uncertainties of the KATRIN experiment — •Hendrik Seitz-Moskaliuk for the KATRIN-Collaboration — Karlsruher Institut für Technologie, Institut für experimentelle Kernphysik, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

KATRIN will perform a direct, kinematics-based measurement of the neutrino mass with a sensitivity of 200 meV (90 % C. L.) reached after 3 years of measurement time. The neutrino mass is obtained by determining the shape of the spectrum of tritium β decay electrons close to the endpoint of 18.6 keV with a spectrometer of MAC-E filter type. To achieve the planned sensitivity, the systematic measurement uncertainties have to be carefully controlled and evaluated. Main sources of systematics are the MAC-E filter on the one hand and the source and transport section (STS) on the other hand. Most of the operational parameters of KATRIN have to be stable at or even below the per mille level and have to meet further strict requirements.

This talk will review the KATRIN systematics with a special focus on the STS. Early commissioning measurements to determine the main systematics will be introduced.

This work is supported by BMBF (05A14VK2) and the Helmholtz Association.

T 69.5 Mi 17:50 VMP5 SR 0079

Stability measurements of the electron gun for the KATRIN Rear Section — •Sylvia Ebenhöch for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The aim of the KArlsruhe TRItium Neutrino (KATRIN) experiment is to determine the antineutrino mass with a sensitivity of 0.2 eV (90 % C.L.) by high-precision spectroscopy close to the tritium beta decay endpoint at 18.6 keV. To achieve the sensitivity aim both statistical and systematic uncertainties must be minimized. One contribution to the systematic error are uncertainties in the column density of the tritium source or in the source activity. In order to detect and monitor changes in the tritium source the Rear Section, which is integrated at the rear end of the KATRIN setup, is used. The Rear Section includes an angular selective electron gun (e-gun) based on the photoelectric effect. With the e-gun it will be possible e.g. to achieve a precise calibration of the column source density. To achieve the requirements on the e-gun a stable UV light source is essential to produce photoelectrons. The presentation will focus on the setup of the e-gun and intensity stability measurements of the UV light source setup.

T 69.6 Mi 18:05 VMP5 SR 0079

Krypton mode of the Windowless Gaseous Tritium Source of the KATRIN Experiment — •Moritz Machatschek for the KATRIN-Collaboration — KIT-IEKP, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Deutschland

The KArlsruhe TRItium Neutrino experiment, currently in its final construction & commissioning phase will perform a kinematic measurement of the neutrino mass, by precision spectroscopy of tritium beta decay at the endpoint of 18.6 keV. To reach the planned sensitivity of 200 meV (90 % C. L.) a precise knowledge of the systematic measurement uncertainties of the experiment is crucial.

Several important systematics arise in the 10 m long source containing the gaseous tritium, for instance related to the low density plasma generated by the beta decay. Together with the rear wall closing off the beam tube this defines an inhomogeneous potential, which has to be known to a level of 10 mV. One way to analyze it is gaseous, excited krypton ^{83m}Kr. The krypton will be added to the tritium with a low concentration of $<10^{-4}$, which will not affect the normal tritium gas profile. ^{83m}Kr deexcites by internal conversion, exhibiting several lines with mono energetic electrons at 18 keV and around 31 keV. When measured by the KATRIN main spectrometer, the shape and position of these lines will carry information on the plasma potential distribution. In this talk an overview of the simulation and modelling of the krypton mode as well as the experimental implications for KATRIN will be given.

Supported by BMBF (05A14VK2) and by the Helmholtz Association

T 69.7 Mi 18:20 VMP5 SR 0079

Work function studies of gold surfaces with a Kelvin Probe for the Rear Section of the KATRIN experiment — •Kerstin Schönung for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The KArlsruhe TRItium Neutrino-Experiment KATRIN will perform a model-independent measurement of the antineutrino mass by the examination of the beta electron energy spectrum of a gaseous molecular tritium source. To achieve the desired sensitivity of $0.2\,\mathrm{eV/c^2}$ (90 % CL) the plasma potential of the tritium gas must be temporally and spatially stable within 20 meV. Therefore, the work function of the so called Rear Wall which probably defines the plasma potential must be known even more precisely and the temporal changes must be investigated.

A common instrument to measure the work function of a surface with a precision of a few meV is a Kelvin Probe. Such a system was built up at the Tritium Laboratory Karlsruhe. In the talk the working principle of a Kelvin Probe and the setup will be presented. In addition first work function measurements of Rear Wall candidates will be discussed.

T 69.8 Mi 18:35 VMP5 SR 0079

Ions in the KATRIN experiment — •Ferenc Glück for the KATRIN-Collaboration — Karlsruhe, KIT, Campus Nord

The aim of the KATRIN experiment is to determine the absolute neutrino mass scale in a model independent way, by measuring the electron energy spectrum shape near the endpoint of tritium beta decay. Beta decays and ionizations produce about $2 \cdot 10^{12}$ $\mathrm{s^{-1}}$ tritium ion rate in the KATRIN source. About 10 % and 1 % of that rate is the expected flux of positive tritium ions and $\mathrm{T^-}$ ions leaving the source in detector direction. The positive tritium ions are not affected by the pumping system, and, when unhindered, they would cause an extremely large background and tritium contamination in the spectrometers. They will be blocked in the transport system by positive potential electrodes and will be removed from the flux tube by dipole electrodes. The ion composition and the ion blocking and removal efficiency will be tested by an FT-ICR trap, a Faraday cup and the KATRIN pre- and main spectrometers and FPD, using both a photoelectron induced deuterium plasma and the tritium beta decay plasma.

This work has been supported by the German BMBF (05A14VK2).

T 69.9 Mi 18:50 VMP5 SR 0079

A Pre-KATRIN search for keV-scale sterile neutrinos — •Anton Huber[1], Susanne Mertens[2,1], and Thierry Lasserre[3] for the KATRIN-Collaboration — [1]Karlsruher Institut für Technologie, Karlsruhe — [2]Lawrence Berkeley National Laboratory, USA — [3]Commissariat à l'énergie atomique, France

Sterile neutrinos in the keV-mass range 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 kink-like signature and distortion. The KATRIN experiment, which is commissioned at the moment, is designed to determine the absolute neutrinos mass by measuring the beta-decay spectrum of gaseous tritium close to its endpoint. Beyond that, the many outstanding features of the experiment 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 Pre-KATRIN 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 set a new world best limit on laboratory search for keV-scale sterile neutrinos. This work presents the expected sensitivity, important systematic effects and the experimental realization of this experiment.

We like to remark, that this work has been supported by the German BMBF (05A14VK2), by the Ministry of Science, Research and the Arts, Baden- Wuerttemberg (MWK), by the CEA and the Deutschlandstipendium (BMBF and SAP SE).

T 70: Kalorimeter II

Zeit: Mittwoch 16:45–18:30 Raum: VMP6 HS E

T 70.1 Mi 16:45 VMP6 HS E

Vergleich von hoch-granularen hadronischen Kalorimeter-Konzepten — •Coralie Neubüser für die CALICE-D-Kollaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Innerhalb der CALICE (Calorimeter for International Linear Collider) Kollaboration werden verschiedene Kalorimeter-Konzepte, optimiert für Particle Flow Algorithmen, für einen zukünftigen $\mathrm{e^+e^-}$ Linearbeschleuniger getestet. Zwei der hadronischen Kalorimeter Konzepte, das auf Widerstandsplattenkammern (RPCs) basierende digitale hadronische Kalorimeter DHCAL mit einer Granularität von $(1\mathrm{x}1)\,\mathrm{cm^2}$ und digitaler Datenauslese, sowie das analoge hadronische Kalorimeter AHCAL welches Plastik-Szintillatoren analog mit einer Granularität von $(3\mathrm{x}3)\,\mathrm{cm^2}$ ausliest, werden hier vorgestellt. Energierekonstruktions-Methoden und Gewichtungs-Prozeduren werden anhand aufgenommener Teststrahl-Daten der Prototypen verglichen und deren Kalibration und Energieauflösung analysiert. Die Ergebnisse und das Verständnis der Technologien werden mit GEANT4 Simulationen untermauert.

T 70.2 Mi 17:00 VMP6 HS E

Studies towards optimisation of the Analog Hadronic Calorimeter for future linear collider detectors — •Huong Lan Tran for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg

The Analog Hadronic Calorimeter (AHCAL) is a highly granular calorimeter developed in the CALICE collaboration for future linear collider detectors. Its design concept is based on $3{\times}3$ cm^2 scintillator tiles readout by Silicon Photomultipliers (SiPM). With this design the ambitious required jet energy resolution of 3-4 % can be achieved using the Pandora Particle Flow Algorithm (PandoraPFA). Recent discussions concerning the overall size and cost of the ILD detector has triggered new studies to optimise AHCAL cell size. A smaller number of cells can reduce the detector cost but the corresponding larger cell size can lead to a degradation of the jet energy resolution. The AHCAL optimisation study therefore has to achieve the best balance between physics performance and cost.

Recent studies using the latest version of PandoraPFA with improved pattern recognition have shown significant improvement of jet energy resolution. Moreover, a better energy reconstruction of single particles, in which software compensation plays an important role, can lead to further improvements. This talk will discuss the software compensation technique and its impact on the final cell size optimisation.

T 70.3 Mi 17:15 VMP6 HS E

The Time Structure of Hadronic Showers in Calorimeters with Gas and Scintillator Readout — •Philipp Goecke for the CALICE-D-Collaboration — Max-Planck-Institut für Physik , Munich, Germany

The focus of the CALICE collaboration is R&D of highly granular calorimeters. One of the possible applications is in a future TeV-scale linear e^+e^- collider for precision SM studies and for direct and indirect the search of new physics. For the hadronic sampling calorimeters subsystem, several absorbers and active material technologies are being investigated.

In this frame, two similar experiments have been conducted to study the time structure of hadronic showers: FastRPC uses resistive plate chambers technology for the active layers whereas T3B is based on scintillating tiles coupled to SiPMs. The high sampling frequency of the readout, coupled to deep memory buffers, allows to carefully investigate the intrinsic time structure of hadronic showers with its prompt and delayed components. This study presents a detailed GEANT4 Montecarlo simulation of the FastRPC and T3B setups. It is aimed to reproduce test beam data acquired at CERN SPS where the setups were installed after 5λ of instrumented tungsten-based calorimeter prototypes. The main focus of the simulation lies on the physical processes involved in the time development of an hadronic showers, to asses the discrepancy that emerged in data for the two setups in the intermediate time range of 10 - 50 ns of shower development that can

be explained with the neutron interactions in the medium.

T 70.4 Mi 17:30 VMP6 HS E

Timing measurement in the CALICE AHCAL. — •Eldwan Brianne for the CALICE-D-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The CALICE Collaboration is developing highly granular calorimeters for a future e^+e^- linear collider. The development of the calorimeters is driven by the Particle Flow (PFA) concept in order to achieve a jet energy resolution of 3-4 %. The Analog Hadronic Calorimeter (AHCAL) is one of the detector concepts based on 3x3 cm^2 scintillating tiles read out by Silicon Photomultipliers and processed by an ASIC (SPIROC2B) capable to measure timing.
A second generation engineering prototype of the AHCAL is developed to focus on the full scalabilty of the detector and features, in addition to amplitude measurements, timing measurements at a single cell level. It was tested at the CERN SPS in summer 2015 with two different absorber materials, steel and tungsten, in muon, electron and hadron beams. This talk will focus on the timing capabilities of the AHCAL prototype and the possible influence on PFA reconstruction.

T 70.5 Mi 17:45 VMP6 HS E

Calibration of the hadronic calorimeter prototype for a future lepton collider — •Sarah Schröder und Erika Garutti für die CALICE-D-Kollaboration — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

The CALICE AHCAL technological prototype is a hadronic calorimeter prototype for a future e^+e^- - collider. It is designed as a sampling calorimeter alternating steel absorber plates and active readout layers, segmented in single plastic scintillator tiles of $3 \times 3 \times 0.3\,cm^3$ volume. Each tile is individually coupled to a silicon photomultiplier, read out by a dedicated ASIC with energy measurement and time stamping capability. The high granularity is meant to enable imaging and separation of single showers, for a Particle Flow approach to the jet energy measurement. The prototype aims to establish a scalable solution for an ILC detector. A total of 3456 calorimeter cells need to be inter-calibrated, for this the response to muons is used. The calibration procedure will be presented and the statistic and systematic uncertainties will be discussed, which have a direct impact on the constant term of the calorimeter energy resolution.

Additionally, the MIP yield in number of fired SiPM pixels can be compared between the muon calibration and a test bench calibrations obtained using a Sr source on the single tiles before the assembly of the calorimeter. A good correlation would enable pre-calibation of the single channels on the test bench to be portable to the assemble detector. This hypothesis is checked with the present work.

T 70.6 Mi 18:00 VMP6 HS E

Energy Corrections from Dijet balance at CMS at 13TeV — •Nataliia Kovalchuk, Marc Stoever, Hartmut Stadie, and Peter Schleper — Universität Hamburg, Institut für Experimentalphysik (Hamburg)

This contribution describes the jet energy correction used by the CMS experiment at the Large Hadron Collider (LHC). Due to colour-confinement, high-energy quarks and gluons emerging from hard interactions undergo hadronisation and lead to the formation of hadronic jets. In order to use hadron jets as probe of a hard process, it is crucial to measure precisely the jet energy. A factorised approach is used to correct reconstructed jets for detector effects. In particular the pseudo-rapidity dependence of the jet energy response is removed. This study uses pp collision data at center-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 2.11/fb.

T 70.7 Mi 18:15 VMP6 HS E

NA62 Hadronic calorimeters performance in 2015 data taking — •Letizia Peruzzo for the NA62-Collaboration — Institut für Physik JGU Mainz

In June 2015 the NA62 experiment at CERN began its physics data taking with the aim to collect in three years around 100 $K^+ \to \pi^+\nu\bar{\nu}$ events and measure the branching ratio with a precision about 10%. Well predicted inside the Standard Model, $Br(K^+ \to \pi^+\nu\bar{\nu}) = (9.11 \pm 0.72) \cdot 10^{-11}$, this decay is closely related to the CKM matrix elements $|V_{td}|$ and $|V_{ts}|$ and any deviation from the theoretical Br could open many scenarios of physics beyond the Standard Model. Only 7 candidates with large background were detected by a previous experiment at BNL. For this reason the NA62 experiment will reduce the background coming from the main K^+ decays as much as possible. In particular the misidentification of μ^+ as π^+ needs to be minimized. The NA62 hadronic calorimeters, called *Muon Veto1&2*, have then a double task: suppressing those decays with muons in the final state at trigger level and taking part in the full particle identification system. This talk describes and presents the results from the *MUV1&2* detectors in the 2015 NA62 data taking.

T 71: Flavour-Physik und CP-Verletzung im D- und K-System

Zeit: Mittwoch 16:45–19:00 Raum: VMP6 HS F

T 71.1 Mi 16:45 VMP6 HS F

Techniques for studies of unbinned model independent CP violation — •Nicholas Bedford, Constantin Weisser, Chris Parkes, Marco Gersabeck, Jolanta Brodzicka, and Shanzhen Chen — University of Manchester, UK

Charge-Parity (CP) violation is a known part of the Standard Model and has been observed and measured in both the B and K meson systems. The observed levels, however, are insufficient to explain the observed matter-antimatter asymmetry in the Universe, and so other sources need to be found. One area of current investigation is the D meson system, where predicted levels of CP violation are much lower than in the B and K meson systems. This means that more sensitive methods are required when searching for CP violation in this system. Several unbinned model independent methods have been proposed for this purpose, all of which need to be optimised and their sensitivities compared.

T 71.2 Mi 17:00 VMP6 HS F

Messung der zeitintegrierten CP-Asymmetrie im Zerfall $D^0 \to K^-K^+$ mit dem LHCb-Experiment — Evelina Gersabeck, •Simon Stemmle und Ulrich Uwer — Physikalisches Institut Heidelberg

CP-Verletzung ist in D-Meson Zerfällen im Standardmodell stark unterdückt. Deshalb sind diese Systeme sehr sensitiv auf Beiträge von Phänomenen jenseits des Standardmodells. Es wird eine Messung der zeitintegrierten CP-Asymmetrie in dem Cabibbo-unterdrückten Zerfall $D^0 \to K^-K^+$ vorgestellt. Diese Größe kann sowohl Anteile an direkter als auch an indirekter CP-Verletzung aufweisen. Der komplette Proton-Proton Run I Datensatz des LHCb-Experiments, welcher einen integrierten Luminosität von $3\,fb^{-1}$ entspricht, wird verwendet. Hierbei werden D^0 Mesonen selektiert, die aus den Zerfällen $D^{*+} \to D^0\pi^+$ und $D^{*-} \to \bar{D}^0\pi^-$ stammen. Der anfängliche Flavour des D^0 Mesons ist durch die Ladung des Pions bestimmt. Um die zusätzliche Produktions- und Detektionsasymmetrie des D^{*+} Mesons und des Pions zu berücksichtigen, werden drei Cabibbo-bevorzugte D-Meson-Zerfälle als Kalibrationskanäle verwendet. Der erhaltene Wert für die CP Asymmetrie stimmt mit der Hypothese keiner CP-Verletzung überein und liefert daher keinen Hinweis auf Physik jenseits des Standardmodells.

T 71.3 Mi 17:15 VMP6 HS F

Amplituden-Analyse des Zerfalls $D^0 \to \pi^-\pi^+\pi^+\pi^-$ — •Philippe d'Argent für die LHCb-Kollaboration — Physikalisches Institut Heidelberg

Die präzise Messung des Winkels γ im Unitaritätsdreieck gehört zu den primären Zielen bei der Untersuchung der CP-Verletzung in den Zerfällen von Charm- und Beauty-Mesonen. Eine vielversprechende Methode besteht darin, die Interferenz zwischen den Zerfallskanälen $B^+ \to D^0K^+$ und $B^+ \to \overline{D^0}K^+$ auszunutzen, wobei das D^0 Meson und dessen Antiteilchen in einen gemeinsamen Endzustand weiterzerfallen, wie zum Beispiel $\pi^-\pi^+\pi^+\pi^-$. Dies erfordert ein umfassendes Verständnis der auftretenden Resonanzstruktur.

In diesem Vortrag wird deshalb die Amplituden Analyse von $D^0 \to$

$\pi^-\pi^+\pi^+\pi^-$ Zerfällen mit Daten des CLEO-c Experiments vorgestellt. Dabei wird die gesamte Information des fünfdimensionalen Phasenraums ausgeschöpft, um die zahlreichen verschiedenen Zwischenzustände zu trennen. Da diese unterschiedlichen Zerfallswege interferieren, ist es notwendig sowohl die relativen Amplituden als auch die relativen Phasen der einzelnen Beiträge zu bestimmen. Zusätzlich wird die Masse und die Zerfallsbreite der $a_1(1260)^+$ Resonanz gemessen, welche der dominierende Zwischenzustand ist.

T 71.4 Mi 17:30 VMP6 HS F

Dalitz Plot Analysis of $D^{\pm}_{(s)} \to K^+K^-\pi^\pm$ — •Andreas Hönle, Daniel Greenwald, Johannes Rauch, and Dmytro Levit — TU München

Singly Cabibbo suppressed (SCS) and doubly Cabibbo suppressed (DCS) decays of charm mesons play an important role in studies of charmed hadron dynamics. The naive expectations for the rates of SCS and DCS decays are of the order of $\tan 2\theta_C$ and $\tan 4\theta_C$, respectively, where θ_C is the Cabibbo mixing angle.

Recent studies of such decays suffered from limited statistics and can be updated in the current era of large data sets provided *e.g.* by the Belle experiment.

We will present the current status of $D^{\pm}_{(s)} \to K^+K^-\pi^\pm$.

Preliminary results of a boosted decision tree-based event selection and a Dalitz plot analysis will be shown.

T 71.5 Mi 17:45 VMP6 HS F

Study of $D^0 \to \pi^+\pi^-\pi^+\pi^-$ at Belle — •Johannes Rauch, Daniel Greenwald, Dmytro Levit, and Andreas Hönle — Technische Universität München, Physik Department E18

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 71.6 Mi 18:00 VMP6 HS F

Measurement of the mixing parameters of neutral charm mesons and search for indirect *CP* violation with $D^0 \to K^0_S\pi^+\pi^-$ decays at LHCb — •Stefanie Reichert and Johannes Albrecht — Technische Universität Dortmund

The hadronic decay $D^0 \to K^0_S\pi^+\pi^-$ provides direct access to the measurement of the mixing parameters of the neutral charm meson system and allows to test for *CP* violation. In the neutral D meson system, the physical eigenstates $D_{1,2}$ are a linear superposition of the flavour eigenstates D^0 and $\overline{D}^0$ as $|D_{1,2}\rangle = p|D^0\rangle \pm q|\overline{D}^0\rangle$. A measurement of the mixing parameters $x \equiv (m_1 - m_2)/\Gamma$ and $y \equiv (\Gamma_1 - \Gamma_2)/(2\Gamma)$ as well as of the parameters $|q/p|$ and $\phi = ar(q,p)$, which govern indirect *CP* violation, will be performed based on a time-dependent amplitude-model analysis of the full LHCb dataset of 2011 and 2012, corresponding to an integrated luminosity of $3\,\mathrm{fb}^{-1}$. The decay mode $D^0 \to K^0_S\pi^+\pi^-$ is accessible via D^* decays produced directly in the *pp* collisions as well as via semileptonic B decays. Through a combined fit of both data sets, the measurement will be sensitive at all D^0 decay times. The status of the analysis will be presented.

T 71.7 Mi 18:15 VMP6 HS F

Measurement of the Form Factors in the Decay Channel $K^+ \to \pi^0 e^+ \nu_e$ — •David Lomidze — Uni Mainz

Within the Standard Model, semileptonic kaon decays can provide the experimentally most accurate and theoretically cleanest way for determination of the element $|V_{us}|$ of the CKM matrix. To do this, a precise knowledge of the form factors in $K^+ \to \pi^0 e^+ \nu_e$ (K_{e3}) decays is crucial.

The NA62 experiment at CERN collected huge sample of K_{e3} decays during a dedicated physics run in 2007 for the measurement of the ratio $R_K = \Gamma(K^+ \to e^+\nu_e)/\Gamma(K^+ \to \mu^+\nu_\mu)$. With these statistics, a determination of the form factors with high precision is possible. This talk reports preliminary measurements of the form factors of the semileptonic decay $K^+ \to \pi^0 e^+ \nu_e$, based on 50 million Ke3 events with negligible background and smallest statistical and systematic errors.

T 71.8 Mi 18:30 VMP6 HS F

Analyse des $\Lambda_b^0 \to \Lambda^0 p\bar{p}$-Zerfalls anhand der LHC*b*-Daten — •Robert Zillmer für die LHCb-Kollaboration — Universität Rostock

Die Studie des $\Lambda_b^0 \to \Lambda^0 p\bar{p}$-Zerfalls mit $\Lambda^0 \to p\pi^-$ verwendet die Daten des LHC*b*-Experiments der Jahre 2011 und 2012 bei einer integrierten Luminosität von $3{,}19\,\mathrm{fb}^{-1}$. Mit der Selektion über einen Boosted Decision Tree Algorithmus reduziert sich der Anteil fehlidentifizierter Zerfälle erheblich. Dadurch liefert der simultane Einzelwert-Fit der in Datennahmeperioden und Long-/Downstream-Tracks aufgeteilten Daten eine signifikante Zahl von Ereignissen des gesuchten Zerfalls. Es handelt sich somit um die erste Beobachtung eines baryonischen Dreikörperzerfalls des Λ_b-Baryons. Mit den Angaben der Effizienzen der Selektionsschritte liefert dieses Ergebnis weiterhin alle nötigen Informationen zur Bestimmung des Verzweigungsverhältnisses, sofern die Zahl der im Experiment produzierten Λ_b-Baryonen bekannt oder ein als Referenz geeigneter Zerfall gefunden wird.

T 71.9 Mi 18:45 VMP6 HS F

Precise measurement of semileptonic kaon decay rates with NA62 — •Mario Vormstein for the NA62-Collaboration — Institut für Physik, Johannes-Gutenberg Universität, Mainz, Germany

An important tool for exploring the limits of the Standard Model is the measurement of the unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) quark mixing matrix with a very high precision. One of the possible unitarity relations is $|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1$ whose uncertainty is dominated by the precision on $|V_{us}|$. The $|V_{us}|$ element is accessible by measuring the decay rate of semileptonic decays of the kaon ($K_{l3} = K^\pm \to \pi^0 l^\pm \nu$ with $l = e, \mu$). These decay rates can be determined both in experiment and in theory to a very high degree of accuracy. Secondly, a stringent constraint can be given on new physics by measuring the ratio $R = \frac{\Gamma(K_{\mu 3})}{\Gamma(K_{e3})}$, which is used to test the lepton universality.
The NA62 collaboration acquired data in 2007 at the CERN SPS. This talk will give an overview of the decay rate analysis of the collected data. The selection of signal decays, suppression of background decays, comparison between data and Monte Carlo simulation, and a preliminary result is discussed.

T 72: Halbleiterdetektoren IV (MAPS, CMOS)

Zeit: Mittwoch 16:45–19:05 Raum: VMP8 HS

Gruppenbericht T 72.1 Mi 16:45 VMP8 HS

A pixel tracker in HV-MAPS technology for the Mu3e experiment — •Heiko Augustin for the Mu3e-Collaboration — Physikalisches Institut Heidelberg

The Mu3e experiment is dedicated to search for the lepton flavour violating decay $\mu^+ \to e^+e^-e^+$ with an uprecedented 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 would be a clear sign for new physics.

The detector consists of a pixel tracker built from 50 μm thin High Voltage Monolithic Active Pixel Sensors (HV-MAPS), providing a very good vertex and momentum resolution of the decay electrons, and scintillating fibre and tile detectors for precise timing information.

In this talk, first characterisation results of the latest HV-MAPS prototype MuPix7 with a 1.25 Gbit/s serial data link are presented and an overview of the developments and the path to the pixel tracker is given.

T 72.2 Mi 17:05 VMP8 HS

Temperaturabhängigkeit von HV-MAPS am Beispiel des MuPix7 — •David Maximilian Immig für die Mu3e-Kollaboration — Physikalisches Institut Heidelberg

Das Mu3e Experiment sucht nach dem leptonzahlverletzenden Zerfall $\mu \to$ eee, der im Standardmodell mit einem Verzweigungsverhältnis von $< 10^{-54}$ stark unterdrückt ist. Das Ziel des Experiments ist es den Zerfall mit einer Sensitivität von mindestens 1 in 10^{16} zu vermessen, wobei

ein beobachtetes Signal ein eindeutiger Hinweis auf neue Physik wäre. Der Detektor besteht aus szintillierenden Faser- und Kacheldetektoren, die präzise Zeitinformatonen liefern, und einem Pixeldetektor in einem Magnetfeld von B = 1T. Letzterer hat hohe Impuls- und Vertex-Auflösung und besteht aus Hochspannung betriebenen monolithischen aktiven Pixelsensoren (HV-MAPS). Die Pixelsensoren werden durch Heliumgas gekühlt und in einem Temperaturbereich von 0°C bis 70°C betrieben.

Der MuPix7 Sensor ist der gegenwärtige HV-MAPS Prototyp mit integrierter, null-unterdrückender Ausleseelektronik in der Peripherie. In diesem Chip sind die Auslesesteuerung und die komplette Zeitmessung integriert. Erforderlich dafür ist ein Taktsignal (Clock), welches von einem spannungsgesteuerten Oszillator (VCO) generiert und über ein von außen gegebenes Referenzsignal mittels einer Phasenregelschleife (PLL) synchronisiert wird.

In diesem Vortrag werden die Komponenten des MuPix7 für den Takt, VCO und PLL, vorgestellt. Des Weiteren werden die Temperaturabhängigkeiten dieser Komponenten, sowie der Pulsform, präsentiert.

T 72.3 Mi 17:20 VMP8 HS

HV-MAPS Ergebnisse für Energieauflösung und Schwellenkalibration — •Jan Hammerich für die Mu3e-Kollaboration — Physikalisches Institut Heidelberg

Das Mu3e Experiment sucht nach dem geladenen-Lepton-Flavourverletzenden Zerfall $\mu \rightarrow eee$ mit einer geplanten Sensitivität von 1 in 10^{16} Zerfällen. Das Herzstück des Experiments ist ein Spurdetektor der den Impuls und die Vertexposition der Zerfallselektronen mit höchster Genauigkeit vermisst, um die Untergrundprozesse um 16 Größenordnungen zu unterdrücken. Der Detektor basiert auf dünnen, mit Hochspannung betriebenen monolithischen aktiven Pixelsensoren (HV-MAPS) und ist für präzise Vermessung der Spuren von niederenergetischen Elektronen optimiert.

HV-MAPS stellen ein neuartiges Konzept für Silizium-Pixelsensoren dar. Sie verfügen über eine schnelle Ladungssammlung, vollständig integrierte Ausleseelektronik und ein Null-unterdrücktes digitales Ausgangssignal.

In diesem Vortrag werden Messergebnisse von aktuellen HV-MAPS Prototypen im Bezug auf die Energieauflösung und Schwellenkalibration vorgestellt.

Der Komparatorpuls der Prototypen wurde für verschiedene Energien von Röntgenstrahlen gemessen. Außerdem werden Ergenisse für die Rauschunterdrückung durch individuelle Schwellenanpassung per Pixel vorgestellt.

T 72.4 Mi 17:35 VMP8 HS

Test beam results of a Depleted Monolithic Active Pixel Sensor (DMAPS) prototype — •Theresa Obermann[1], Tomasz Hemperek[1], Fabian Hügging[1], Hans Krüger[1], Benjamin Schwenker[2], and Norbert Wermes[1] for the ATLAS Pixel-Collaboration — [1]Nussallee 11, 53113 Bonn — [2]Friedrich-Hund-Platz 1, 37077 Göttingen

New monolithic detector concepts are currently being explored for future particle physics experiments, in particular for the upgrade of the ATLAS detector. Common to monolithic pixel detectors is the integration of the front-end circuitry and the sensor on the same silicon substrate. The DMAPS concept makes use of high resistive silicon as substrate. It enables the application of a high bias voltage to create a drift field for the charge collection in the sensor part as well as the full usage of CMOS logic in the same piece of silicon. DMAPS prototypes from several foundries are available since three years and have been extensively characterized in the lab. In this talk, results of test beam campaigns, with neutron irradiated prototypes implemented in the ESPROS process, will be presented.

T 72.5 Mi 17:50 VMP8 HS

A Monolithic Active Pixel Sensor for ionizing radiation using a 180 nm HV-SOI process — •Tomasz Hemperek, Tetsuichi Kishishita, Hans Krüger, and Norbert Wermes — Institute of Physics, University of Bonn, Bonn, Germany

An improved SOI-MAPS (Silicon On Insulator Monolithic Active Pixel Sensor) for ionizing radiation based on thick-?lm High Voltage SOI technology (HV-SOI) has been developed. Similar to existing Fully Depleted SOI-based (FD-SOI) MAPS, a buried silicon oxide interdielectric (BOX) layer is used to separate the CMOS electronics from the handle wafer which is used as a depleted charge collection layer. Standard FD-SOI MAPS suffer from radiation damage such as transistor threshold voltage shifts due to trapped charge in the buried oxide layer and charged interface states created at the silicon oxide boundaries (back gate effect). The X-FAB 180nm HV-SOI technology offers an additional isolation using a deep non-depleted implant between the BOX layer and the active circuitry which mitigates this problem. Therefore we see in this technology a high potential to implement radiation-tolerant MAPS with fast charge collection. The design and measurement results from first prototypes are presented including radiation tolerance to total ionizing dose and charge collection properties of neutron irradiated samples.

T 72.6 Mi 18:05 VMP8 HS

Characterization of Active CMOS Pixel Sensors on High Resistive Substrate — •Toko Hirono, Tomasz Hemperek, Fabian Hügging, Hans Krüger, Piotr Rymaszewski, and Norbert Wermes — Physikalisches Institut Universität Bonn, Bonn, Germany

Active CMOS pixel sensors are very attractive as radiation imaging pixel detector because they do not need cost-intensive fine pitch bump bonding. High radiation tolerance and time resolution are required to apply those sensors to upcoming particle physics experiments. To achieve these requirements, the active CMOS pixel sensors were developed on high resistive substrates. Signal charges are collected faster by drift in high resistive substrates than in standard low resistive substrates yielding also a higher radiation tolerance.

A prototype of the active CMOS pixel sensor has been fabricated in the LFoundry 150 nm CMOS process on 2k Ωcm substrate. This prototype chip was thinned down to 300 μm and the backside has been processed and can contacted by an aluminum contact. The breakdown voltage is around -115 V, and the depletion width has been measured to be as large as 180 μm at a bias voltage of -110 V. Gain and noise of the readout circuitry agree with the designed values. Performance tests in the lab and test beam have been done before and after irradiation with X-rays and neutrons. In this presentation, the measurement results of the active CMOS prototype sensors will be shown.

T 72.7 Mi 18:20 VMP8 HS

Characterization and radiation studies of diode test structures in LFoundry CMOS technology — •Michael Daas[1], Laura Gonella[1], Tomasz Hemperek[1], Fabian Hügging[1], Hans Krüger[1], Anna Macchiolo[2], David-Leon Pohl[1], and Norbert Wermes[1] — [1]Physikalisches Institut der Universität Bonn — [2]Max-Planck-Institut für Physik in München

In order to prepare for the High Luminosity upgrade of the LHC, all subdetector systems of the ATLAS experiment will be upgraded. In preparation for this process, different possibilities for new radiation-hard and cost-efficient silicon sensor technologies to be used as part of hybrid pixel detectors in the ATLAS inner tracker are being investigated.

One promising way to optimize the cost-efficiency of silicon-based pixel detectors is to use commercially available CMOS technologies such as the 150 nm process by LFoundry.

In this talk, several CMOS pixel test structures, such as simple diodes and small pixel arrays, that were manufactured in this technology are characterized regarding general performance and radiation hardness and compared to each other as well as to the current ATLAS pixel detector.

T 72.8 Mi 18:35 VMP8 HS

Charakterisierung von HVCMOS Pixeldetektoren für den HL-LHC — Jörn Grosse-Knetter, Arnulf Quadt, •Julia Rieger und Jens Weingarten — II. Physikalisches Institut, Georg-August-Universität Göttingen

Im Jahr 2023 soll der LHC zum High-Luminosity LHC (HL-LHC) erweitert werden. Die instantane Luminosität wird steigen, womit es mehr Wechselwirkungen pro Kollision geben wird, und durch die extrem hohen Teilchenraten werden sehr hohe Teilchenfluenzen erwartet. Damit ergeben sich neue Herausforderungen an die Detektoren. Um diesen gerecht zu werden, wird der aktuelle Spurdetektor ersetzt werden.

Die konkreten Anforderungen an den Spurdetektor hängen vom Abstand zum Wechselwirkungspunkt ab. In den innersten Lagen müssen die Detektoren mit Fluenzen von bis zu 2×10^{16} $n_{\mathrm{eq}}/\mathrm{cm}^2$ umgehen und deswegen besonders strahlenhart sein. Das Hauptaugenmerk bei den äußeren Lagen liegt durch ihre große Fläche von um die 20 m^2 auf der Kosteneffizienz.

In diesem Vortrag wird der HV2FEI4 Sensor als ein mögliches Modulkonzept für die äußeren Lagen vorgestellt. Dieser kapazitiv gekoppelte Pixeldetektor (CCPD) ist mit einem ATLAS Pixel FE-I4 Ausle-

sechip verbunden. Die Ergebnisse aus Labor- und Teststrahlmessungen werden präsentiert.

T 72.9 Mi 18:50 VMP8 HS

A passive CMOS pixel sensor for the high luminosity LHC — Michael Daas[1], Laura Gonella[1], Tomasz Hemperek[1], Fabian Hügging[1], Jens Janssen[1], Hans Krüger[1], Anna Macchiolo[2], •David-Leon Pohl[1], and Norbert Wermes[1] — [1]Physikalisches Institut der Universität Bonn — [2]Max-Planck-Institut für Physik in München

The high luminosity upgrade for the Large Hadron Collider at CERN requires a new inner tracking detector for the ATLAS experiment. About 200 m^2 of silicon detectors are needed demanding new, low cost hybridization- and sensor technologies. One promising approach is to use commercial CMOS technologies to produce the passive sensor for a hybrid pixel detector design.

In this talk a fully functional prototype of a 300 um thick, backside biased CMOS pixel sensor in 150 nm LFoundry technology is presented. The sensor is bump bonded to the ATLAS FE-I4 with AC and DC coupled pixels. Results like leakage current, noise performance, and charge collection efficiency are presented and compared to the actual ATLAS pixel sensor design.

T 73: Spurkammern

Zeit: Mittwoch 16:45–18:50 Raum: VMP8 SR 05

Gruppenbericht T 73.1 Mi 16:45 VMP8 SR 05

The Pixel-TPC: Demonstration of the concept and results — •Michael Lupberger for the LCTPC-Deutschland-Collaboration — Universität Bonn

A Time Projection Chamber (TPC) is foreseen as tracker for the ILD, one of the two detector concepts at the planned International Linear Collider (ILC). At the TPC endplates, Micromegas or GEMs will be used as gas amplification structure.

Besides segmented anodes, also an active endplate with pixel chips, in our experiments the Timepix ASIC, is considered as a readout option. In a photolithographic process a grid has been produced on top of the chip to form a so called InGrid, which is a Micromegas-like gas amplification structure.

Several thousand InGrids are necessary to equip a complete TPC endplate. For demonstration of the concept, three endplate modules have been built with a total of 160 InGrids covering an active area of about 300 cm^2. To read out the 10.5 million channels, the Timepix ASIC was implemented in a general readout system. A dedicated powering scheme, DAQ and online event display were developed by our group. The feasibility of the Pixel-TPC could be proven in a test beam campaign at DESY early 2015. The data has partly been analysed and shows the potential of this new type of detector.

An overview of the developments necessary to build the detector will be presented followed by impressions from the test beam and some of the results from the data analysis.

T 73.2 Mi 17:05 VMP8 SR 05

Untersuchung des Einflusses der Unebenheit von GEM-Folien auf die Gleichmäßigkeit der Gasverstärkung in einer TPC — •Paul Malek für die LCTPC-Deutschland-Kollaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Für den International Large Detector (ILD) - einer der Detektoren für den geplanten International Linear Collider (ILC) - ist als Spurdetektor eine Zeitprojektionskammer (TPC) vorgesehen. Eine der untersuchten Möglichkeiten für die Gasverstärkung und Detektion sind Gas-Electron-Multiplier (GEM), die von dünnen Rahmen aus Keramik getragen werden. Die Eignung einer solchen Gasverstärkungsstufe in einer TPC wurde bereits in vorherigen Studien gezeigt.
In diesem Beitrag werden aktuelle Untersuchungen vorgestellt, die sich damit beschäftigen, Ungleichmäßigkeiten in der Gasverstärkung, die durch Unebenheit der Gem-Folien entstehen, zu verringern, um eine möglichst genaue Messung des Energieverlusts durch die Gasionisation (dE/dx) zu gewährleisten. Es werden Ergebnisse von Präzisionsmessungen der Unebenheit der von Keramikrahmen getragenen GEM-Folien und deren Einfluss auf die Gasverstärkung vorgestellt. Es wurden verschiedene Rahmengeometrien untersucht, um eine hohe Ebenheit der GEM-Folien und Stabilität der Rahmen bei gleichzeitiger Minimierung der nicht-sensitiven Fläche zu erreichen.

T 73.3 Mi 17:20 VMP8 SR 05

TPC Teststrahl-Messungen mit einem GEM Auslesemodul — Felix Müller[1,2] und •Ralf Diener[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg, Deutschland — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Im Rahmen des ILD Detektorkonzepts für den International Linear Collider ist als zentraler Spurdetektor eine Zeitprojektionskammer (TPC) vorgesehen. Die im Kammergas entstehenden Primärelektronen müssen vor der Auslese verstärkt werden. Ein Möglichkeit hierzu ist die Verwendung von Gas-Electron-Multipliern (GEM).
Am DESY wurde ein Auslesemodul mit GEM Gasverstärkung entwickelt und in einen großen TPC Prototypen getestet. Die GEM Folien bilden hier zusammen mit schmalen Keramikrahmen eine integrale mechanische Struktur, welche direkt auf der Platine mit Ausleseelektroden montiert wird. Bei der Entwicklung des Moduls wurde ein besonderes Augenmerk darauf gelegt, eine möglichst große empfindliche Fläche zu bekommen. Eine separat kontrollierbare Elektrode am Modulrand erlaubt es die lokalen Feldverzerrungen an den Grenzen zu Nachbarmodulen zu minimieren.
In diesem Vortrag werden die Ergebnisse von Messungen mit diesem Modul in einem 1T Magnetfeld am DESY Teststrahl vorgestellt. Ergebnisse der Einzelpunktauflösung werden diskutiert. Ein besonderer Schwerpunkt der Analyse lag auf dem Studium der Feldverzerrungen und ihrer Korrektur.

T 73.4 Mi 17:35 VMP8 SR 05

Messung der longitudinalen Diffusion in den TPCs des T2K Nahdetektors — Lukas Koch, •Thomas Radermacher, Stefan Roth und Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

In einer Time Projection Chamber (TPC) beeinflusst die auftretende longitudinale Diffusion die Rekonstruktion der Ortskoordinate entlang der Driftrichtung. Die Diffusion kann, bei geeigneter Frontendelektronik, direkt durch die zeitliche Ausdehnung der Ladungspulse gemessen werden. Dazu wird die Breite des Signals in Abhängigkeit der rekonstruierten Driftstrecke untersucht. Dieser Vortrag zeigt die Messung der longitudinalen Diffusion in den TPCs des T2K Nahdetektors ND280. Anhand dieser Messung kann der Einfluss der Diffusion in der Simulation und der Rekonstruktion überprüft werden.

T 73.5 Mi 17:50 VMP8 SR 05

Auslese einer Zeitprojektionskammer mit GEMs, Pads und Timepix — •Ulrich Einhaus für die LCTPC-Deutschland-Kollaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Für den International Large Detector (ILD) am geplanten International Linear Collider (ILC) ist als Spurdetektor eine Zeitprojektionskammer (TPC) vorgesehen. Zur Auslese des Gasvolumens gibt es verschiedene mögliche Mikrostruktur-Gasdetektoren (MPGDs). Dieser Vortrag beschäftigt sich mit einer neuen Kombination von Ausleseelementen: Die Verstärkung der Elektronen geschieht mittels Gas-Elektron-Vervielfachern (GEMs), die Auslese mit Pads der Größenordnung mm oder kleiner und die Digitalisierung durch hochintegrierte Timepix-Chips. Kleinere Pads als bisher erlauben die Auflösung von bis zu einzelnen Elektronenclustern. Es werden Simulationen der Auslese vorgestellt, insbesondere in Hinblick auf Auflösung in Impuls und dE/dx in Abhängigkeit von der Padgröße. Der aktuelle Status der Hardware sowie der geplante Prototyp und Messungen werden erläutert.

T 73.6 Mi 18:05 VMP8 SR 05

Investigations of the long-term stability of a GEM-TPC — •Oleksiy Fedorchuk for the LCTPC-Deutschland-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607

Hamburg, Deutschland — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg, Deutschland

For the International Large Detector (ILD) at the planned International Linear Collider (ILC) a Time Projection Chamber (TPC) is foreseen as the main tracking detector. The gas amplification will be done by Micro Pattern Gaseous Detectors (MPGD). One option is to use Gas Electron Multipliers (GEM).While the applicability of GEMs for the gas amplification in a TPC readout has been shown, the focus of the current research is to improve the high voltage stability and reliability of the readout modules. This is a crucial requirement for the operation in the final ILD TPC.

The main focus of the research presented in this talk is on studies of the discharge stability and operational features of large area $22\times18\text{cm}^2$ GEM foils. We present systematic studies of the stability of GEM foils under different operation conditions. These studies include measurements and calculations of the dynamic behavior of charges in the GEM foils after a trip. The results will be used to develop methods to avoid destructive discharges in the final readout module.

T 73.7 Mi 18:20 VMP8 SR 05

Studies for a Silicon Telescope to extend the magnet facility at the DESY test beam — •Dimitra Tsionou — Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg

The International Large Detector is a detector concept for the International Linear Collider (ILC) which uses a Time Projection Chamber (TPC) as its main tracking detector. Within the framework of the LCTPC collaboration, a large prototype (LP) TPC has been built as a demonstrator. The LP has been equipped with Micro-Pattern Gas Detector modules and studied with an electron beam (1-6 GeV) in a 1 Tesla magnetic field at DESY.

To extend the capabilities of the test beam setup, an external silicon tracker to be installed inside the magnet will be discussed. The silicon detector will provide high precision space points in front and behind the TPC inside the magnet. It will provide reference tracks that will allow to determine the momentum of the tracks passing the TPC, and which will help in correcting for field distortion effects in the LPTPC volume. In order to meet these requirements, simulation studies have been performed to determine the layout of the system and have placed stringent requirements on the sensor spatial resolution of better than 10 μm. These studies will be presented along with the hardware options under evaluation.

T 73.8 Mi 18:35 VMP8 SR 05

Recent developments for the pattern recognition in the Central Drift Chamber of the Belle II detector — •Viktor Trusov, Michael Feindt, Martin Heck, Thomas Hauth und Pablo Goldenzweig für die Belle II-Kollaboration — Karlsruhe Institute of Technology

The Belle II experiment is designed to perform more precise measurements (e.g. CP-violation measurements, New Physics phenomena, rare decays etc) than its predecessor, the Belle experiment. To achieve this goal, the luminosity of the experiment will be increased by a factor of 40 and as result multiple times more data will be collected. Due to this fact, faster reconstruction algorithms for the data processing need to be developed and at the same time accurate physical results should be retained. One important part in the data processing chain is the track reconstruction section.

We present the development of one of the pattern recognition algorithms for the Belle II experiment based on conformal and Legendre transformations. In order to optimize the performance of the algorithm (CPU time and efficiency) we have introduced specialized processing steps. To show improvements in the results we introduce efficiency measurements of the tracking algorithms in the Central Drift Chamber (CDC) which were done using Monte-Carlo simulation of e^+e^- collisions followed by a full simulation of the Belle II detector.

T 74: Experimentelle Methoden II

Zeit: Mittwoch 16:45–18:30 Raum: VMP8 SR 105

T 74.1 Mi 16:45 VMP8 SR 105

Jet energy resolution measurement at CMS — Roman Kogler, •Marek Niedziela, Christian Sander, and Hartmut Stadie — Institute of Experimental Physics, Luruper Chaussee 149, D-22761 Hamburg, Germany

At the LHC, the collision of coloured particles are often producing many jets in the final state. Precise measurements and searches for deviations from predictions of the Standard Model require a precise understanding of these objects. In particular, the jet energy resolution is of great importance. It has to be measured for jets as a function of their kinematic properties, such as the transverse momentum p_T and the pseudorapidity η. At 7 and 8 TeV, measurements of jet resolutions have been carried out using the transverse momentum balance of γ+jets or di-jet events. In this presentation, the first jet energy resolution measurements from CMS at 13 TeV, applying the same technique, will be presented.

T 74.2 Mi 17:00 VMP8 SR 105

Studies of the misidentification probability of electrons as photons at $\sqrt{s} = 13$ TeV with the CMS experiment — •Ralf Meyer, Lutz Feld, and Maximilian Knut Kiesel — 1. Physikalisches Institut B, RWTH Aachen University

In high energy proton-proton collisions, several processes lead to final states containing at least one photon. These are of particular interest in many analyses, for example searches for physics beyond the Standard Model. A possible source of backgrounds are objects misreconstructed as photons. To accurately estimate the contribution of these objects to a photon sample, the origin of reconstructed photons has to be investigated. This presentation focuses on electrons which are misidentified as photons. The propability of an electron being reconstructed as a photon is described by the so called "fake rate".

The fake rate is studied in data and simulation at a center-of-mass energy of 13 TeV with the CMS experiment. As a clean electron source, the Z-boson decay to electrons is used. The dependency of the fake rate on several observables is studied and compared to earlier results.

T 74.3 Mi 17:15 VMP8 SR 105

Identification of Hadronic Tau Decays at the ATLAS Detector Using Artificial Neural Networks — Dirk Duschinger, Stefanie Hanisch, Wolfgang Mader, •Nico Madysa, and Arno Straessner — Institut für Kern- und Teilchenphysik, TU Dresden, Germany

One of the primary goals of the ATLAS experiment at the LHC is the search for physics beyond the Standard Model. The efficient identification of hadronically decaying tau leptons is crucial for this as they comprise the final states of several decay channels sensitive to new physics. (e. g. Higgs boson decays $H \to \tau_{\text{had}}\tau_{\text{had}}$) The identification algorithm currently applied at ATLAS utilizes multi-variate methods and reconstructed particle properties to discriminate against QCD jets, which constitute an important background.

This talk presents a new neural-network-based approach to hadronic tau decay identification and investigates its dependence on hyperparameters such as the network topology or number of training cycles. Ensembling is presented as a technique to improve classifier performance and robustness against overtraining. The resulting classifier is compared to the current approach based on Boosted Decision Trees. The study is based on 2012 data taken at the ATLAS detector at a center-of-mass energy of $\sqrt{s} = 8\,\text{TeV}$.

T 74.4 Mi 17:30 VMP8 SR 105

Track reconstruction in hadronic tau decays — •Dirk Duschinger, Arno Straessner, and Wolfgang Mader — IKTP, TU Dresden

Tau leptons often play an important role in searches for new physics. Not only because the Higgs decay probability into two tau leptons is of magnitudes larger than that for decays into muons and electrons, but also physics beyond the standard model can introduce enhanced couplings to tau leptons. However, the small decay length of 87μm 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 decay of taus into hadrons and an additional neutrino makes up 65% of all decays. The correct classification of hadronic tau

decay products plays a crucial role in ATLAS tau reconstruction in terms of rejection against QCD jets and electrons. This relies on the correct selection of charged particles.

Several changes have been applied to the ATLAS detector during the first long shutdown phase of the LHC. This requires a revision of the track selection criteria applied for hadronic tau decays used for the first run of the LHC. Performance of the former track selection is presented as well as a new approach using multivariate techniques is presented. The focus is set on improving efficiency to reconstruct the correct number of tracks for each hadronic tau decay. For this purpose correlations of track quality criteria as a function of the transverse momentum of the tau are also considered to account for conditions at different p_{T} regions.

T 74.5 Mi 17:45 VMP8 SR 105

B-tagging in CMS at 13 TeV — Ivan Marchesin, Alexander Schmidt, and •Svenja Schumann — Universität Hamburg

At the LHC the CMS experiment investigates high energy p-p-collisions to study the Standard Model (SM) of particles physics and to search for physics beyond the Standard Model (BSM). The collisions of protons often result in processes with b quarks which hadronize in jets. The identification of these jets from b quarks is very important for BSM searches and SM measurements because it can reduce the background a lot. Based on the characteristics of b hadrons, such as long life time or presence of soft leptons, CMS has various algorithms to select jets form b quarks. The tracking system, the lepton identification and the segmented calorimeters of the CMS detector are excellent to identify jets from b quarks (b-tagging). The efficiencies of the different algorithms and the scale factors are measured with the 13 TeV data which will be shown in this talk. The commissioning of b-tagging in boosted topologies at 13 TeV will also be presented.

T 74.6 Mi 18:00 VMP8 SR 105

Calibration of the light-jet fraction in *b*-tagging algorithms for the ATLAS detector in Run 2 of the LHC — Alexander Mann and •Balthasar Schachtner — LMU München

B-tagging algorithms have, depending on the working point used, a small probability to tag a light jet as a *b*-jet. This mistag-rate can be determined using the "negative-tag method" and allows to derive data-to-Monte-Carlo scale factors.

To tag jets originating from *b*-quarks, ATLAS has developed a new multivariate algorithm (MV2c20) for Run 2. The input variables are designed to exploit the finite decay length of *b*-hadrons and the event kinematics. Assuming that light jets are tagged as *b*-jets mainly due to the finite resolution of the detector, lifetime-based variables used in the algorithm will be symmetric with respect to the primary vertex. A "negative" version of the algorithm with all lifetime-based variables inverted is defined to obtain an estimate of the fraction of light jets tagged as *b*-jets due to resolution effects.

For the calculation of the data-to-Monte-Carlo scale factors, corrections need to be applied and are derived from Monte Carlo. The correction factors account for the heavy-flavour contribution and asymmetries in the positive and negative tagging due to decays of long-lived particles and conversions in the detector.

T 74.7 Mi 18:15 VMP8 SR 105

Messung der B-Tagging-Effizienz in $\sqrt{s}$ = 13 TeV ATLAS-Daten mit p_T^{rel} — •Ingo Burmeister, Reiner Klingenberg, Claus Goessling und Kevin Kroeninger — TU Dortmund, Experimentelle Physik IV

Bei vielen Analysen am ATLAS-Experiment spielen b-Quarks eine wichtige Rolle. Für solche Analysen ist die Fähigkeit Jets zu identifizieren, welche ein B-Hadron enthalten eine wichtige Vorraussetzung. Dazu existieren verschiedene Flavour-Tagging-Algorithmen. Diese Algorithmen verwenden bestimmte Arbeitspunkte mit einer in Simulationen bestimmten Effizienz. Diese Effizienz stimmt nicht exakt mit der Tagging-Effizienz in Daten überein. Somit ist die möglichst genaue Messung der Effizienz dieser Flavour-Tagging-Algorithmen von großer Bedeutung für alle Analysen, die Flavour-Tagging verwenden. Die p_T^{rel}-Methode misst die B-Tagging-Effizienz anhand von B-Hadronen, bei deren Zerfall ein Myon entsteht. Dazu wird der Transversalimpuls p_T^{rel} des Myons relativ zur Jet+Myon-Achse gemessen. Dabei wird ausgenutzt, dass Myonen, die aus einem B-Hadron-Zerfall kommen, tendenziell einen höheren Wert für p_T^{rel} aufweisen. Ein Vergleich der Effizienzen, die sowohl in Daten und Simulationen bestimmt werden, erlaubt die Berechnung von Skalierungsfaktoren, die dann in Analysen als Korrekturfaktoren benutzt werden. Diese Faktoren werden erstmals für ATLAS-Daten bei einer Schwerpunktsenergie von $\sqrt{s}$ = 13 TeV mit der p_T^{rel}-Methode bestimmt.

T 75: Detektorsysteme III

Zeit: Mittwoch 16:45–18:30 Raum: VMP8 SR 205

T 75.1 Mi 16:45 VMP8 SR 205

Micro-channel cooling for ATLAS silicon sensors — •Nils Flaschel and Kerstin Tackmann — Notkestraße 85, 22607 Hamburg

The ATLAS experiment at the LHC has been taking data since November 2009. The innermost tracking systems of the ATLAS detector are silicon pixel and strip detectors. In LHC experiments, the silicon detectors, which are positioned very close to the proton-proton interaction point, receive considerable radiation doses. The sensors need to be kept at low temperatures to keep the leakage current small, avoid thermal run-away and to avoid uncontrolled annealing. The cooling system typically adds a significant amount of material and hence radiation lengths to the detector. As part of the planned detector upgrade for the HL-LHC the ATLAS inner tracking system will be replaced by an all-silicon system, with a larger number of detector layers compared to the current detector, increasing the amount of material in the detector.

Micro-channel cooling is considered to be a promising technology to reduce the material per layer in current and future HEP detectors. As the channels are etched directly into silicon, the cooling system can be brought into direct thermal contact with the sensor.

A prototype micro-channel layout has been designed, produced and tested in collaboration with CNM in Barcelona. A test stand has been prepared to characterize both the thermal and mechanical properties of the micro-channel device. First results for the thermal properties and ongoing developments are presented.

T 75.2 Mi 17:00 VMP8 SR 205

Investigation of the impact of mechanical stress on the properties of silicon sensor modules for the ATLAS Phase II Upgrade — •Martin Stegler, Luise Polay, Dennis Spehrlich, and Ingo Bloch — DESY, Zeuthen, Germany

The new ATLAS tracker for phase II will be composed of silicon pixel and strip sensor modules. Such a module consists of silicon sensors, boards and readout chips. In a currently ongoing study new adhesives to connect the modular components thermally and mechanically are examined. It was shown that the silicon sensor is exposed to mechanical stress when part of a module. Mechanical stress can cause damage to a sensor and can change the tensors of electrical properties. The study of the effects of mechanical stress on characteristics of the silicon sensor modules are the focus in this presentation. The thermal induced tensile stress near to the surface of a silicon sensor build in a module was simulated. A four point bending setup was used to measure the maximum tensile stress of silicon and to verify the piezoresistive effect on ATLAS07 sensors. The results of the electrical measurements and simulations of stressed silicon sensor modules are shown in the presentation.

T 75.3 Mi 17:15 VMP8 SR 205

System Tests with Silicon Strip Module Prototypes for the Phase-2-Upgrade of the CMS Tracker — Lutz Feld, Waclaw Karpinski, Katja Klein, and •Marius Preuten — I. Physikalisches Institut B, RWTH Aachen University

To prepare the CMS experiment for the High Luminosity LHC and its instantaneous luminosity of $5 \cdot 10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$, in the Long Shutdown 3 (around 2024) the CMS Silicon Tracker will be replaced.

The Silicon Strip Modules for the new Tracker will host two vertically stacked sensors. The combination of hit information from both sensors will allow the estimation of the transverse momentum ($\mathrm{p_T}$) of

charged particles in the module front-end. This can be used to identify hits from potential interesting high-p_T tracks (above 2 GeV) for the first trigger level.

The CMS Binary Chip (CBC) provides the analogue readout of two sensors and a digital section, into which the momentum discrimination is integrated. The modules will host a new DC-DC converter chain, which will allow individual powering of each module. First measurements with early prototypes on the interplay between DC-DC powering and the read-out functions of the module will be presented in this talk.

T 75.4 Mi 17:30 VMP8 SR 205

FE-I4b Quad Module Serial Powering Stave Prototype for ATLAS ITk upgrade — •Viacheslav Filimonov, Laura Gonella, Fabian Hügging, and Norbert Wermes — University of Bonn, Bonn, Germany

ATLAS ITk is a new inner tracker that will be built for the Phase II upgrade in order to meet the requirements of increased Luminosity.

Current detector modules are powered according to the parallel (direct) powering scheme: each detector module is powered with an independent power supply and a set of cables. With this powering scheme modules can be operated individually, which is a big advantage. However, due to increased granularity of the detector more cables are needed for powering. Increased FE current consumption leads to increase in cable cross section. All these increases power losses in the cables as well as the amount of passive material in the active detector volume. Finally, it results into unwanted interactions of particles with the inactive part of the detector and degradation of the detection performance.

Solution is to use a new powering scheme, different from direct powering. Proposed options are Serial powering and DC-DC converters scheme.

The talk will focus on the investigation of the Serial powering scheme. It will describe a Serial Powering Stave Prototype that was built in Bonn using FE-I4b Quad Modules. Detailed investigation of the Stave performance in the Serial powering scheme will be shown.

T 75.5 Mi 17:45 VMP8 SR 205

Thermische Eigenschaften der 2S-Module für das Phase-2-Upgrade des CMS-Trackers — Lutz Feld, Katja Klein, Marius Preuten, •Max Rauch und Michael Wlochal — RWTH Aachen, 1. Physikalisches Institut B

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 rund 8500 2S-Module eingesetzt werden, in denen zwei Silizium-Streifensensoren beidseitig auf eine Trägerstruktur aus einem Aluminium-Kohlefaser-Verbundmaterial gebaut werden, über die auch die Anbindung an das 2-phasige CO_2-Kühlsystem erfolgt. Die Temperatur der Si-Sensoren soll bei einer CO_2-Temperatur von $-30\,°C$ unter $-20\,°C$ gehalten werden und der Effekt des „Thermal Runaway“ muss vermieden werden. Zusätzlich soll das Materialbudget minimiert werden.
Für die 2S-Module werden Abschätzungen der Wärmeleistungen und thermische FE-Simulationen sowie ein Konzept zur Messung der thermischen Eigenschaften vorgestellt.

T 75.6 Mi 18:00 VMP8 SR 205

Wärmetransporteigenschaften verschiedener Kohlefaserschichten in Kombination mit Hartschaumstoffen für den Einsatz als Supportstrukturen für Siliziumsensormodule — Tobias Barvich, Conny Beskidt, Wim de Boer, Alexander Dierlamm und •Stefan Maier — Institut für Experimentelle Kernphysik (IEKP), KIT

Für das Phase II Upgrade des CMS-Spurdetektors werden sowohl Siliziumpixel-, als auch Streifensensoren in einer Modulbauweise eingesetzt. Die bisherigen Konzepte verursachen durch viele Produktionsschritte mit flüssigem Klebstoff einen hohen logistischen Aufwand, der mit der notwendigen langen Aushärtezeit des Klebstoffes verbunden ist. Am Karlsruher Institut für Technologie wird parallel zum bisherigen Konzept neue Möglichkeiten untersucht, Module ohne flüssigen Klebstoff zu bauen um somit die Anzahl der einzelnen Produktionsschritte zu senken und den logistische Aufwand zu verringern. Hierfür werden Hartschaumstoffe in Verbindung mit unidirektionalen Kohlefaserschichten als Supportstrukturen in Betracht gezogen. Diese Schichten sorgen sowohl für die Stabilität als auch für den Abtransport der entstehenden Wärme. Der Vortrag soll Einblick in die Wärmetransporteigenschaften verschieden kombinierter Kohlefaserschichten geben und die Einsatzmöglichkeiten beleuchten.

T 75.7 Mi 18:15 VMP8 SR 205

Mechanics and Cooling of the Mu3e Detector — René Philipp Austermühl, Lars Henkelmann, •Adrian Herkert, and Yanwing Ng for the Mu3e-Collaboration — Physikalisches Institut, Uni Heidelberg

The Mu3e experiment will search for the charged lepton falvour violating decay $\mu^+ \to e^+e^-e^+$, which is suppressed to unobservable levels in the Standard Model. A signal would be a clear sign of new physics. The aim is to reach a sensitivity for the branching ratio of 10^{-16}, which requires high momentum resolution. Since the muons will decay at rest on target, the energy of the decay electrons will be $E \leq 53\,\text{MeV}$. In this energy regime the momentum resulotion is limited by multiple scattering in the detector material. Therefore, the Mu3e detector, including support structure and services, has to consist of as little material as possible in the active region. The main component of the detector is a pixel tracker consisting of four barrels of high voltage monolithic active pixel sensors (HV-MAPS) that can be thinned to $50\,\mu\text{m}$. A power consumption of $400\,\text{mW/cm}^2$ is expected. To keep the material budget low, it is planned to cool with gaseous helium.
In this talk results of computational fluid dynamics simulations of the Mu3e cooling system and experimental tests concerning the detector's stability against flow-induced vibrations will be presented.

T 76: Elektroschwache Wechselwirkung (Experiment) II

Zeit: Mittwoch 16:45–18:45 Raum: VMP8 SR 206

T 76.1 Mi 16:45 VMP8 SR 206

Search for triboson $WWW \to l\nu l\nu l\nu$ final state in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector — •Martina Javurkova-Pagacova — University of Freiburg, Freiburg, Germany

This talk presents a study of triple W-boson production in the $WWW \to l\nu l\nu l\nu$ channel, where l=e, μ, using $20.3 fb^{-1}$ of proton-proton collisions at a center-of-mass energy of $\sqrt{s} = 8$ TeV recorded with the ATLAS detector at the LHC in 2012. The analysis represents one of the first searches for the Standard Model electroweak processes with the Quartic Gauge boson Couplings (QGC). Therefore, this measurement is also used to test SM by setting limits on anomalous QGC.

T 76.2 Mi 17:00 VMP8 SR 206

Elektroschwache Eichboson-Streuung im WZjj-Endzustand mit dem ATLAS-Detektor am LHC — •Felix Socher, Philipp Anger, Carsten Bittrich, Michael Kobel, Tobias Sandmann und Anja Vest — Institut für Kern- und Teilchenphysik, TU Dresden

Streuprozesse zwischen elektroschwachen Eichbosonen sind eine zentrale Voraussage der elektroschwachen Theorie des Standardmodells. Zu diesen Streuprozessen tragen bosonische Dreier- und Vierer-Kopplungen sowie das Higgs-Boson bei. Erst durch Berücksichtigung aller Beiträge liefern die theoretischen Vorhersagen physikalische Ergebnisse. Somit sind die Streuprozesse eng mit der elektroschwachen Wechselwirkung verknüpft, welche die longitudinalen Komponenten der streuenden Eichbosonen erzeugt. Zudem bieten diese Streuprozesse die Möglichkeit anomale Eichkopplungen zu untersuchen, und somit vergleichsweise modell-unabhängig nach Physik jenseits des Standardmodells zu suchen.

Dieser Beitrag stellt die ATLAS-Analyse der elektroschwachen Eichboson-Streuung im doppelt-leptonischen WZjj-Endzustand vor. Neben der Messung eines Wirkungsquerschnittes werden entfaltete Verteilungen und Ausschlussgrenzen für anomale quartische Eichkopplungen gezeigt und mit bisherigen Ergebnissen aus Analysen zur Eichboson-Streuung verglichen.

T 76.3 Mi 17:15 VMP8 SR 206

Messung des kombinierten $WW/WZ \to l\nu qq$ Wirkungsquerschnitts mit dem ATLAS-Experiment bei $\sqrt{s} = 8$ TeV — •Felix Bührer, Valerio Dao, Karl Jakobs und Christian Weiser — Physikalisches Institut, Universität Freiburg

Die Untersuchung der Diboson-Produktion am LHC erlaubt einen präzisen Test der elektroschwachen Symmetriebrechung. Eine Abweichung des Wirkungsquerschnitts von den Standardmodellvorhersagen könnte außerdem ein Anzeichen für anomale Drei-Boson-Kopplungen sein.
Vorgestellt wird eine Analyse, welche die Produktion von Vektorbosonpaaren im Endzustand $l\nu qq$ untersucht. Die zentrale Herausforderung ist dabei die Abschätzung des großen Untergundes der W+jets Produktion und das daraus resultierende geringe Signal-zu-Untergrund-Verhältnis. Daher ist eine umfassende Berücksichtigung aller systematischen Unsicherheiten, sowohl von Detektoreffekten als auch der Beschreibung des Signals und der Untergründe von Bedeutung.
Diskutiert wird insbesondere die Modellierung der dominanten W+jets und $t\bar{t}$ Untergründe, eine Methode zur Abschätzung des Untergrundes der QCD-Multijet-Produktion, sowie die Signal-Extraktion mit Hilfe eines Maximum-Likelihood-Fits.
Neben der Messung des Wirkungsquerschnitts wird die Analyse zudem benutzt, um Ausschlußgrenzen auf anomale Drei-Boson-Kopplungen zu setzen.

T 76.4 Mi 17:30 VMP8 SR 206

Studies towards the measurement of W^+W^- cross section in pp collisions at $\sqrt{s} = 13$ TeV at the ATLAS Detector — •Baishali Dutta — DESY, Zeuthen, Germany

The production of pairs of electroweak gauge bosons plays an important role for both, tests of the Standard Model and searches for new physics. With the first run of data-taking at LHC, the W^+W^- cross section has already been measured at both ATLAS and CMS experiments.
With the data collected by the ATLAS experiment in 2015 comprising an integrated luminosity of 3.3 fb^{-1}, the W^+W^- cross section measurement will be repeated at a centre-of-energy $\sqrt{s} = 13$ TeV.
This talk mainly presents studies on the W^+W^- cross section measurement at a centre-of-energy $\sqrt{s} = 13$ TeV. The events are selected in the leptonic decay channel i.e both W decaying into two leptons (electrons, muons) and associated missing transverse momentum. The main focus is given to the estimation of various dominating backgrounds using data-driven method.

T 76.5 Mi 17:45 VMP8 SR 206

Studien zur Messung von anomalen Vektorbosonenkopplungen in W^+W^--Ereignissen mit dem ATLAS Detektor — •Elias Rüttinger — DESY, Zeuthen, Deutschland

Mit dem ATLAS Detektor am LHC lässt sich nach neuer Physik im elektroschwachen Sektor suchen. Dazu wird in diesem Beitrag der Prozess $q\bar{q} \to W^+W^-$ betrachtet. Bei diesem spielt die Selbstwechselwirkung der Vektorbosonen untereinander eine Rolle, in diesem Fall durch den s-Kanal Austausch eines Photons oder Z-Bosons nach W^+W^-. Neben den im Standardmodel (SM) enthaltenen Selbstkopplungen sind prinzipiell auch weitere – anomale – Kopplungen möglich. Diese würden den WW-Wirkungsquerschnitt sowie die differentiellen Verteilungen der W Zerfallsprodukte verändern und wären effektiv ein Anzeichen von neuer Physik.

Bei der Suche nach solchen anomalen Kopplungen ist es notwendig, Messdaten mit theoretischen Vorhersagen (Monte-Carlo Simulationen) zu vergleichen. Es wird eine Umgewichtungsmethode vorgestellt, mit der sich Vorhersagen für Wirkungsquerschnitte von beliebigen anomalen Kopplungen aus einem SM Monte-Carlo gewinnen lassen. Damit ist es dann auch möglich, nach verschiedenen sensitiven Region für anomale Kopplungen zu suchen und somit sowohl eine gezieltere als auch eine sensitivere Analyse durchzuführen.

T 76.6 Mi 18:00 VMP8 SR 206

Measurement of the ZZ production cross section in Run 2 of the LHC with the ATLAS experiment: acceptance determination — Maurice Becker, Stefan Tapprogge, and •Anton Wolf — Institut für Physik, Johannes Gutenberg-Universität Mainz, Deutschland

The study of Z boson pair production in proton-proton interactions tests the predictions of the electroweak sector of the Standard Model (SM), and this process is also an important background in Higgs analyses. Furthermore the production of new resonances decaying to pairs of Z bosons, as well as non-zero neutral triple gauge boson couplings could lead to deviations from the SM prediction.

For the measurement of the cross section for ZZ production the decay channel $ZZ \to l^+l^-l'^+l'^-$ was analyzed, where l resp. l' denote an electron, or a muon. For this analysis data from proton-proton collisions at the LHC, located at CERN, were used to measure the cross section in a fiducial region. These data were recorded with the ATLAS experiment at $\sqrt{s} = 13$ TeV with an integrated luminosity of 3.2 fb^{-1}. In order to extrapolate this fiducial cross section to a on-shell phase space a so called acceptance factor needs to be determined. In this talk the acceptance with its systematic uncertainties will be presented in a detailed way and the resulting total cross section will be shown.

T 76.7 Mi 18:15 VMP8 SR 206

Measurement of the ZZ production cross section with ATLAS at $\sqrt{s} = 8$ TeV — •Simon Schmitz and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität Mainz

The study of the ZZ production has an excellent potential to test the electroweak sector of the Standard Model, where Z boson pairs can be produced via non-resonant processes or via Higgs decays. A deviation from the Standard Model expectation for the ZZ production cross section would be an indication for new physics. This could manifest itself in so called anomalous neutral triple gauge couplings via ZZZ or $ZZ\gamma$, which the Standard Model forbids at tree level.

The measurement of the ZZ production cross section is based on an integrated luminosity of 20.3 fb^{-1} of proton-proton collision data at $\sqrt{s} = 8$ TeV recorded with the ATLAS detector in 2012. Measurements of differential cross sections as well as searches for anomalous triple gauge couplings have been performed. This talk presents the analysis details with the main emphasis on the unfolding as well as the results of the measurement of the ZZ production in the $ZZ \to 4l$ channel.

T 76.8 Mi 18:30 VMP8 SR 206

Limits on anomalous triple gauge couplings at $\sqrt{s} = 13$ TeV in the CMS experiment — •Ivan Shvetsov, Matthias Mozer, and Thomas Müller — Institut für Experimentelle Kernphysik (IEKP), KIT

One of the main goals of the LHC Run II is the search for possible effects of new physics. A model-independent way to look for new physics is the so called effective field theory approach. In this approach, new physics is parametrized by the addition of higher dimensional operators to the Standard Model Lagrangian. Here we focus on a set of operators in the electroweak sector, which lead to anomalous triple gauge couplings. In this talk an analysis for setting limits on anomalous triple gauge couplings in WW/WZ final states in the semileptonic decay channel is presented. The event selection and reconstruction, as well as the procedure for setting limits are described.

T 77: Top Quark IV (single top, FCNC)

Zeit: Mittwoch 16:45–19:00 Raum: VMP9 HS

T 77.1 Mi 16:45 VMP9 HS

Suche nach FCNC in Prozessen mit Top-Quarks und Photonen bei $\sqrt{s}$ =13 TeV am ATLAS-Experiment — Johannes Erdmann, •Gregor Gessner, Claus Gössling und Kevin Kröninger — TU Dortmund, Experimentelle Physik IV

Im Standardmodell der Teilchenphysik sind Flavor-changing-neutral-currents aufgrund des GIM-Mechanismus stark unterdrückt. In der Suche nach Abweichungen von dessen Vorhersage könnte das Top-Quark eine entscheidende Rolle spielen, da seine Masse nahe der Skala der elektroschwachen Symmetriebrechung liegt. In Modellen für BSM-Physik kann der Wirkungsquerschnitt von Prozessen mit Top-Quarks und FCNC um einige Größenordnungen größer sein als im Standardmodell erwartet.
Es werden Studien zur Suche nach Prozessen vorgestellt, in denen ein

Top-Quark über FCNC in Assoziation mit einem Photon produziert wird ($qg \to t\gamma$ mit $q = u, c$) oder über FCNC in ein Photon und ein Quark zerfällt ($t\bar{t} \to Wb\, q\gamma$ mit $q = u, c$).

T 77.2 Mi 17:00 VMP9 HS

Measurements of differential cross-sections for t-channel single top-quark production in proton-proton collisions at $\sqrt{s} = 8$ TeV using the ATLAS detector — •Pienpen Seema[1], Ian Brock[1], Dominic Hirschbühl[2], Phillipp Tepel[2], and Wolfgang Wagner[2] — [1]University of Bonn — [2]University of Wuppertal

Differential cross sections for single top quarks produced in the t-channel are measured as a function of their transverse momentum and their absolute value of rapidity. The measurements are performed in the lepton+jets final state using 20.3 fb^{-1} of proton-proton collisions at a center-of-mass energy of $\sqrt{s} = 8$ TeV with the ATLAS detector. A neural network is used to discriminate between the t-channel signal and its backgrounds. A cut on the neural network discriminator is applied in order to enhance a purity of t-channel signal sample. The transverse momentum and the absolute value of rapidity of the top quarks, top anti-quarks and light-favour jets are unfolded using an iterative Bayesian method, that is used to correct detector effects. Hence, their true distributions are obtained and can be directly compared to theoretical predictions.

T 77.3 Mi 17:15 VMP9 HS

Messung des Wirkungsquerschnittes der Einzel-Top-Quark-Erzeugung im t-Kanal mit dem ATLAS-Detektor bei 13 TeV — •Gunnar Jäkel, Dominic Hirschbühl, Phillipp Tepel und Wolfgang Wagner — Bergische Universität Wuppertal

Die elektroschwache Erzeugung einzelner Top-Quarks wird am LHC vom t-Kanal-Austausch dominiert. In diesem Kanal erzeugt ein virtuelles W-Boson, das von einem leichten Quark aus der Proton-Proton-Kollision abgestrahlt wird, das einzelne Top-Quark. Präsentiert wird eine Analyse zur Messung der Top-Quark- und Top-Antiquark-t-Kanal-Produktionswirkungsquerschnitte mit dem ATLAS-Detektor und einer Datenmenge von 3.2 fb^{-1} bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV . Das Ziel ist eine möglichst präzise Messung der Wirkungsquerschnitte und des CKM-Matrixelements $|V_{tb}|$. Zur Trennung von Signal und Untergrundprozessen werden Neuronale Netze verwendet.

T 77.4 Mi 17:30 VMP9 HS

Kombinierte Messung elektroschwacher Produktion von Top-Quarks im s- und t-Kanal bei ATLAS — •Sören Stamm — 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 assoziierte Produktion von W-Bosonen. Im Herbst 2015 konnte durch die ATLAS-Kollaboration zum ersten Mal Evidenz für die Produktion im s-Kanal in pp-Streueung am Large Hadron Collider beobachtet werden, was im ersten Teil des Vortrages kurz vorgestellt wird. Diese Analyse wird im Rahmen von Suchen nach Neuer Physik jenseits des Standardmodells zu einer kombinierten Messung des s- und t-Kanals erweitert. Erste Ergebnisse hierzu werden im zweiten Teil des Vortrags präsentiert. In beiden Analysen wird zur besseren Trennung des Signals vom Untergrund die Matrixelement-Methode verwendet, welche kurz erläutert wird.

T 77.5 Mi 17:45 VMP9 HS

Wt-channel cross section measurement in single top quark production at with the ATLAS detector at $\sqrt{s} = 13$ TeV — •Rui Zhang, Regina Moles Valls, and Ian C. Brock — Physikalisches Institut, Universität Bonn

The inclusive production cross-section for the associated production of a W boson and a top quark is measured using data from proton–proton collision at a centre of mass energy 13 TeV collected in 2015 by the ATLAS detector at the Large Hadron Collider at CERN. Events are separated into signal and control regions based on the number of jets and the number of jets which are identified as containing b-hadrons. The Wt signal is separated from the $t\bar{t}$ background using a boosted decision tree discriminant. The cross-section is extracted by fitting Monte Carlo templates to the data distributions. A measurement of the fiducial cross-section is also performed.

T 77.6 Mi 18:00 VMP9 HS

Messung des Produktionswirkungsquerschnitts von Einzel-Top-Quarks bei einer Schwerpunktsenergie von 13 TeV mit dem CMS-Experiment — Thorsten Chwalek, •Nils Faltermann und Thomas Müller — Institut für Experimentelle Kernphysik (IEKP), KIT

Das Top-Quark spielt als schwerstes Elementarteilchen eine spezielle Rolle in vielen Theorien für Physik jenseits des Standardmodells. Im Gegensatz zur Top-Quark-Paarproduktion findet die Produktion einzelner Top-Quarks über die elektroschwache Wechselwirkung statt und ist daher sensitiv auf neue Physik in diesem Sektor. Im t-Kanal wird ein einzelnes Top-Quark durch den Austausch eines virtuellen W-Bosons erzeugt.
Dieser Vortrag beinhaltet eine Beschreibung der Analyse und die Ergebnisse für den Wirkungsquerschnitt der Einzel-Top-Quark-Produktion, gemessen mit dem CMS-Experiment. Dafür wurden Proton-Proton-Kollisionendaten des LHC bei einer Schwerpunktsenergie von 13 TeV aus dem Jahr 2015 verwendet.

T 77.7 Mi 18:15 VMP9 HS

Messung des Wirkungsquerschnittes der elektroschwachen Einzel-Top-Quark-Erzeugung im t-Kanal mit dem ATLAS Experiment — •Phillipp Tepel, Dominic Hirschbühl und Wolfgang Wagner — Bergische Uni Wuppertal

Die elektroschwache Erzeugung einzelner Top Quarks wird am LHC vom Austausch eines virtuellen W-Bosons im t-Kanal dominiert. Das W-Boson wird typischerweise von einem Valenzquark der kollidierenden Protonen abgestrahlt. Ziel dieser Analyse ist eine möglichst präzise Messung des t-Kanal Produktionswirkungsquerschnitts mit dem ATLAS-Detektor und einer Datenmenge von 20.3 fb^{-1}. Die Messung des Produktionswirkungsquerschnitts, bei einer Schwerpunktsenergie von $\sqrt{s} = 8$ TeV, ermöglicht es, das CKM-Matrixelement $|V_{tb}|$ zu bestimmen, ohne die Unitarität der CKM-Matrix vorauszusetzen.
In dieser Analyse wird das Signal, nach einer schnittbasierten Vorselektion, mittels multivariaten Analysemethoden (Neuronale Netze) von den Untergrundprozessen getrennt. Der Wirkungsquerschnitt wird bezogen auf den zugänglichen Phasenraum gemessen (fiducial cross-section) und zusätzlich auf den gesamten Phasenraum extrapoliert (total cross-section). Vergleiche mit den Vorhersagen verschiedener Generatoren werden vorgenommen.

T 77.8 Mi 18:30 VMP9 HS

Single top production in association with a Z boson at ATLAS — Ian C. Brock and •Irina Cioară — Physikalisches Institut, University of Bonn

An interesting channel to be investigated with the new 13 TeV data at ATLAS is the electroweak process in which a Z boson is radiated in the t-channel single top production (tZ channel). The lepton + jets decay topology of this channel produces one b-jet, one charged lepton with high transverse momentum, three light-quark jets plus one in the forward direction and one neutrino. Almost four times less frequent, the dilepton channel is investigated as well by searching for events with two leptons coming from the Z boson decay, three jets from the hadronic top-quark decay and one jet in the forward region.

Because of the low production rate and many background processes with much higher cross section, multivariate analysis techniques are used for separating signal and background.

Besides the potential to constrain the top-Z boson coupling, this channel is also interesting because it is, until now, an unconsidered irreducible background for flavour changing neutral current decays of the top quark in $t\bar{t}$ production and will also constitute one of the main sources of background for a single-top + Higgs($H \to bb$) analysis. Some BSM models also predict a final state in which a top-quark and a Z boson are produced.

T 77.9 Mi 18:45 VMP9 HS

FCNC involving top quarks: current results, future experimental expectations, theory predictions — •Ozan Arslan[1], Ian C. Brock[1], and Dominic Hirshbuehl[2] — [1]University of Bonn — [2]University of Wuppertal

Flavour Changing Neutral Current (FCNC) processes are highly suppressed in the Standard Model due to Glashow-Iliopoulos-Maiani (GIM) mechanism. However, in some extensions of the Standard Model such as supersymmetry (SUSY) and the 2-Higgs doublet model, the FCNC contributes at tree level, enhancing the branching ratio significantly. The FCNC are searched in single top-quark production, where a

u(c)-quark interacts with a gluon, producing a single top-quark with no associated quark production. In this talk, we present the latest ATLAS results from the 8 TeV centre-of-mass energy collisions corresponding to an integrated luminosity of ~ 20 fb^{-1}. Furthermore, we discuss the current theory predictions and compare them to the expectations from future ATLAS analyses in this channel.

T 78: Niederenergie-Neutrinophysik II

Zeit: Mittwoch 16:45–19:15 Raum: VMP9 SR 07

T 78.1 Mi 16:45 VMP9 SR 07

The History of Neutrino Physics from a Methodological Point of View — •Alexander Unzicker — Pestlozzi-Gymnasium München

A famous letter by Wolfgang Pauli in 1930, directed at the participants of the Naturforschertagung in Tübingen, marked the beginning of neutrino physics.

Since then, the field has undergone a dramatic change, though each conceptual step seemed to be a minor modification of the paradigm of the time.

A summary review of the crucial experiments and their interpretations is given: the early period, the Cowan-Reines experiment, the discovery of flavours, and ultimately, the establishment of neutrino oscillations that was rewarded with the Nobel Prize in 2016.

The current state of the field is discussed from a historical perspective. It is argued that there are distinct patterns regarding the methods that have appeared several times.

T 78.2 Mi 17:00 VMP9 SR 07

New reconstruction method for liquid scintillator – First results for muon tracks — Caren Hagner[1], •Sebastian Lorenz[1,2], Björn Wonsak[1], and Michael Wurm[2] — [1]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg — [2]Johannes Gutenberg-Universität Mainz, Institut für Physik, Staudinger Weg 7, 55128 Mainz

An efficient veto-based rejection of muon-induced background is an important prerequisite for experiments in low-energy neutrino physics. For unsegmented liquid scintillator detectors, common tools in this field, this requires the precise reconstruction of muon tracks within the active volume based on the isotropically emitted scintillation photons.

A novel reconstruction technique for this challenging task, which could be employed in the future large-volume detector of JUNO, is in development. The method aims to reconstruct the 3D number density distribution of photon emissions, which reflects an event's geometry and topology. Based on single muons simulated in the LENA detector, first results on the method's performance are presented.

T 78.3 Mi 17:15 VMP9 SR 07

Light yield and timing of the JUNO detector as function of scintillator transparency — •Wilfried Walter Depnering for the JUNO-Collaboration — Johannes Gutenberg - Universität & EC PRISMA, Mainz, Deutschland

In the last years, large-volume liquid scintillator detectors have made important contributions to low-energy neutrino physics. One of these future neutrino detectors is JUNO with its primary goal to determine the neutrino mass hierarchy. To be able to reach that goal a resolution of at least 3% at a neutrino energy of 1 MeV is needed. For this reason, at least 1200 photoelectrons need to be registered within the photomultipliers at the verge of the detector, independent of their creation point. Therefore, a high light yield and high transparency of the liquid scintillator are crucial. This talk is about a study investigating the expected amount of photoelectrons considering different absorption- and scattering lengths for the used liquid scintillator LAB. In addition to that, the impact of these optical parameters on the rise time of the emission profile is examined, determining the time resolution of event reconstruction.

T 78.4 Mi 17:30 VMP9 SR 07

Development of a scintillator-purity monitor for JUNO — •Heike Enzmann for the JUNO-Collaboration — Johannes Gutenberg Universität, Ec Prisma, Mainz, Deutschland

The unknown mass hierarchy of the neutrinos is one of the open issues of the standard model. The Jiangmen Underground Neutrino Observatory (JUNO) which is currently under construction in China is designed to determine the hierarchy via the measurement of the survival probability of reactor electron antineutrinos. These neutrinos are detected in a 20kt liquid scintillator. High optical purity of the scintillator is required to reach the aimed measurement precision. This talk discusses the development of an online monitor for optical transparency. To assure that the necessary quality levels of the scintillator are fulfilled over the entire filling process, the device will be installed in the filling line to continuously monitor the purity of the scintillator via a measurement of the attenuation length.

T 78.5 Mi 17:45 VMP9 SR 07

Measurement of the Rayleigh scattering length in liquid scintillators for JUNO — •Paul Hackspacher for the JUNO-Collaboration — Johannes Gutenberg-Universität Mainz & PRISMA Excellence Cluster

In liquid scintillator neutrino detectors such as the upcoming Jiangmen Underground Neutrino Observatory (JUNO), neutrino interactions are being detected by means of inverse beta decay and analysis of the resulting luminescent light. In order to reliably reconstruct these events from photomultiplier signals, the scattering properties of the detector materials need to be sufficiently well known. In the LAB-based liquid scintillator that has been proposed for JUNO, the primary contribution to the scattering process comes from Rayleigh scattering. The characteristic Rayleigh scattering length can be experimentally obtained in an optical laboratory setup. This talk will present the approach, the current status and the future plans of the experiment.

T 78.6 Mi 18:00 VMP9 SR 07

Reconstruction of proton decay events in a densely instrumented neutrino telescope-like detector — •Maria Tselengidou and Alexander Kappes for the IceCube-Collaboration — ECAP, Erlangen, Germany

After successfully lowering IceCubes neutrino threshold to 10 GeV with its DeepCore infill-array, ideas arose to leverage the optically quiet Antarctic deep-ice to build an extremely densely instrumented, large-volume detector sensitive to MeV neutrinos. Among several interesting physics topics, such a detector would be able to pursue detection of proton decay. Using decays of protons into pi0 and positron, the talk presents the status of the reconstruction of such events via Cherenkov-ring identification. Different detector configurations are examined in order to determine the optimal design for the reconstruction.

T 78.7 Mi 18:15 VMP9 SR 07

Current status of the SOX mockup and simulation — •Michael Gschwender, Tobias Lachenmaier, Stephanie Göggelmann, and Sebastian Rottenanger — Physikalisches Institut, Universität Tübingen, Germany

The **S**hort distance neutrino **O**scillations with Bore**X**ino (SOX) Experiment is committed to the search of sterile neutrinos in the eV-scale. SOX is searching for the disappearance of antineutrinos from a radioactive source (^{144}Ce - ^{144}Pr).

If no distinct oscillationary pattern will be found, it will be of utmost importance to know the number of the emitted antineutrinos from the source with an overall accuracy <1%. This is achieved by a calorimeter, which is able to measure the thermal power of the source, from which the activity can be derived.

In order to accomplish a precise measurement, a calibration of the calorimeter is crucial. A dummy source (mockup), using electrical heaters, is able to deposit a known amount of power inside the calorimeter. The goal of this talk is to give an update of the current status of the mockup as well as the concomitant simulation. This simulation was build using the commercial finite element simulation environment Comsol.

This work is funded by the Deutsche Forschungsgemeinschaft.

T 78.8 Mi 18:30 VMP9 SR 07

Betaspectroscopy of a Ce/Pr-144 sample for the SOX experiment — •Simon Appel for the BOREXINO-Collaboration — TU München

The very low radioactive background of the Borexino detector, its large size, and the well proved capability to detect both low energy electron neutrinos and anti-neutrinos make an ideal case for the study of short distance neutrino oscillations in the ev scale, which is the goal of the SOX experiment.

As neutrino generator SOX will use a Ce/Pr-144 source with expected activity aorund 100 kCi. The experiment will look for distortions in the anti-neutrino spectrum. Therefore it is crucial to have a good understanding of the original spectrum. This is done via betaspectroscopy of a Ce/Pr-144 sample, based on a plastic scintillator setup. To distinguish electron and gamma particles the setup is equipped with an multi-wire-chamber.

This talk will present the latest results of the setup.

This work is supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 78.9 Mi 18:45 VMP9 SR 07

Reducing deadtime with a modified Li-He veto in BoreXino — •Stefan Weinz and Michael Wurm — Physics Institute, University of Mainz

Although the BoreXino detector is located in a deep underground lab in Gran Sasso with huge of rock overburden (≈ 3500m water equivalent), a non-negligible flux of high energetic cosmic muons is still able to penetrate the fiducial volume of the detector. These muons can be tagged with high efficiency, but more dangerously, a muon passing the detector may interact with the ^{12}C nuclei of the liquid scintillator, thus creating cosomogenic radioisotopes. A prominent example for these unstable nuclei are ^{8}He and ^{9}Li isotopes, whose decay products can mimic very well the ν-signature of inverse β-decay. To suppress this serious background source, the common strategy in BoreXino is to simply veto the whole fiducial volume for two seconds, introducing an overall deadtime of ≈ 10%. This muon-induced deadtime can be greatly reduced by introducing cuts based on the study of muon properties which may be related to the production of ^{8}He and ^{9}Li isotopes. The talk presents the muons cuts in three observables as well as their performance and limitations.

T 78.10 Mi 19:00 VMP9 SR 07

SOX Sensitivity Study — •Johann Martyn for the BOREXINO-Collaboration — Johannes Gutenberg-Universität, Mainz, Germany

To this day most experimental results on neutrino oscillations can be explained in the standard three neutrino model. There are however a few experiments that show anomalous behaviour at a very short baselines. These anomalies can hypothetically be explained with the existence of one or additional more light neutrino states that do not take part in weak interactions and are thus called sterile. Although the anomalies only give a hint that such sterile neutrinos could exist the prospect for physics beyond the standard model is a major motivation to investigate the neutrino oscillations in new very short baseline experiments. The SOX (Short distance Oscillations in BoreXino) experiment will use the Borexino detector and a ^{144}Ce source to search for sterile neutrinos via the occurance of an oscillation pattern at a baseline of several meters. This talk will examine the impact of the Borexino detector systematics on the experimental sensitivity of SOX.

The work is supported by the funds of the Deutsche Forschungsgemeinschaft.

T 79: Neutrinoastronomie IV

Zeit: Mittwoch 16:45–19:20 Raum: VMP9 SR 08

Gruppenbericht T 79.1 Mi 16:45 VMP9 SR 08

Bestimmung der Neutrinomassenhierarchie mit ORCA — •Thomas Eberl für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

Eine der wichtigsten offenen Fragen der Neutrinophysik ist die Bestimmung des Massenspektrums der drei Neutrinos des Standardmodells. Durch die Messung der energie- und zenitwinkelabhängigen Oszillationswahrscheinlichkeit von atmosphärischen Neutrinos, die die Erde durchquert haben, kann unterschieden werden, ob die Massenhierarchie der Neutrinos normal oder invertiert ist. ORCA (Oscillation Research with Cosmics in the Abyss) ist ein sich im Bau befindlicher Wasser-Cherenkov-Detektor der KM3NeT-Kollaboration zum Nachweis atmosphärischer Neutrinos im Energiebereich von 1 - 50 GeV in der Tiefsee des Mittelmeeres. Im Vortrag wird die Technologie und der Status von ORCA vorgestellt und die erzielbare Sensitivität auf die Bestimmung der Massenhierarchie sowie der Oszillationsparameter diskutiert.

T 79.2 Mi 17:05 VMP9 SR 08

IceCube als γ-Teleskop — •Johannes Werthebach für die IceCube-Kollaboration — johannes.werthebach@tu-dortmund.de

IceCube ist ein Neutrino-Observatorium mit einem instrumentierten Volumen von einem Kubikkilometer. Auf Grund seines großen Volumens ist er dazu geeignet seltene Prozesse wie Myonen aus Gammaschauern zu untersuchen. Dieser Vortrag befasst sich mit der praktischen Umsetzung IceCube als ein γ-Observatorium für Energien größer als 0,5 TeV zu nutzen. Hierzu wird nach einem Myonen Überschuss aus Richtung der γ-Quelle gesucht. Dabei ist eine gute Winkelrekonstruktion wichtig. Mit Hilfe einer multivariaten Methode, des Random Forest, wird die Winkelrekonstruktion überprüft.

T 79.3 Mi 17:20 VMP9 SR 08

All-Flavor Searches for Solar Dark Matter with the IceCube Neutrino Observatory — •Klaus Wiebe for the IceCube-Collaboration — Institut für Physik, Universität Mainz, Deutschland

The talk will discuss current limits on dark matter accumulated in the sun with the IceCube Neutrino Observatory, using neutrinos of all flavors. In this context, the reconstruction of cascade-like signatures was significantly improved by the development of a new and efficient resolution estimator algorithm. To obtain limits on signal events - and as such also on the spin-dependent neutralino-proton scattering cross section - an unbinned likelihood approach is employed, using directional and energy information. The dark matter candidate is assumed to be of supersymmetric nature and limits are thus presented in the framework of the pMSSM. The latter was scanned for valid models and the complementarity between direct, indirect and accelerator searches was investigated.

T 79.4 Mi 17:35 VMP9 SR 08

Durch Myonen verursachte Spallations-Events in Eis-Cherenkov-Detektoren — •Elisa Lohfink und Sebastian Böser für die IceCube-Kollaboration — Johannes Gutenberg-Universität, Mainz

MICA (Mega ton Ice Cherenkov Array) ist eine Niedrigenergie-Erweiterung des IceCube Neutrinoteleskopes mit dem Ziel, Neutrinos aus Kern-Kollaps-Supernovae in nahe gelegenen Galaxien zu detektieren. Die Signatur solcher Supernovae besteht in einer Häufung (burst) von Neutrino-Ereignissen auf der Zeitskala von Sekunden. Der Nachweis erfordert eine Energieschwelle von weniger als ∼10MeV. Gleichzeitig darf die Rate an signalartigen Untergrundereignissen maximal einige mHz betragen, um die Anzahl an Fake-Events zu minimieren.

Da niedrigere Energien betrachtet werden gewinnen verschiedene Untergrundquellen, welche für IceCube vernachlässigbar sind, an Bedeutung. Diskutiert wird hier durch Myonen verursachte Spallation in Eis. Einige der dabei entstehenden Isotope verursachen signalartige Ereignisse die räumlich sowie zeitlich, insbesondere aufgrund langer Halbwertszeiten, schwer dem ursprünglichen Myon zuzuordnen sind. Die Relevanz verschiedener solcher Isotope wird im Bezug auf die spezifischen Detektoreigenschaften abgeschätzt. Mithilfe einer Simulation der resultierenden Signale in IceCube- und angenommenen MICA-Modulen werden effektive Methoden entwickelt, um die einzelnen Untergrund-Anteile zu reduzieren.

T 79.5 Mi 17:50 VMP9 SR 08

Simulation akustischer Neutrinodetektoren — •Dominik Kiessling für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

Die akustische Detektion von ultrahochenergetischen kosmischen Neu-

trinos ($E_\nu > 10^{18}$ eV) in Wasser ist eine Möglichkeit, um die Sensitivität von Neutrinoteleskopen zu höheren Energien zu erweitern. Die Erfahrungen mit dem akustischen Aufbau AMADEUS im ANTARES Detektor im Mittelmeer haben gezeigt, dass die bipolare Form des akustischen Signals zur Unterdrückung des transienten Untergrunds nicht ausreicht. Die Entwicklung einer Klassifikation von akustischen Ereignissen in großvolumigen Detektoren, wie z.B. KM3NeT, wird in diesem Vortrag erläutert. Eine vollständige Simulationskette für akustische Teilchendetektion ist verfügbar. Aus den Signaturen der simulierten Ereignisse werden charakteristische Größen berechnet, die im wesentlichen durch die Emissionsgeometrie des Schalls, einer Ebene (oft "pancake" genannt), bestimmt werden. Diese Werte werden verwendet, um das Ereignis mit Hilfe von Algorithmen aus dem Bereich des maschinellen Lernens zu klassifizieren.

Im Rahmen der Klassifikation werden die Parameter der Schall-Emissionsebene ebenfalls ermittelt. Die Richtung des einfallenden Neutrinos kann z.B. direkt aus dem Normalenvektor zur Ebene bestimmt werden. Die Qualität dieser Rekonstruktion wird in diesem Beitrag zusammen mit der Leistungsfähigkeit der Klassifikation untersucht.

Gefördert durch das BMBF unter Kennzeichen 05A08WE1 und 05A11WE1.

T 79.6 Mi 18:05 VMP9 SR 08

Transiente Hintergrundsignale im AMADEUS-Experiment — •Christoph Sieger für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

Das AMADEUS-Experiment ist ein Teil des ANTARES-Neutrinoteleskops im Mittelmeer und untersucht die Machbarkeit der akustischen Detektion ultrahochenergetischer ($E_\nu \gtrsim 10^{18}$ eV) kosmischer Neutrinos in Meerwasser. Diese Nachweismethode beruht auf dem thermoakustischen Modell: durch die Energiedeposition eines neutrinoinduzierten Teilchenschauers wird das umgebende Medium lokal erwärmt. Die dadurch entstehende Druckänderung breitet sich in Form einer akustischen Welle aus. Der akustische Neutrinonachweis ist besonders vielversprechend für die Instrumentierung großer Detektionsvolumina, die zur Untersuchung ultrahochenergetischer kosmischer Neutrinos aufgrund ihres geringen erwarteten Flusses benötigt werden.

Der Untergrund bei der akustischen Nachweismethode am ANTARES Standort resultiert dabei aus ambientem Rauschen und neutrinoähnlichen Signalen transienter Quellen. Um ein fiducial volume für die Neutrinodetektion bestimmen zu können, ist eine Untersuchung der Verteilung transienter Signale nötig. Im Vortrag werden vorläufige Ergebnisse der Analyse bisher aufgezeichneter akustischer Signale vorgestellt. Dabei wird insbesondere auf die Charakteristika neutrinoähnlicher Signale transienten Hintergrundes eingegangen. Gefördert durch das BMBF unter Kennzeichen 05A08WE1 und 05A11WE1.

T 79.7 Mi 18:20 VMP9 SR 08

The mDOM - A multi-PMT optical module for IceCube-Gen2 — •Lew Classen[1], Alexander Kappes[1], Timo Karg[2], Alexander Kölpin[3], Axel Kretzschmann[2], Stefan Lindner[3], and Jürgen Röber[3] — [1]Institut fur Kernphysik, Westfälische Wilhelms-Universität Münster — [2]DESY, Zeuthen — [3]LTE, Friedrich-Alexander-Universität Erlangen-Nürnberg

Following the discovery of an astrophysical neutrino flux by IceCube in 2013, planning is under way for the next generation neutrino telescope at the South Pole, IceCube-Gen2, which will significantly enhance and expand IceCube's sensitivity both towards high neutrino energies as well as in the low-energy regime.

In the scope of these efforts, a novel multi-PMT optical sensor is being developed which, following the KM3NeT design, consists of an array of several small PMTs inside a transparent pressure vessel. This design provides some significant advantages compared to the conventional single-PMT module design, such as an increased effective area, homogeneous coverage of the full solid angle, and intrinsic angular sensitivity.

The talk presents an overview of the project and its current status, featuring hardware development, testing, and simulation efforts.

T 79.8 Mi 18:35 VMP9 SR 08

Development of an acoustic sensor for the future IceCube-Gen2 detector — •Stefan Wickmann, Dmitry Eliseev, Dirk Heinen, Peter Linder, Martin Rongen, Franziska Scholz, Lars Steffen Weinstock, Christopher Wiebusch, and Simon Zierke for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen University

In the planned high-energy extension of the IceCube Neutrino Observatory in the deep ice at the geographical South Pole the spacing of detector modules will be increased with respect to IceCube. Because of these larger distances the quality of the optical geometry calibration is expected to deteriorate. To counter this an independent acoustic geometry calibration system based on trilateration is introduced. Such an acoustic positioning system (APS) has already been developed for the Enceladus Explorer Project (EnEx), initiated by the DLR Space Administration. In order to integrate such APS-sensors into the IceCube detector the power consumption needs to be minimized. In addition, the frequency response of the front-end electronics is optimized for positioning as well as the acoustic detection of neutrinos. The new design of the acoustic sensor and results of test measurements with an IceCube detector module will be presented.

T 79.9 Mi 18:50 VMP9 SR 08

First results from simulations of an IceCube-Gen2 high-energy detector equipped with multi-PMT optical modules — •Thomas Kittler and Alexander Kappes for the IceCube-Collaboration — Erlangen Centre for Astroparticle Physics, Erlangen, Germany

The high energy array (HEA) of IceCube-Gen2, the planned next generation neutrino telescope at the South Pole, aims at the detection of neutrinos with $E_\nu > 100$ TeV. In the current baseline design which follows the proven IceCube design, the central detection unit, called Digital Optical Module (DOM), is a pressure resistant glass sphere equipped with a single 10" photomultiplier (PMT) facing downwards. In parallel, alternative designs are under development which aim at improving on several aspects of the baseline design. One such design is the multi-PMT optical module (mDOM) which incorporates 24 3" PMTs uniformly distributed within the sphere. Apart from a larger photocathode area, this design features a very uniform solid-angle coverage and intrinsic directional sensitivity. The talk presents first results from simulations of a HEA detector equipped with mDOMs including studies concerning their intrinsic directional sensitivity.

T 79.10 Mi 19:05 VMP9 SR 08

Testing the Precision Optical CAlibration Module for PINGU — •Kilian Holzapfel, Antonio Becerra, Martin Jurkovic, Roman Gernhäuser, and Irene Mayoral for the IceCube-Collaboration — TUM - ECP, München, Germany

The Precision IceCube Next Generation Upgrade (PINGU) is primarily designed to determine the neutrino mass hierarchy. This measurement requires an accurate calibration of the detector in order to reduce systematic uncertainties. The Precision Optical CAlibration Module (POCAM) will be placed in the detector as a self-calibrated artificial light source in the ice. The POCAM will be enclosed in a glass sphere identical to those used for the detector modules. To construct and simulate a prototype of the POCAM, every component needs to be analyzed by their optical characteristics. We report the status of the testing environment and the selected hardware together with progress on the nanosecond LED driver circuit.

T 80: Gammaastronomie IV

Zeit: Mittwoch 16:45–19:05 Raum: VMP9 SR 27

Gruppenbericht T 80.1 Mi 16:45 VMP9 SR 27

M@TE - Monitoring at TeV Energies — •Daniela Dorner[1], Thomas Bretz[2], Magdalena González[3], Ruben Alfaro[3], and Gagik Tovmassian[4] — [1]Universität Würzburg, Deutschland — [2]RWTH Aachen, Deutschland — [3]Universidad Nacional Autónoma de México, Mexiko — [4]Instituto de Astronomia Sede Ensenada, Mexiko

A dedicated long-term monitoring programm at TeV energies has been started by the FACT project about four years ago. Being limited to one site, gaps due to the rotation of the Earth remain in the measured

light curves. This makes it difficult to study typical variability time scales of few hours to one day. To allow for systematic studies of continuous observations over up to 12 hours, a second telescope is being installed at a site in about six hours distance in longitude. For the M@TE (Monitoring at TeV energies) telescope, a mount from a previous experiment is being refurbished and will be equipped with a new camera. Using silicon based photo sensors like in FACT, an excellent and stable performance will be achieved. M@TE is a joint project of German and Mexican universities which aims at extending the blazar monitoring to so far unexplored time ranges. In the presentation, the status of this emerging project will be reported.

T 80.2 Mi 17:05 VMP9 SR 27

Sternenspuren mit dem Fluoreszenzteleskop FAMOUS — •Tim Niggemann[1], Jan Auffenberg[2], Thomas Bretz[1], Bengt Hansmann[2], Tim Hansmann[2], Thomas Hebbeker[1], Julian Kemp[1], Lukas Middendorf[1], Leif Rädel[2], Merlin Schaufel[2], Christine Peters[1], Johannes Schumacher[1], Martin Stahlberg[2], Ansgar Werhan[2] und Christopher Wiebusch[2] — [1]III. Physikalisches Institut A, RWTH Aachen University — [2]III. Physikalisches Institut B, RWTH Aachen University

Ein etabliertes Verfahren zur Detektion hochenergetischer kosmischer Strahlung ist die Messung ausgedehnter Luftschauer. Diese Teilchenkaskaden regen Stickstoffatome in der Erdatmosphäre zur isotropen Abstrahlung von Fluoreszenzlicht im UV-Bereich an. Durch die Detektion des Fluoreszenzlichts wird eine kalorimetrische Messung der Energie des Primärteilchens ermöglicht. Aus dem Lichtprofil lassen sich Rückschlüsse auf die Masse des Teilchens gewinnen. Am Pierre-Auger-Observatorium in Argentinien werden zu diesem Zweck Teleskope eingesetzt, deren lichtsensitive Detektorkomponente Photomultiplierröhren sind.

Wir haben den Teleskop-Prototypen FAMOUS ("First Auger Multipixel photon counter camera for the Observation of Ultra-high-energy air Showers") mit 64 Pixeln in Betrieb genommen, welcher durch den Einsatz von Silizium-Photomultipliern zukünftig eine gesteigerte Sensitivität bei der Messung ausgedehnter Luftschauer verspricht. In diesem Vortrag werden wir die neu entwickelte Spannungsversorgung und Messungen von Sternenspuren am Nachthimmel vorstellen.

T 80.3 Mi 17:20 VMP9 SR 27

Messung und Überwachung der atmospärischen Parameter bei den MAGIC-Teleskopen — •Martin Will für die MAGIC-Kollaboration — Instituto de Astrofísica Canarias, La Laguna, Tenerife, Spain

Die MAGIC-Teleskope auf La Palma auf den Kanarischen Inseln messen ausgedehnte Luftschauer, die von hochenergetischen Gamma-Strahlen in der Atmosphäre produziert werden. Die Kenntnis des genauen Zustands der Atmosphäre ist dabei von großer Wichtigkeit, sowohl für den korrekten und sicheren Betrieb der Teleskope, als auch für die spätere Datenanalyse.

Eine Wetterstation misst Zustandsgrößen wie Temperature und Luftfeuchte, die atmosphärische Transmission wird mittles eines LIDAR-Systems und eines Infrarot-Pyrometers bestimmt. Mit Hilfe einer AllSky-Kamera kann die Bewölkung abgeschätzt werden. Die Messwerte werden vervollständigt durch Daten des GFS-Modells aus globalen Messungen und numerischer Wettervorhersage.

Im Vortrag wird eine Übersicht der genannten Instrumente und deren Messungen präsentiert, sowie langjährige Studien der archivierten Wetterdaten am Standort der MAGIC-Teleskope und deren Vergleich zu Modell-Daten.

T 80.4 Mi 17:35 VMP9 SR 27

FACT – Normalized and Asynchronous Mirror Alignment for Cherenkov Telescopes — •Sebastian Achim Mueller[1] and Jens Buss[2] — [1]ETH Zurich, Switzerland — [2]TU Dortmund

Imaging Atmospheric Cherenkov Telescopes (IACTs) need fast and large imaging optics to map the faint Cherenkov light emitted in cosmic ray air showers onto their image sensors. Segmented reflectors are inexpensive, lightweight and offer good image quality. However, alignment of the mirror facets remains a challenge. A good alignment is crucial in IACT observations to separate gamma rays from hadronic cosmic rays. We present a star tracking alignment method which is not restricted to clear nights. It normalizes the mirror facet reflections to be independent of the reference star or the cloud coverage. It records asynchronously of the telescope drive which makes the method easy to integrate in existing telescopes. It can be combined with remote facet actuation, but it does not need one to work. Furthermore, it can reconstruct all individual mirror facet point spread functions. We present the method and alignment results on the First Geiger-mode Photo Diode Avalanche Cherenkov Telescope (FACT) on the Canary Island of La Palma, Spain.

T 80.5 Mi 17:50 VMP9 SR 27

FACT – Bokeh Alignment for Cherenkov Telescopes — •Sebastian Achim Mueller[1] and Jens Buss[2] — [1]ETH Zurich, Switzerland — [2]TU Dortmund

Imaging Atmospheric Cherenkov Telescopes (IACTs) need fast and large imaging optics to map the faint Cherenkov light emitted in cosmic ray air showers onto their image sensors. Segmented reflectors are inexpensive, lightweight and offer good image quality. However, alignment of the mirror facets remains a challenge. A good alignment is crucial in IACT observations to separate gamma rays from hadronic cosmic rays. We present a simple, yet extendable method, to align segmented reflectors using their Bokeh. Bokeh alignment does not need a star or good weather nights but can be done anytime, even during the day. Bokeh alignment optimizes the facet orientations by comparing the segmented reflector's Bokeh to a predefined template. The Bokeh is observed using the out of focus image of a nearby point like light source in a distance of about ten times the focal lengths. We introduce Bokeh alignment on segmented reflectors and present its use on the First Geiger-mode Avalanche Cherenkov Telescope (FACT) on Canary Island La Palma, as well as on the Cherenkov Telescope Array (CTA) Medium Size Telescope (MST) prototype in Berlin Adlershof.

T 80.6 Mi 18:05 VMP9 SR 27

First Data from IceAct, an Imaging Air Cherenkov Telescope with SiPMs at the South Pole — •Jan Auffenberg, Thomas Bretz, Bengt Hansmann, Tim Hansmann, Thomas Hebbeker, Julian Kemp, Lukas Middendorf, Tim Niggemann, Leif Rädel, Merlin Schaufel, Johannes Schumacher, Martin Stahlberg, Ansgar Werhan, and Christopher Wiebusch — RWTH Aachen University

IceCube-Gen2 is planned to extend the IceCube Neutrino Observatory at the geographic South Pole. 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 powerful 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, IceVeto. Part of these extension plans is an array of imaging air Cherenkov telescopes, IceAct. A first IceAct prototype is consisting of an SiPM camera and lens optics optimized for harsh environments. Compared to IceTop stations, these telescopes potentially lower the detection threshold for air showers at the cost of a lower duty cycle. We will present first data, taken during the commissioning of an IceAct prototype in December 2015 at the South Pole.

T 80.7 Mi 18:20 VMP9 SR 27

Template Analysis for the MAGIC telescopes — •Uta Menzel for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München

The MAGIC telescopes are two 17-m-diameter Imaging Air Cherenkov Telescopes located on the Canary island of La Palma. They record the Cherenkov light from air showers induced by very high energy photons. The current data analysis uses a parametrization of the two shower images (including Hillas parameters) to determine the characteristics of the primary particle. I am implementing an advanced analysis method that compares shower images on a pixel basis with template images based on Monte Carlo simulations. To reduce the simulation effort the templates contain only pure shower images that are convolved with the telescope response later in the analysis. The primary particle parameters are reconstructed by maximizing the likelihood of the template. By using all the information available in the shower images, the performance of MAGIC is expected to improve. In this presentation I will explain the general idea of a template-based analysis and show the first results of the implementation.

T 80.8 Mi 18:35 VMP9 SR 27

Spectral, morphological and temporal analysis of the Galactic Center gamma-ray emission based on new observations with MAGIC — Christian Fruck[1], •John E Ward[2], and Iev-

gen Vovk[1] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik, München, GERMANY — [2]Institut de Fisica d'Altes Energies, Barcelona, SPAIN

During the past four years, MAGIC has observed the Galactic Center (GC) region at large zenith distance (58°-70°) for more than 60 h after quality cuts. Based on this data set we have studied the gamma-ray spectrum of the central source up to 40 TeV, and searched for time variability in its flux during the pericentre passage of the G2 object, which approached the central black as close as about 2000 Schwarzschild radii in 2013/14. These observations also gave us the opportunity to study the morphology of the extended TeV emission in the GC region.

T 80.9 Mi 18:50 VMP9 SR 27

A spatial likelihood analysis for MAGIC skymaps — •Marcel Strzys, Ievgen Vovk, and Christian Fruck for the MAGIC-Collaboration — Max-Planck-Institut für Physik, München, Deutschland

Due to the constant improvement of the sensitivity of Cherenkov telescopes the detection of ever weaker signals becomes possible resulting in much more details in the morphologies of the observed sources. The task of flux extraction from different subregions of the observed source is challenging with the traditional approach employing the "aperture photometry" technique. We therefore developed a new analysis tool for MAGIC that allows the user to simultaneously fit several sources, similar to what is common practice in space gamma-ray observatories such as EGRET and *Fermi*-LAT. The method incorporates an user-defined composite source model, the background from hadronic events, and a full Monte-Carlo based modelling of the instrument response functions. A model of the source as seen by the telescopes is constructed and fitted to the data. In this way arbitrarily complex morphological models can be tested for their significance and the spectrum of several subcomponents can be extracted self-consistently. We are going to present the method and its applicability to gamma-ray observations using data from the MAGIC telescopes.

T 81: BSM Suchen V (Leptoquarks und exotische top-Quarks)

Zeit: Mittwoch 16:45–19:00 Raum: VMP9 SR 28

T 81.1 Mi 16:45 VMP9 SR 28

Search for scalar leptoquarks with the ATLAS experiment — •Vojtech Pleskot and Stefan Tapprogge — Institut fur Physik, JGU Mainz, Staudinger Weg 7, D-55099 Mainz

Scalar leptoquarks are hypothetical particles predicted by many theories beyond the Standard Model. They carry both color and electric charge. They couple to leptons and quarks via a Yukawa interaction lagrangian term. In a minimalistic Buchmueller-Rueckl-Wyler model, there are three generations of leptoquarks each of which couple to one lepton family only. In proton-proton collisions, leptoquarks can be produced in pairs.

The talk will summarize recent efforts of the ATLAS collaboration in the search for the pair production of scalar leptoquarks in proton-proton collisions at a centre-of-mass energy of 13 TeV. The detector signature searched for are two electrons (muons) and two jets in the case of a first (second) generation leptoquark pair production.

T 81.2 Mi 17:00 VMP9 SR 28

ATLAS search for 1st and 2nd generation Leptoquarks at $\sqrt{s} = 13$ TeV — •Ruth Pöttgen — Universität Stockholm

In the Standard Model, there are many striking similarities between the quark and the lepton sector. Leptoquarks are hypothetical particles that are part of many models for physics beyond the Standard Model and provide a connection between the two sectors. They are commonly assumed to couple to quarks and leptons of only one generation. This contribution gives an overview of the motivation for and presents important aspects of the search for 1st- and 2nd-generation leptoquarks performed by the ATLAS collaboration using 3.2 fb^{-1} of data collected at a centre-of-mass energy of $\sqrt{s} = 13$ TeV during 2015.

T 81.3 Mi 17:15 VMP9 SR 28

Search for Scalar Leptoquarks with the ATLAS detector. - Recent results and prospects — •Giovanni Siragusa — Julius-Maximilians-Universität, Würzburg, Germany

Similarities between leptons and quarks in the SM suggest the existence of symmetries beyond the EW symmetry breaking scale. Leptoquarks (LQ) are hypothetical charged particles which carry both quark and lepton flavour quantum numbers. They appear naturally in many BSM theories and there have already been searches at previous collider experiments. A model independent search of pair-produced LQs with the ATLAS detector, based on a effective theory, will be reported, together with the prospects for LQ searches at the Large Hadron Collider.

T 81.4 Mi 17:30 VMP9 SR 28

Search for pair production of leptoquarks decaying into a top quark and a muon at the CMS experiment — Johannes Haller, Roman Kogler, Thomas Peiffer, •Arne Reimers, and Marc Stöver — Institut für Experimentalphysik, Universität Hamburg

In this talk we present a search for pair produced scalar leptoquarks in pp-collisions of $\sqrt{s} = 13$ TeV. The data have been collected by the CMS experiment in 2015. Leptoquarks are hypothetical particles with simultaneous couplings to quarks and leptons. In this analysis, the decay channel of scalar leptoquarks decaying into a top quark and a muon is studied. Therefore the basic event signature are muons and jets.

In the event selection possible leptoquark events are enriched and the standard model background is reduced as much as possible. In events containing additional electrons, the 4-momentum of top quark candidates is calculated from information of the leading electron, missing transverse energy and at least one jet. Leptoquark hypotheses are then tested via a χ^2 minimization using top quark candidates and muons. A data driven method for the estimation of the dominant standard model background is presented. The expected sensitivity to leptoquarks and exclusion limits are derived.

T 81.5 Mi 17:45 VMP9 SR 28

Search for pair production of leptoquarks decaying into a top quark and a tau lepton at the CMS experiment — Johannes Haller, Roman Kogler, Thomas Peiffer, Arne Reimers, and •Marc Stöver — Institut für Experimentalphysik, Universität Hamburg

A search for third generation leptoquarks at the LHC is presented. Leptoquarks are hypothetical gauge bosons which are predicted by many theories beyond the standard model. They couple to both quarks and leptons. In this analysis, the pair production of leptoquarks decaying into a top quark and a tau lepton is studied.
We focus on the lepton + jets channel where one of the top quarks decays hadronically and the other one leptonically. The study uses the full dataset of the year 2015 which was collected with the CMS detector at $\sqrt{s} = 13$ TeV. The event selection is optimized such that the standard model background is reduced as much as possible. Finally, the expected limits on the leptoquark production cross section with the current and the forthcoming datasets will be discussed.

T 81.6 Mi 18:00 VMP9 SR 28

Studie zum Zerfall angeregter Top-Quarks durch Abstrahlung von Gluonen mit Hilfe des CMS-Detektors — Johannes Haller, Roman Kogler und •Jens Multhaup — Institut für Experimentalphysik Universität Hamburg

Das Top-Quark nimmt durch seine hohe Masse eine Sonderrolle im Standardmodell ein und macht es zudem für Hinweise auf eine Physik jenseits des Standardmodells interessant. In der hier vorgestellten Erweiterung des Standardmodells wird angenommen, dass es sich bei dem Top-Quark um ein zusammengesetztes Teilchen handelt. Eine Anregung auf ein höheres Energieniveau und die anschließende Abregung durch die Abstrahlung von Gluonen, dient dabei als Signatur nach der in der präsentierten Studie gesucht wird. Um diese nachzuweisen wurden Daten des CMS-Experimentes aus pp-Kollisionen bei einer Schwerpunktsenergie von 13 TeV untersucht. Im Vortrag wird der aktuelle Stand der Analyse präsentiert.

T 81.7 Mi 18:15 VMP9 SR 28

Search for $t\bar{b}$ resonances with the ATLAS detector at the LHC — •Geoffrey Gilles for the ATLAS Pixel-Collaboration —

Bergische Universität Wuppertal, Wuppertal, Germany

Despite the success of the Standard Model (SM) all along the last fifty years, conceptual limitations do not allow it to answer to some theoretical questions or justify certain experimental observations. These elements let us think that the SM would be only an approximation at low energy of a more fundamental theory. The challenge of particle physics is to search for new phenomena at high-energy not included in the SM. The unique properties of the top quark make it an outstanding tool to probe new dynamics beyond the SM, where it should play a key role, especially by coupling to new heavy resonances.

This presentation will report on searches for new heavy charged vector or scalar bosons, usually called W' and H^+, decaying into a top and a bottom quark through effective coupling approaches, in lepton plus jets final states. These searches are performed with 20.3 fb^{-1} of proton collision data, produced by the LHC at Run I, at a center-of-mass energy of 8 TeV and collected by the ATLAS detector in 2012. This talk intends to present the analysis strategy using multivariate techniques based on boosted decision trees to search for an excess of W' or H^+ signal processes in the recorded data, and the statistical analysis performed to extract exclusion limits on the mass, the production cross section or the effective couplings of these particles. It will finally conclude on the perspectives of these searches at the LHC Run II.

T 81.8 Mi 18:30 VMP9 SR 28

Search for a Z' heavy resonance decaying to top and vector-like quarks in the all hadronic channel at 13 TeV with CMS — Ivan Marchesini, Alexander Schmidt, and •Emanuele Usai — Universität Hamburg

Many models predicting a heavy neutral spin-1 resonance also predict the existence of vector-like quarks. A hypothetical resonance might then predominantly decay to these heavy quark partners rather than SM particles.

We present a search for a Z' heavy resonance decaying in a top and a heavy vector-like top partner (T'). The analysis is tailored for the final state where the T' decays in a W boson and a b quark. We focus on the all hadronic channel where both the top and the W quark coming from the T' decay hadronically.

In this kind of searches, the decay products of the top quark and the W boson are highly boosted and cannot be reconstructed as separate jets. Top and boson tagging algorithms are then used to reconstruct the decays.

Jet substructure tools, in addition to b-tagging in boosted topologies, are employed to reduce the QCD multijet background and improve the sensitivity of the analysis.

T 81.9 Mi 18:45 VMP9 SR 28

Search for singly produced Z' boson decaying into $T't$ at the CMS experiment — •Anna Benecke, Johannes Haller, and Roman Kogler — Institut für Experimentalphysik, Universität Hamburg

Many models of physics beyond the standard model predict vector-like quarks (T') and in addition a new heavy gauge boson (Z'). While decays of the Z' and T' into standard model particles have been studied already, no experimental results for the decay $Z' \to T't$ are avaible so far. In this talk a search for singly produced Z' bosons decaying into $T't$ in pp collisions at $\sqrt{s}$=13 TeV is presented. The analysis is performed in the lepton + jets channel. Two decay channels of the T' into the Higgs boson and a top quark or a Z boson and a top quark are considered. For this purpose the full dataset collected by the CMS experiment at $\sqrt{s}$=13 TeV is used. The status of this analysis will be shown, including the event selection and the reconstruction of the decay chain.

T 82: Kosmische Strahlung IV

Zeit: Mittwoch 16:45–19:05 Raum: VMP9 SR 29

Gruppenbericht T 82.1 Mi 16:45 VMP9 SR 29

The JEM-EUSO mission — •Francesca Bisconti for the JEM-EUSO-Collaboration — Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT)

The JEM-EUSO (Extreme Universe Space Observatory onboard the Japanese Experiment Module) Collaboration aims to investigate ultra high-energy cosmic rays (UHECRs), with a detector sensitive to the UV fluorescence emission of extensive air showers in the Earth's atmosphere, looking down from the International Space Station. This will result in a large field of view and about tenfold better statistics for UHECRs than with ground-based observatories.

The basic component of the detector's focal surface (about 2 m diameter) is the photo detector module (PDM, about 16 cm side), composed of 36 Multi-Anode Photomultiplier Tubes from Hamamatsu, with 64 pixels each. In front of the focal surface, Fresnel lenses focus photons on it.

Some telescope prototypes with one PDM focal surface are already active or under development, in order to validate the design and the potentiality of such a space based telescope. Moreover, silicon photomultipliers (SiPMs) are under consideration for the realization of a PDM.

Motivation, detection principle and features of the space-based telescope, as well as those of its prototypes will be described.

T 82.2 Mi 17:05 VMP9 SR 29

EUSO-TA data and simulations — •Francesca Bisconti for the JEM-EUSO-Collaboration — Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT)

EUSO-TA is one of the fluorescence cosmic ray detector prototypes developed by the JEM-EUSO Collaboration. The prototype has two 1 m diameter Fresnel lenses and one photo detector module (PDM) as focal surface. The PDM consists of 36 multi-anode photomultiplier tubes from Hamamatsu. The prototype has been designed to get information about the calibration of the Fresnel lense system and the PDM, basic parts of the main space-based fluorescence detector under development.

EUSO-TA is located at the Black Rock Mesa site of the Telescope Array project (Utah-USA) and works in parallel with the TA fluorescence detectors since February 2015. During its campaigns, EUSO-TA detects cosmic ray events, as well as the pulsed laser from the Central Laser Facility, necessary for the detector calibration. Also planes and stars signatures are well visible in the data, although out of the scientific purpose.

The analysis of EUSO-TA data and the comparison of data with simulations will be shown.

T 82.3 Mi 17:20 VMP9 SR 29

SPOCK - Single PhOton Calibration stand at Kit — •Michael Karus[1], Andreas Ebersoldt[2], Simon Ehnle[1], Nils Hampe[1], Andreas Haungs[1], Thomas Huber[1], Max Renschler[1], Sally-Ann Sandkuhl[1], Harald Schieler[1], and Andreas Weindl[1] for the JEM-EUSO-Collaboration — [1]Institut für Kernphysik (IKP), Karlsruher Institut für Technologie (KIT) — [2]Institut für Prozessdatenverarbeitung und Elektronik (IPE), KIT

For JEM-EUSO many photodetectors need to be calibrated pre-flight. Therefore, the *Single PhOton Calibration stand at Kit* (SPOCK) was built. It is a multi-purpose calibration stand for different photodetectors, e. g. PMTs and SiPMs, that are needed for the detection of fluorescence light from extensive air showers. The capabilities of SPOCK are that different kinds of detectors can be compared with the same systematics. For this, several calibration modes are possible. Detectors can be thoroughly tested in single-photon mode, measuring their *photo detection efficiency* (PDE) and their *gain*, with single photons. SPOCK allows for the uniform illumination of bigger detector areas and thus the simultaneous calibration of either several small detectors or of one bigger detector. The dynamic range of detectors can be also tested with SPOCK, via a variable optical output power, ranging from single photons to several 10000 photons per light pulse. Furthermore, different wavelengths can be used with SPOCK. This is especially interesting, as newest SiPMs get more sensitive to the UV-regime. This contribution will show how SPOCK is able to perform single-photon calibration and show examples of the calibration process.

T 82.4 Mi 17:35 VMP9 SR 29

Investigating the physics performance of air shower univer-

sality at the Pierre Auger Observatory — •Ariel Bridgeman, Alexander Schulz, and Markus Roth for the Pierre-Auger-Collaboration — Karlsruhe Institute of Technology

Recent updates to the air shower universality reconstruction of surface detector data at the Pierre Auger Observatory have reduced the bias and improved the resolution of mass-sensitive variables: the depth of shower maximum and the relative number of muons. For better-informed studies of a possible anisotropy in the arrival direction of ultra-high-energy cosmic rays, a quantification of the power of these parameters to separate a proton-like signal from background is presented. The analysis is furthered with an outlook to the detector*s overall sensitivity to a proton-like signal as well as a projection of our ability to distinguish between different astrophysical flux scenarios.

T 82.5 Mi 17:50 VMP9 SR 29

Das Energiespektrum der kosmischen Strahlung rekonstruiert mit einer kombinierten Analyse der KASCADE und KASCADE-Grande Messungen — •Sven Schoo für die KASCADE-Grande-Kollaboration — KIT, Karlsruhe, Germany

Das KASCADE Luftschauer-Array bestand aus 252 Stationen, die mit Szintillations-Detektoren ausgestattet waren. 192 dieser Stationen waren zudem mit abgeschirmten Szintillatoren versehen, die als Myon-Detektoren dienten. Damit war die Rekonstruktion der Energie und der Masse des kosmischen Teilchens möglich. KASCADE-Grande war eine Erweiterung des ursprünglichen KASCADE Detektors um 37 Stationen, wurde jedoch separat rekonstruiert. In diesem Beitrag wird die kombinierte Rekonstruktion der beiden Arrays, sowie die Analyse vorgestellt. Die Vorteile dieser Kombination gegenüber den separaten Analysen werden erläutert und die Ergebnisse bezüglich des Energiespektrums und der Massenkomposition diskutiert.

T 82.6 Mi 18:05 VMP9 SR 29

Messung der atmosphärischen Tiefe des Schauermaximums mit dem Pierre-Auger-Observatoriums und Untersuchung der systematischen Unsicherheiten — •Joachim Debatin, Ralph Engel, Michael Unger und Alessio Porcelli für die Pierre-Auger-Kollaboration — KIT, Karlsruhe

Kenntnis der nuklearen Zusammensetzung der kosmischen Strahlung ist wichtig um verschiedene Quell- und Transportmodelle der kosmischen Strahlung testen zu können. Die mittlere atmosphärischen Tiefe des Schauermaximums, X_{max}, und die Schauer-zu-Schauer Fluktuationen von X_{max} sind Messgrößen, die direkt mit der Massenzusammensetzung der kosmischen Strahlung zusammenhängen. Durch das beschränkte Sichtfeld der Fluoreszenzteleskope stimmt die beobachtete X_{max} - Verteilung nicht mit der tatsächlichen Verteilung in der Atmosphäre überein. In diesem Vortrag wird eine von der Auger-Kollaboration entwickelte Methode vorgestellt, die eine weitgehend simulationsunabhängige Selektion der Daten erlaubt, um eine unverzerrte X_{max} - Verteilung zu erhalten. Die Anwendung dieser Methode wird mit Daten der Fluoreszenzteleskope demonstriert, wobei der Schwerpunkt auf der Untersuchung sys. Unsicherheiten der so gewonnenen X_{max} - Verteilung liegt.

T 82.7 Mi 18:20 VMP9 SR 29

KASCADE Cosmic Ray Data Centre (KCDC) — •Sven Schoo, Andreas Haungs, Donghwa Kang, Doris Wochele und Jürgen Wochele für die KASCADE-Grande-Kollaboration — KIT, Karlsruhe, Germany

Das KASCADE Cosmic Ray Data Centre (KCDC) ist ein Open Data Internetportal (https://kcdc.ikp.kit.edu) für die Veröffentlichung von Luftschauerdaten, die mit dem KASCADE Experiment aufgenommen beziehungsweise rekonstruiert wurden. Neben den Daten selbst umfasst das Portal eine umfangreiche Dokumentation zum Experiment und den Daten. Zudem werden Lehrbeispiele zur Verfügung gestellt, die sich in erster Linie an interessierte Schüler und Studenten richten. Dieser Beitrag stellt das Konzept des Portals vor, fasst den momentanen Umfang zusammen und stellt die Neuerungen der aktuellen Version MERIDIAN, sowie die Pläne für die weitere Entwicklung und die Veröffentlichung der Software des Projekts vor. Der Fokus liegt dabei auf der Implementierung des Software Paketes und dessen Anwendbarkeit für andere Experimente.

T 82.8 Mi 18:35 VMP9 SR 29

Analyse hochenergetischer Myonen in IceCube — •Tomasz Fuchs für die IceCube-Kollaboration — TU Dortmund

Ein Großteil der gemessenen Ereignisse in IceCube besteht aus Myonen, welche durch Wechselwirkung der kosmischen Strahlung mit der Atmosphäre erzeugt werden. Mit Hilfe eines Energiespektrums der Myonen ist es möglich für hohe Myonenergien den Beitrag der prompten Komponente der Myonen zu bestimmen. In diesem Vortrag wird eine Analyse zur Selektion von hochenergetischen atmosphärischen Myonen mit maschinellen Lernverfahren vorgestellt. Anschließend werden die Ergebnisse einer Entfaltung des erstellten Datensatzes gezeigt, mit dessen Hilfe ein Spektrum der wahren Energie der hochenergetischen Myonen im Energiebereich von 10 TeV bis 1 PeV erstellt wurde.

T 82.9 Mi 18:50 VMP9 SR 29

Laterally separated muons from cosmic ray air showers in IceCube — •Dennis Soldin for the IceCube-Collaboration — Bergische Universität Wuppertal

Cosmic ray air showers with primary energies above $\gtrsim$ 1 TeV can produce muons with high transverse momentum ($p_{\mathrm{T}} \gtrsim 2$ 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, and the muon lateral distribution depends on the composition of the incident nuclei. Hence, the composition of high energy cosmic rays can be determined from muon separation measurements. For $p_{\mathrm{T}} \gtrsim 2$ GeV particle interactions can be described in the context of perturbative quantum chromodynamics (pQCD). Thus, measurements of these muons may contribute to test pQCD predictions of high energy interactions involving intermediate nuclei.

We present an analysis of laterally separated muons in IceCube using data taken from May 2012 to May 2013. Based on dedicated simulations we discuss the contributions from various hadrons produced in air showers to the high p_{T} muon flux. Moreover, the lateral separation distribution, and a method to derive the transverse momentum distribution at generation, will be shown. The resulting distributions are used to study the cosmic ray mass composition in the PeV range.

T 83: Kosmische Strahlung

Zeit: Mittwoch 16:45–19:05 Raum: VMP9 SR 30

Gruppenbericht T 83.1 Mi 16:45 VMP9 SR 30

An alternative explanation for the GeV excess in the Fermi gamma ray data. — Iris Gebauer, •Wim de Boer, and Alexander Neumann — Karlsruhe Institute of Technologie, Karlsruhe, Germany

Towards the Galactic center the diffuse Fermi Gamma Ray data show a 1-3 GeV excess, which has been interpreted previously as a new source, like dark matter annihilation, contributions from millisecond pulsars or cosmic rays interacting with molecular clouds. We search for this excess in the whole Galactic Plane and find it to be perfectly correlated with the spatial distribution of the 26Al line, thought to be a tracer of SNRs. So the excess is not only found in the Galactic Center, but found everywhere, where there are molecular clouds (MCs). This excludes the dark matter annihilation interpretation. If we assume the proton spectrum in MCs to be depleted at energies below 14 GeV by a combination of trapping, solar winds and energy losses, we find a perfect description of the whole gamma ray sky. In this case the excess is not an excess, but a depletion of low energy gamma rays below a few GeV due to the depletion of the protons in MCs below 14 GeV, which happens not only in the Galactic Center, but everywhere in the Galactic Plane, where there are MCs with star formation, as proven by the identical morphology of the excess and the 1.8 MeV line of 26Al, observed by Comptel and Integral.

T 83.2 Mi 17:05 VMP9 SR 30

High-energy neutrinos from AGN — •Marius Toschke[1,2], Ju-

lia Becker Tjus[1], and Wolfgang Rhode[2] — [1]Ruhr-Universität Bochum — [2]TU Dortmund

In the outer space there are galactic and extragalactic sources like gamma-ray bursts (GRB), active galactic nuclei (AGN), supernovae or other phenomena which produce high-energy neutrinos. In contrast to supernovae, GRBs and AGN are supposed to generate neutrinos at the highest energies. Neutrinos have a tiny cross section as they mainly suffer from the weak interaction. Therefore, they are useful messenger particles providing information about the direction of the source. With observations of the gamma flux from galactic and extragalactic sources, it is possible to make predictions for the neutrino flux. We suppose that neutrinos are predominantly generated by inelastic proton-proton interactions and derive the possible galactic and extragalactic sources. In this talk, first results are presented.

T 83.3 Mi 17:20 VMP9 SR 30

Neutrino and Gamma-ray connections during flaring states of Mrk 421 — •Stefan Coenders[1], Maria Petropoulou[2], and Stavros Dimitrakoudis[3] — [1]Technische Universität München, Boltzmannstr. 2, 85748 Garching — [2]Department of Physics and Astronomy, Purdue University, 525 Northwestern Avenue, West Lafayette, IN 47907, USA — [3]Department of Physics, University of Alberta, Edmonton, Alberta T6G 2E1, Canada

Blazars, being highly variable sources across the electromagnetic spectrum, may serve as promising targets for high-energy neutrino detection, especially during flaring activity. The nearby blazar Mrk 421 provides a unique testbed using unprecedented multi-wavelength data during a 13-day flaring period to create a detailed model of the hadronic interactions. From that, connections of the neutrino spectrum above TeV energies with gamma-rays can be deduced, resulting in predictions of the neutrino event rate observable by cubic kilometre neutrino observatories. Within the data available, IceCube reaches sensitivities low enough to test the hadronic emission model of Mrk 421. We report about the modelling of Mrk 421 and implications for observations with the IceCube Neutrino Observatory.

T 83.4 Mi 17:35 VMP9 SR 30

Propagating ultra-high energy cosmic rays through galactic and extragalactic space using CRPropa 3* — Rafael Alves Batista[1], Andrej Dundovic[1], Martin Erdmann[2], Karl-Heinz Kampert[3], •Daniel Kuempel[2], Gero Müller[2], Guenter Sigl[1], Arjen van Vliet[1,4], David Walz[2], and Tobias Winchen[3,5] — [1]II. Institut für Theoretische Physik, Hamburg University — [2]III. Physikalisches Institut A, RWTH Aachen University — [3]Fachbereich C, Wuppertal University — [4]IMAPP Department of Astrophysics, Radboud University — [5]Astrophysical Institute, Vrije Universiteit Brussel

The interpretation of the measured energy spectrum, composition and arrival direction of ultra-high energy cosmic rays (UHECRs) above $\sim 10^{17}$ eV is still under controversial debate. The development and improvement of numerical tools to propagate UHECRs in galactic and extragalactic space is a crucial ingredient to interpret data and to draw conclusions on astrophysical parameters. In this contribution recent developments of the publicly available propagation code CRPropa 3 are outlined. Examples are given for 1D and 3D simulations in structured magnetic fields including secondary messengers such as photons and neutrinos. To take into account cosmological effects, also 4D simulations are possible and discussed in the talk.

* Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik

T 83.5 Mi 17:50 VMP9 SR 30

Astroparticle tests of Lorentz symmetry — •Jorge Diaz — Karlsruhe Institute of Technology, Karlsruhe, Germany

Lorentz symmetry is a cornerstone of modern physics. As the spacetime symmetry of special relativity, Lorentz invariance is a basic component of the standard model of particle physics and general relativity, which to date constitute our most successful descriptions of nature. Deviations from exact symmetry would radically change our view of the universe and current experiments allow us to test the validity of this assumption. In this talk, I will describe effects of Lorentz violation in cosmic rays and gamma rays that can be studied in current observatories.

T 83.6 Mi 18:05 VMP9 SR 30

Bubbles, Superbubbles and their impact on cosmic ray transport — •Matthias Weinreuter, Iris Gebauer, Wim de Boer, and Alexander Neumann — KIT, Karlsruhe

The Fermi-LAT data on diffuse gamma rays show variations in the gamma ray intensity, which are linked to either variations in the gas density or variations in the cosmic ray density. Such small scale variations are not modeled in current state-of-the-art models for galactic cosmic ray propagation. Inhomogeneities in the interstellar material can be formed by cavities like the so-called Local Bubble, an underdense region surrounding our Sun, which was created by several supernova explosions in the past. We show that the Local Bubble can have a strong impact on the cosmic ray energy spectra and density. In particular, it enhances cosmic ray scattering in the surrounding molecular cloud complexes and can significantly distort the cosmic ray arrival directions. We briefly discuss the consequences for pulsar searches in energetic positrons and electrons. By making simple assumptions on the level of inhomogeneity in the interstellar medium we investigate if the observed variations in the diffuse gamma ray emission can indeed be explained by cavities similar to the Local Bubble.

T 83.7 Mi 18:20 VMP9 SR 30

Analytic investigation of extended Heitler-Matthews model — •Stefan Grimm, Darko Veberič, and Ralph Engel — KIT, http://www.ikp.kit.edu/

Many features of extensive air showers are qualitatively well described by the Heitler cascade model and its extensions. The core of a shower is given by hadrons that interact with air nuclei. After each interaction some of these hadrons decay and feed the electromagnetic shower component. The most important parameters of such hadronic interactions are inelasticity, multiplicity, and the ratio of charged vs. neutral particles. However, in analytic considerations approximations are needed to include the characteristics of hadron production.

We discuss extensions of the simple cascade model by analytic description of air showers by cascade models which include also the elasticity, and derive the number of produced muons. In a second step we apply this model to calculate the dependence of the shower center of gravity on model parameters. The depth of the center of gravity is closely related to that of the shower maximum, which is a commonly-used composition-sensitive observable.

T 83.8 Mi 18:35 VMP9 SR 30

Studie zu einem Fixed-Target Experiment mit LHC Strahl für die Astroteilchenphysik — •Uwe Krämer, Ralf Ulrich, Colin Baus, Felix Riehn und Tanguy Pierog — Karlsruher Institut für Technologie (KIT), Institut für Kernphysik (IKP)

Mit Hilfe von Monte Carlo Modellen wurden Simulationen zu einem Fixed-Target Experiment mit LHC Strahl durchgeführt. Von besonderem Interesse ist die Möglichkeit von Kohlenstoff als Target sowie die Messung bis in den hohen x_f-Bereich. Solche Messungen sind z.B. wichtig für die Interpretation von Ultra-hochenergetischen kosmischen Strahlen. Zudem kann die Charm Produkion im hohen x_f-Bereich detailliert gemessen werden, welche eine der Unsicherheiten für die PeV Neutrinos darstellt. Die speziellen experimentellen Probleme eines solchen Fixed-Target Experiments werden vorgestellt und mögliche Lösungsansätze aufgezeigt.

T 83.9 Mi 18:50 VMP9 SR 30

Simulation of Galactic cosmic ray propagation using CrPropa3 — •Lukas Merten and Julia Tjus — Ruhruniversität Bochum, Germany

The propagation of charged cosmic rays through the Galactic environment influences all aspects of the observation at Earth. Energy spectrum, composition and anisotropy are changed due to deflections in magnetic fields and interactions with the interstellar medium. Today the transport is simulated with different simulation methods either based on the solution of a transport equation (multi-particle picture) or a solution of an equation of motion (single-particle picture).

This talk evaluates the possibility of a single-particle simulation of the Galactic propagation. In difference to the multi-particle picture this approach makes additional information available, e.g. trajectory information and concrete interaction positions of single particles. Furthermore, stochastic energy losses can be implemented very easily and even backtracking of particles is possible in some cases.

In doing so, the publicly available simulation software CrPropa3 is extended to suit Galactic modelling needs. This is done using a random walk ansatz for the diffusive Galactic propagation. This new procedure increased the performance of the program by a factor of more than 1 000 and is still sufficiently accurate. We will discuss the current status of this ansatz in this talk.

T 84: Trigger und DAQ III

Zeit: Mittwoch 16:45–19:00 Raum: VMP11 HS

T 84.1 Mi 16:45 VMP11 HS

Entwicklung eines auf den ATLAS-Myondriftrohrkammern basierenden Level-0-Myontriggers für HL-LHC — Philipp Gadow, Oliver Kortner, Hubert Kroha, Felix Müller, •Sebastian Nowak und Robert Richter — Max-Planck-Institut für Physik, München

Für den Ausbau des ATLAS-Detektors für hohe LHC-Luminositäten im Rahmen des HL-LHC-Upgrades wird eine Verbesserung der Impulsauflösung des Level-0-Myontriggers benötigt. Um einen Austausch der vorhandenen Triggerkammern zu vermeiden, sollen zusätzlich zu diesen die Myondriftrohrkammern (MDT-Kammern) mit ihrer hohen Ortsauflösung für den Myontrigger verwendet werden. Hierfür ist eine neue, schnelle Ausleseelektronik der MDT-Kammern erforderlich, sowie die Entwicklung von auf FPGAs und Mikrocomputern basierenden Triggerprozessoren, die die Myonspuren auch bei hohem Untergrund von Neutronen- und Gammastrahlung innerhalb der Level-0-Triggerlatenzzeit von ca. 6μs rekonstruieren können. Zur Demonstration der Realisierbarkeit des Triggerkonzepts wurde eine Prototypversion der schnellen Ausleseelektronik entwickelt und in einem Myonstrahl am CERN bei unterschiedlichen Untergrundraten von einer starken ^{137}Cs-Gammastrahlungsquelle getestet. Das Triggerkonzept, der Algorithmus zur Myonspurrekonstruktion sowie die Ergebnisse des Prototypentests werden vorgestellt.

T 84.2 Mi 17:00 VMP11 HS

Entwicklung schneller Spurrekonstruktionsalgorithmen für den auf den ATLAS MDT-Kammern beruhenden Level-0-Myontrigger für HL-LHC — •Philipp Gadow, Oliver Kortner, Hubert Kroha und Sebastian Nowak — Max-Planck-Institut für Physik, München

Das ATLAS-Experiment wird einen mehrstufigen Trigger für die Datennahme am HL-LHC verwenden. Um niederenergetische Myonen aus Zerfällen von Hadronen mit gleichzeitig hoher Effizienz für Myonen aus schwachen Eichbosonzerfällen zu verwerfen, wird eine hochselektive erste Triggerstufe (Level-0) mit hoher Myonimpuls-Auflösung benötigt.

Die Impulsauflösung der bisherigen ersten Myontriggerstufe ist durch die moderate Ortsauflösung der Triggerkammern begrenzt. Es ist daher geplant, die hochauflösenden MDT-Myonspurdetektoren des ATLAS-Myonspektrometers in die Level-0-Entscheidung am HL-LHC einzubeziehen. Für eine Triggerentscheidung innerhalb der Latenzzeit der Level-0-Triggerstufe von 6 μs werden neben neuer Ausleseelektronik schnelle und effiziente Spurrekonstruktionsalgorithmen benötigt.

Geeignete Algorithmen werden vorgestellt und deren Leistungsfähigkeit wird mit Monte-Carlo-Simulationen und Teststrahldaten demonstriert.

T 84.3 Mi 17:15 VMP11 HS

Ein verbessertes Myontriggersystem des CMS-Detektors für hohe LHC-Luminositäten — •Florian Scheuch[1], Thomas Hebbeker[1], Andreas Künsken[2], Markus Merschmeyer[1] und Oliver Pooth[2] — [1]III. Physikalisches Institut A, RWTH Aachen University — [2]III. Physikalisches Institut B, RWTH Aachen University

Der Large-Hadron-Collider (LHC) bei Genf erzeugt Proton-Proton-Kollisionen bei einer Schwerpunktsenergie von 13 TeV, deren Produkte unter anderem im Compact-Muon-Solenoid-Detektor (CMS) nachgewiesen werden. In Zukunft soll die Luminosität des LHC erhöht werden. Diese geplante Verbesserung der Luminosität stellt einen hohen Anspruch an die Detektoren dar, da sie zur Erhöhung der Triggerraten und der deponierten Strahlendosis führt. Strahlenschäden können dabei zum Ausfall einzelner Subdetektoren oder ganzer Detektorteile führen. Dies wiederum führt zu einer Reduzierung der Triggereffizienz. In diesem Vortrag werden Studien des CMS-Myonsystems vorgestellt und geprüft, wie sich Ausfälle von Teilen des Myonsystems auf die Triggereffizienz auswirken. Ebenso wird untersucht, inwieweit die Hinzunahme von Signalen des Hadron-Outer-Systems den eventuellen Ausfall von einzelnen Myonkammern kompensieren kann.

T 84.4 Mi 17:30 VMP11 HS

Electrons and photons at High Level Trigger in CMS for Run II — •Afiq Anuar[1] and Matteo Sani[2] — [1]DESY, Hamburg — [2]UCSD, San Diego

The CMS experiment has been designed with a 2-level trigger system. The first level is implemented using custom-designed electronics. The second level, the High Level Trigger (HLT), is a streamlined version of the CMS offline reconstruction software running on a computer farm. For Run II of the Large Hadron Collider, the increase in center-of-mass energy and luminosity will raise the event rate to a level challenging for the HLT algorithms. New approaches have been studied to keep the HLT output rate manageable while maintaining thresholds low enough to cover physics analyses. The strategy mainly relies on porting online the ingredients that have been successfully applied in the offline reconstruction, thus allowing to move HLT selection closer to offline cuts. Improvements in HLT electron and photon definitions will be presented, focusing in particular on: updated clustering algorithm and the energy calibration procedure, new Particle-Flow based isolation approach and pileup mitigation techniques, and an electron-dedicated track fitting algorithm based on Gaussian Sum Filter.

T 84.5 Mi 17:45 VMP11 HS

Konzeption des neuen Jet/Energiesummen-Moduls der ersten Triggerstufe des ATLAS-Detektors — •Stefan Rave, Bruno Bauss, Volker Büscher, Elena Rocco, Ulrich Schäfer und Stefan Tapprogge — Institut für Physik, Universität Mainz

Die höheren Schwerpunktsenergien und Luminositäten der kommenden Ausbaustufen des LHCs stellen eine Herausforderung an das Triggersystem des ATLAS-Detektors dar. Um unter diesen Anforderungen effizient interessante Ereignisse zu selektieren, muss das existierende System ausgebaut werden. Die gesamte erste Stufe hat, um die mit einer Rate von 40 MHz eingehenden Daten zu verarbeiten, eine Latenz von 2,5 μs zur Verfügung.

Dieser Beitrag stellt den Prototypen für den Jet Feature Extractor (jFEX) vor. Dieses Modul soll ab dem Jahre 2020 die Berechnung von Jets und Energiesummen in der ersten Triggerstufe durchführen. Dazu werden die Daten des Kalorimeters mit einer feineren Granularität als bisher verarbeitet, um eine höhere Flexibilität bei der Jet-Definition zu gewährleisten. Zudem wird die Sensitivität für größere Jets verbessert, indem die überarbeiteten Algorithmen, dank verbesserter Hardware, mit größeren Radien arbeiten können, als es bei dem aktuellen System der Fall ist. Ein weiterer, wichtiger Aspekt ist die Korrektur der Effekte von Pile-Up Ereignissen. Um die für diese Aufgaben erforderlichen Daten empfangen zu können, ist eine Eingangsbandbreite von mehreren Tb/s pro Modul erforderlich, die auf 4 FPGAs verteilt werden. Für die dort laufenden Algorithmen steht von der gesamten Latenzzeit nur etwa 100 ns zur Verfügung.

T 84.6 Mi 18:00 VMP11 HS

Module control of the jFEX for the ATLAS Calorimeter Trigger Upgrade — •Rouven Spreckels, Reinhold Degele, Ulrich Schäfer, and Stefan Tapprogge — Johannes Gutenberg University of Mainz, Germany

The jFEX (jet Feature EXtractor) will identify jets and τ particles and calculate energy sums with the data received from electromagnetic and hadronic calorimeters by running its algorithms on multiple processor FPGAs. The firmware and configuration of these algorithms are provided by a single control FPGA accessed through a central Ethernet port. For reasons of flexibility this control FPGA is placed on a mezzanine card based on a hybrid SoC (System on Chip) combining an FPGA and a CPU inside a single chip with many interconnects in between. This talk will present the design of this mezzanine card and the usage of the hybrid SoC approach.

T 84.7 Mi 18:15 VMP11 HS

Improved energy resolution for the ATLAS Level-1 Calorimeter trigger in Run 2 — •Stanislav Suchek — Kirchhoff-Institute for Physics, Universität Heidelberg, Im Neuenheimer Feld 227, 69120 Heidelberg, Deutschland

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 new Multi-Chip Module (nMCM), at the centre of the L1Calo upgrade for Run 2, provides provides the possibility to apply a dedi-

cated hadronic calibration to jets and missing or summed transverse momentum. In this talk, an improved hadronic calibration for L1Calo in Run 2 is presented. This calibration achieves an improved jet energy resolution, and therefore results in better performance of jet and missing transverse energy triggers, which are of central importance for many physics analyses. The optimisation is validated using jet transverse energy and missing transverse energy triggers turn-on curves and rates.

T 84.8 Mi 18:30 VMP11 HS

Cosmic Ray Test of the Belle II z-Vertex Trigger — •Sara Neuhaus[1], Sebastian Skambraks[1], Yang Chen[2], and Christian Kiesling[2] — [1]Technische Universität München — [2]Max-Planck-Institut für Physik, München

The z-vertex trigger is part of the first level track trigger in the Belle II experiment. Its task is the rejection of tracks not coming from the interaction region, suppressing a large part of the machine background. Therefore the z-vertex trigger allows to relax other track trigger conditions and thus strongly increases the efficiency for channels with low track multiplicity (e.g. tau pair production). The track trigger works in several steps, first combining hits to track segments, followed by a 2D track finding in the transverse plane and finally the 3D reconstruction. Our method employs neural networks to estimate the z-vertex without explicit track reconstruction. For the first real test with cosmic rays special neural networks have been prepared. Although the track shape in the cosmic test is different than in the Belle II experiment, the neural networks require only a retraining with an appropriate data set to adapt to the new geometry.

T 84.9 Mi 18:45 VMP11 HS

Study of improved K_S^0 detection at the Belle II detector — •Leonard Koch, Wolfgang Kühn, and Sören Lange for the Belle II-Collaboration — II. Physikalisches Institut, JLU Gießen

In the near future, the Belle II experiment at the SuperKEKB accelerator at KEK in Tsukuba, Japan, will start operation at a luminosity a factor 40 higher than its predecessor experiment, Belle. The physics program includes the search for physics beyond the Standard Model of particle physics by the investigation of CP violating processes and rare B meson decays. Many important decay channels involve K_S^0 mesons.

The detector features two layers of silicon pixel cells (PXD) closest to the interaction point surrounded by four layers of double sided silicon strip detectors (SVD). The high backgoround level of the Pixel Detector requires an online data reduction system: Using the SVD and the surrounding detectors, the online reconstructed tracks of charged particles are extrapolated to the PXD layers, where Regions of Interest (ROIs) are defined around the intercepts. Only the pixel data inside these ROIs are stored. Thus, particles creating an insufficient number of hits in the outer detectors are not reconstructed and subsequently no ROIs are created, resulting in the loss of the related hits in the Pixel Detector. As a consequence, particles creating a sufficient number of hits in all six layers, but not in the outer four, are lost.

In this contribution, we perform online tracking using all six layers to find the tracks of pions for improved K_S^0 detection. The combinatorics of the hit-track assignments is reduced by artificial neural networks.

This work is supported by the BMBF under grant 05H1SRGKBA.

T 85: Hauptvorträge

Zeit: Donnerstag 8:30–9:50 Raum: VMP4 Audimax 1

Hauptvortrag T 85.1 Do 8:30 VMP4 Audimax 1

Messung der Eigenschaften der kosmischen Strahlung mit dem LOFAR Radio-Teleskop — •Jörg R. Hörandel — Radboud University Nijmegen, Nijmegen, Niederlande

Hochenergetische kosmische Strahlung (ionisierte Atomkerne) wechselwirken beim Auftreffen auf die Atmosphäre der Erde mit den Atomkernen der Luft und es entsteht eine Lawine von Sekundärteilchen. Ein Großteil der geladenen Sekundärteilchen sind Elektronen und Positronen, die sich mit fast Lichtgeschwindigkeit durch die Atmosphäre (mit einem Brechungsindex > 1) und das Erdmagnetfeld bewegen. Hierdurch erzeugen diese Teilchen Radiostrahlung. Diese Strahlung wird mit dem LOFAR Radio-Teleskop im Frequenzbereich von 30 bis 240 MHz gemessen. Aus den Messungen werden die Eigenschaften der kosmischen Strahlung bestimmt: Ankunftsrichtung, Energie der Teilchen und ihr Teilchentyp (die Masse des Atomkerns).

Mit LOFAR untersuchen wir den Energiebereich der kosmischen Strahlung von 10^{17} bis 10^{18} eV. Dieser ist astrophysikalisch besonders interessant, da in diesem Bereich ein Übergang erwartet wird: Unterhalb dieser Energien entsteht die kosmische Strahlung in unserer Milchstraße, während man bei höheren Energien davon ausgeht, daß diese in anderen Galaxien beschleunigt wird.

Die hohe Antennendichte und gute Zeitauflösung des LOFAR Instrumentes erlaubt eine genaue Vermessung der Eigenschaften der Radiostrahlung in Luftschauern. Neueste Ergebnisse werden vorgestellt und ihre Implikationen für unser Verständnis des Ursprungs der kosmischen Strahlung werden diskutiert.

Hauptvortrag T 85.2 Do 9:10 VMP4 Audimax 1

Die Entschlüsselung des Higgs-Bosons: Neue Resultate vom LHC — •Christian Weiser — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

In diesem Vortrag werden die Ergebnisse zu den Eigenschaften des im Juli 2012 entdeckten Higgs-Bosons, basierend auf den endgültigen Analysen der vollständigen Datensätze der Experimente ATLAS und CMS der ersten Datennahmeperiode (Run 1) mit Schwerpunktsenergien bis zu 8 TeV, vorgestellt. Des Weiteren werden erste Resultate der im Jahr 2015 begonnenen zweiten Phase der Datennahme (Run 2) präsentiert.

In den vergangenen Jahren wurden enorme Fortschritte bei der zunehmend präzisen Vermessung der Eigenschaften des für das Standardmodell der Teilchenphysik zentralen Higgs-Bosons erzielt, unter anderem durch die Kombination der Ergebnisse der ATLAS- und CMS-Kollaborationen zu den Kopplungen des Higgs-Bosons an andere Teilchen. Verschiedene Zerfallskanäle und Produktionsprozesse wurden im Detail untersucht, die hohe zur Verfügung stehende integrierte Luminosität erlaubte die Vermessung differentieller Wirkungsquerschnitte. Eigenschaften wie Masse, Spin oder Breite des Higgs-Bosons konnten mit teilweise hoher Präzision vermessen warden.

Verschiedene Modelle zu Erweiterungen des Standardmodells sagen die Existenz weiterer Higgs-Bosonen voraus. Neue Ergebnisse zu deren Suche, unter Berücksichtigung erster Daten des Run 2 bei höherer Schwerpunktsenergie, werden präsentiert sowie ein Ausblick in die weitere Zukunft gegeben.

T 86: Hauptvorträge

Zeit: Donnerstag 11:00–12:30 Raum: VMP4 Audimax 1

Hauptvortrag T 86.1 Do 11:00 VMP4 Audimax 1

Neues aus der experimentellen Top-Quark-Physik — •Sebastian Schätzel — Physikalisches Institut der Universität Heidelberg

Aufgrund seiner hohen Masse spielt das Top-Quark eine bedeutende Rolle im Standardmodell und darüber hinaus. In Proton-Antiproton-Kollisionen am Tevatron und in Proton-Proton-Kollisionen am LHC wurde und wird durch die große Schwerpunktsenergie eine Vielzahl an Top-Quarks produziert, was die genaue Messung von Wirkungsquerschnitten sowie die präzise Bestimmung von Top-Quark-Eigenschaften erlaubt. Da das Top-Quark in vielen Erweiterungen des Standardmodells besonders stark an neue Teilchen koppelt, sind Endzustände mit Top-Quarks vielversprechend für Suchen nach Neuer Physik. Im Vortrag wird auf Ergebnisse neuer Messungen und Suchen der letzten 12 Monate eingegangen.

Hauptvortrag T 86.2 Do 11:45 VMP4 Audimax 1

Neutrino Oscillations: from the current status to the future — •Achim Stahl — RWTH Aachen University — JARA-FAME

Neutrino Oscillations are a very active field of research. I will summarize the current status and discuss future projects. I will focus on the experiments with reactor neutrinos and long-baseline beams.

T 87: Eingeladene Vorträge III

Zeit: Donnerstag 13:45–16:15 Raum: VMP4 Audimax 1

Eingeladener Vortrag T 87.1 Do 13:45 VMP4 Audimax 1
Reconstruction of tau lepton decays and applications in the ATLAS experiment — •Peter Wagner — Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

Final states with hadronically decaying tau leptons play an important part in the physics programme of the ATLAS experiment. Examples are measurements of Standard Model processes, evidence of the Higgs-boson Yukawa couplings to tau leptons, and searches for new physics phenomena, such as Supersymmetry. These analyses depended on robust tau reconstruction and excellent particle identification algorithms that provided suppression of backgrounds from jets, electrons and muons.

I will present a new "particle flow" method of reconstructing the individual charged and neutral hadrons in tau decays with the ATLAS detector which leads to a significant improvement in the tau energy and directional resolution. It further gives access to the individual charged and neutral hadron four-momenta and offers a high purity decay mode selection. These features will play a particularly important role in analyses that exploit tau spin information, such as a measurement of the CP mixture of the Higgs boson in $H \to \tau\tau$ decays.

Eingeladener Vortrag T 87.2 Do 14:15 VMP4 Audimax 1
Auf der Suche nach neuer Physik mit geboosteten Bosonen bei CMS — •Andreas Hinzmann — University of Zurich, Zurich, Switzerland

Viele Erweiterungen des Standard Modells (SM) sagen neue Teilchen mit Massen von mehreren TeV vorher, die in W-, Z- und Higgs-Bosonen zerfallen. Bei den ersten Suchen nach solchen Teilchen im Run 1 des LHC gab es kleine Hinweise auf die Existenz einer Resonanz bei 2 TeV, weshalb ihre Suche am Anfang des Run 2 des LHC (2015) von höchster Priorität ist. Da hochenergetische W-, Z- und Higgs-Bosonen, die hauptsächlich in Quark-Antiquark-Paare zerfallen, massive Teilchenjets im Detektor bilden, für deren Identifikation komplexe Rekonstruktionstechniken basierend auf Jetsubstruktur erforderlich sind, birgt diese Suche große experimentelle Herausforderungen. In diesem Vortrag werden diese Techniken anhand der Run-1-Analysen erklärt und die neusten Ergebnisse von Run 2 präsentiert.

Eingeladener Vortrag T 87.3 Do 14:45 VMP4 Audimax 1
Hunting for new, weakly coupled particles with high intensities — •Babette Döbrich — CERN, 1211 Geneva 23, Switzerland

A number of smaller and diverse experiments complements the high-energy explorations for new physics at the LHC. Many of these experiments are searching for new physics hiding at comparably low mass but very weak coupling.

Examples of such particles are axion-like particles and dark gauge bosons, which could also explain Dark Matter. The technology to directly search for such particles are often high-intensity and precision set-ups.

In my talk I will give a brief overview of the motivation and search for axion-like particles and then focus on the possibility to find them in a proton-dump experiment at CERN.

Eingeladener Vortrag T 87.4 Do 15:15 VMP4 Audimax 1
Probing low mass dark matter with the CRESST direct search — •Federica Petricca for the CRESST-Collaboration — Max-Planck-Institut für Physik, Föhringer Ring 6, D-80805 München

In this era of precision cosmology we know that dark matter constitutes about 85% of the matter in the Universe, although its nature is still unknown. Direct dark matter searches apply a great variety of different detector technologies, all aiming to observe dark matter particles via their elastic scattering off nuclei in their detectors. Cryogenic experiments currently provide the best sensitivity for light dark matter particles, with the CRESST-II experiment advancing to the sub-GeV/c^2 dark matter particle mass regime.

The CRESST target consists of scintillating $CaWO_4$ crystals operated as cryogenic calorimeters at millikelvin temperatures. The low energy thresholds of these detectors, combined with the presence of light nuclei in the target material, allow to probe the low-mass region of the parameter space for spin-independent dark matter-nucleon scattering with high sensitivity.

In this contribution we present results of the latest measurement campaign. With 52kg live days and a threshold for nuclear recoils of 307eV we obtain an unprecedented sensitivity for light dark matter, extending the reach of direct dark matter searches to the sub-GeV/c^2 region. Currently, CRESST-III is on its way, featuring detectors consequently optimized for the measurement of very small energy deposits to further explore the low-mass region. We will report on the status of the experiment and give an outlook on the anticipated sensitivity.

Eingeladener Vortrag T 87.5 Do 15:45 VMP4 Audimax 1
The Top Quark and the Higgs Boson: Vital Actors at LHC — •Johannes Hauk — Deutsches Elektronen-Synchrotron

The two heaviest elementary particles known so far, the top quark and the Higgs boson, were discovered relatively late, long time after their prediction by the Standard Model (SM). This is due to the high masses which could not be predicted directly, but this makes them especially interesting for validating the SM or revealing signs of new physics. The high collision energy of protons at LHC leads to plenty of top quarks, mainly via pair production ($t\bar{t}$), and also numerous Higgs bosons.

Many properties of the top quark are meanwhile studied with high precision, and also the Higgs boson is undergoing scrutiny – so far everything in agreement with the SM. One important test is to measure the interplay between these two particles. The only possibility to measure directly the coupling is the Higgs production in association with top quarks, and especially $t\bar{t}$. This requires a good understanding of the overwhelming background processes, namely $t\bar{t}$ production in association with other particles. In this talk, measurements from the CMS experiment will be discussed concerning both, understanding the background processes as well as targeting the detection of associated $t\bar{t}$ and Higgs boson production.

T 88: Eingeladene Vorträge IV

Zeit: Donnerstag 13:45–16:15 Raum: VMP8 HS

Eingeladener Vortrag T 88.1 Do 13:45 VMP8 HS
Mass composition of ultra-high energy cosmic rays: new results from the Pierre Auger Observatory and their astrophysical implications — •Alexey Yushkov for the Pierre-Auger-Collaboration — University of Siegen, Siegen, Germany

The recent experimental data on the composition of cosmic rays from the 'knee' to the GZK cut-off region are reviewed. Special emphasis is given to the results of the Pierre Auger Observatory in the region around the 'ankle'. These results have important implications for the astrophysical scenarios concerning the transition between galactic and extragalactic cosmic rays. The perspectives of the experimental studies of the mass composition for GZK and super-GZK energies with the AugerPrime upgrade of the Pierre Auger Observatory are discussed.

Eingeladener Vortrag T 88.2 Do 14:15 VMP8 HS
Particle Flow Calorimetry — •Eva Sicking — CERN, Geneva,

Switzerland — LAPP - Laboratoire d'Annecy-le-vieux de Physique des Particules, France

High energy e+e- colliders such as the Compact Linear Collider (CLIC) or the International Linear Collider (ILC) are very promising future projects for complementing and extending the LHC physics reach. At these colliders, many interesting physics processes will produce multi-jet final states which can be accompanied by charged leptons and missing momentum. High precision measurements at these colliders pose stringent requirements on the detector performance, in particular on the jet energy resolution (sigma(E)/E<3.5% for 100 GeV–1 TeV jets). The Particle Flow approach to calorimetry shows potential to meet the unprecedented demands on the jet energy resolution. It is based on highly granular calorimeters and particle flow analysis, i.e. resolving energy depositions of individual particles by sophisticated algorithms. Over the last decade, particle flow calorimetry was explored by the detector R&D collaborations of the future linear colliders, who built and tested large scale high-granularity calorimeter prototypes and studied the detector and software performance in full detector simulations. This talk describes the principles of particle flow analysis and discusses the advancements in particle flow calorimetry. Recent prototype developments of the CALICE (Calorimetry for Linear Collider Experiments) collaboration and results from beam tests and full physics simulations are presented with emphasis on the CLIC physics programme.

Eingeladener Vortrag T 88.3 Do 14:45 VMP8 HS
Flavour physics as a microscope for new phenomena — •Martin Jung — Excellence Cluster Universe, TU Munich

Flavour Physics is a central component in our search for new phenomena beyond the Standard Model. The continued absence of a direct, conclusive measurement pointing beyond the SM constitutes the central challenge for both theory and experiment at the moment. This talk discusses the resulting necessity for new and modified theoretical methods on the one hand, and for the combination of observables from different sectors of particle physics on the other. These general points are illustrated by examples, focussing on heavy-flavour physics.

Eingeladener Vortrag T 88.4 Do 15:15 VMP8 HS
Neue Ergebnisse der B-Fabriken und Ausblick auf Belle II — •Florian Bernlochner für die Belle II-Kollaboration — Physikalisches Institut der Rheinische Friedrich-Wilhelms-Universität Bonn, Bonn, Germany

Im letzten Jahrzehnt sind die beiden B-Fabriken BaBar und Belle der Frage nach dem Ursprung der Ladungs- und Paritätsverletzung im Universum nachgegangen. Die Idee, welche beide Experimente später bestätigten, geht auf Kobayashi und Maskawa zurück: beide brachten 1973 die Ladungs- und Paritätsverletzung und das Standardmodell in Einklang mittels einer irreduziblen komplexen Phase in der schwachen Wechselwirkung und der Voraussage, daß es sechs Arten von Quarks geben müsse. Kobayashi und Maskawa erhielten 2008 hierfür den Nobelpreis. Zurzeit wird in Tsukuba in Japan das Nachfolgeexperiment Belle-II aufgebaut. Deutschland ist mit starker Partizipation dabei und baut Teile des wichtigen Vertexdetektors mit. Läuft alles nach Plan, werden Ende 2018 große Mengen von B-Mesonen erzeugt um deren Zerfälle zu studieren. Präzisionsmessungen von semileptonischen Zerfälle spielen bei der Messung der komplexen KM Phase eine wichtige Rolle: sie erlauben es die absolute Grösse der CKM-Matrixelemente Vub und Vcb zu messen, welche die Grösse der komplexen Phase einschränkt. In diesem Vortrag gebe ich einen Überblick über neue Resultate von den bestehenden B-Fabriken mit dem Fokus auf semileptonische Zerfälle und gebe einen Ausblick über die Fragestellungen, welche wir mit dem Belle-II-Experiment erforschen wollen.

Eingeladener Vortrag T 88.5 Do 15:45 VMP8 HS
The DEAP-3600 Dark Matter Search Experiment - Updates and Commissioning Results — •Tina Pollmann — Laurentian University, Sudbury, Canada

The DEAP-3600 experiment uses a 3.6 tonne liquid argon target for a direct dark matter search with a projected sensitivity to the spin-independent WIMP-nucleon cross-section of 10^{-46} cm^2 at 100 GeV WIMP mass after a three-year background-free exposure.

DEAP is operated as a single-phase detector. The liquid argon volume is viewed by 255 high efficiency photo multiplier tubes, which record the scintillation light emitted when particles interact there. The resulting pulse shapes allow very efficient rejection of the overwhelming electromagnetic backgrounds from the dark matter signal region using pulse shape discrimination.

To meet the detector's extremely stringent background targets, remaining backgrounds are suppressed through several layers of active and passive shielding - including 6000 m.w.e of rock overburden, through material screening, through the use of clean construction techniques, through careful detector design, and in offline analysis through fiducialization.

The DEAP detector was built between the years of 2011 and 2016 at the SNOLAB facility, 2 km underground, and is currently taking commissioning data. We will present the status of the experiment and results from analysis of the first commissioning data on behalf of the DEAP-3600 collaboration.

T 89: Higgs-Boson (Zerfall in WW/ZZ)

Zeit: Donnerstag 16:45–19:05 Raum: VMP5 HS B1

Gruppenbericht T 89.1 Do 16:45 VMP5 HS B1
Measurement of the Higgs boson production and decay rates from a combination of ATLAS and CMS data — •Andrew Gilbert, Günter Quast, and Roger Wolf — Karlsruher Institut für Technologie, Karlsruhe

The discovery of the Higgs boson by the ATLAS and CMS Collaborations was a major triumph of the first run of the Large Hadron Collider. The focus now switches to measuring the properties of this new particle as precisely as possible to both test the predictions of the standard model and search for deviations which would be an indication of new physics.

In this talk measurements of the Higgs boson production and decay rates from a combination of ATLAS and CMS data are presented. The combination includes an analysis of six decay modes: H→ZZ, WW, $\gamma\gamma$, bb, $\tau\tau$ and $\mu\mu$, and production via gluon fusion, vector-boson fusion and in association with a W or Z boson or a $t\bar{t}$ pair. Results are presented in models based on either signal strength or coupling modifier parameterisations, and the combination procedure itself is discussed.

T 89.2 Do 17:05 VMP5 HS B1
Untersuchung des reduzierbaren Myon-Untergrunds im Zerfallskanal H → ZZ* → 4l mit dem ATLAS-Detektor am LHC — •Verena Walbrecht, Katharina Ecker, Sandra Kortner und Hubert Kroha — Max-Planck-Institut für Physik, München

Im Jahr 2012 wurde das Higgs-Boson mit den Experimenten ATLAS und CMS am LHC endeckt. Ein wichtiger Prozess für die Entdeckung und Messung der Eigenschaften des Higgs-Bosons ist der Higgs-Boson-Zerfall in zwei Z-Bosonen, die jeweils in ein e^+e^-- oder $\mu^+\mu^-$-Paar zerfallen – $pp \to H \to ZZ^* \to 4\ell$. Die bisherigen Messungen werden mit neuen Run-II-Daten bei einer höheren Schwerpunktsenergie von 13 TeV fortgesetzt und optimiert.

Die Hauptuntergrundprozesse sind dabei der irreduzierbare ZZ-Untergrund und die reduzierbaren $Z + Jets$- und $t\bar{t}$-Prozesse. Mindestens zwei der vier Leptonen in den reduzierbaren Untergrundprozessen sind umgeben von einem Jet und können durch die relativ hohe deponierte Energie um das Lepton herum vom Signal unterschieden werden. Die Myonen in den Jets werden durch Zerfälle der geladenen Pionen, Kaonen oder B-Hadronen erzeugt. In diesem Vortrag werden die Studien der Eigenschaften solcher Myonen vorgestellt. Die Studien werden mit den Kontrolldaten, in denen kein Signal erwartet wird, durchgeführt und ermöglichen eine auf experimentellen Daten basierte Abschätzung des reduzierbaren Untergrundbeitrags.

T 89.3 Do 17:20 VMP5 HS B1
Studies of the gluon-fusion production of the Higgs boson in the decay channel $WW^* \to lvlv$ using LHC proton-proton data collected at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Ralf Gugel and Karsten Köneke — Albert-Ludwigs-Universität Freiburg

The single most precise measurement of the production cross section of the Higgs boson was performed using the $WW^* \to lvlv$ decay channel

using the full LHC run 1 dataset collected by the ATLAS experiment. Data collected at $\sqrt{s} = 13$ TeV has the prospect of further increasing the precision of this measurement. However, the signal-to-background cross-section ratios at this new center-of-mass energy change in some cases disfavorably, especially for background processes involving top quarks. Several dedicated background control regions using data allow to reduce uncertainties on the individual background normalizations as well as uncertainties on various experimental efficiencies. Studies of these control regions and background estimates for the signal region derived from the control regions will be shown, as well as sensitivity estimates of the cross-section measurement.

T 89.4 Do 17:35 VMP5 HS B1

Suche nach 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, Christian Schmitt und Marcel Weirich — Johannes Gutenberg-Universität Mainz

Seit der Entdeckung des Higgs-Bosons im Jahr 2012 konnten mit seiner Masse und seinem Spin wesentliche Eigenschaften bestimmt werden. Der nächste Schritt ist die Präzisionsmessung der Kopplungen. Eine Messung von Kopplungen des Higgs-Bosons hat das Potential, Erweiterungen des Standardmodells wie zum Beispiel Supersymmetrie zu testen, und ist daher von großer Bedeutung. Die assoziierte Produktion des Higgs-Bosons mit einem W-Boson bei anschließendem Zerfall in zwei W-Bosonen eignet sich zur Messung der Kopplung zwischen W- und Higgs-Boson besonders gut, da das Higgs-Boson bei dieser Reaktion ausschließlich an W-Bosonen koppelt. Der Vortrag stellt den aktuellen Stand der Analyse mit den 2015 gesammelten Daten bei einer Schwerpunktsenergie von 13 TeV vor.

T 89.5 Do 17:50 VMP5 HS B1

Messung des Wirkungsquerschnittes der Higgs-Erzeugung durch Vektorbosonfusion im Zerfallskanal $H \to WW$ mit dem ATLAS-Detektor — •Marc Geisen, Claudia Bertella, Volker Büscher, Frank Fiedler, Adam Kaluza und Christian Schmitt — Johannes Gutenberg-Universität Mainz

Die Entdeckung des Higgs-Bosons am LHC basierte auf Ereignissen in denen das Higgs-Boson durch Gluon-Gluon-Fusion entsteht. Zum Test von Standardmodellvorhersagen müssen jedoch möglichst viele Produktionsmechanismen und Zerfallskanäle genau vermessen werden. Ein wichtiges Ziel der wieder angelaufenen Datennahme am LHC ist der direkte Nachweis der Higgs-Boson-Produktion durch Vektorbosonfusion (VBF), bei der zwei sogenannte Tag-Jets nahe der Strahlachse erwartet werden. Der Zerfall in zwei W-Bosonen ist experimentell interessant, da er mit 21,6% ein hohes Verzweigungsverhältnis aufweist und im leptonischen W-Zerfall gut nachweisbare geladene Leptonen entstehen sowie Neutrinos, die zu fehlender Transversalenergie im Detektor führen. Der Schwerpunkt dieses Vortrages liegt auf der Anpassung der Analyse an die veränderten Bedingungen am LHC seit Sommer 2015. Darunter zählen aufgrund der erhöhten Schwerpunktsenergie von $\sqrt{s} = 13$ TeV veränderte Wirkungsquerschnitte der beteiligten Prozesse und Änderungen in ihren Topologien, jedoch auch eine höhere integrierte Luminosität bei der Datennahme. Insbesondere ist ein genaues Verständnis der Untergrundprozesse essenzielle Voraussetzung zu deren Diskriminierung und zur Reduzierung von systematischen Fehlern, die bei erhöhter Statistik mehr Gewicht erhalten werden.

T 89.6 Do 18:05 VMP5 HS B1

Untersuchung von Eigenschaften des Higgs-Bosons im Vektorbosonfusions-Produktionskanal mit Zerfall $H \to WW \to \ell\nu\ell\nu$ mithilfe der Morphing-Methode bei ATLAS — •Adam Kaluza, Claudia Bertella, Marc Geisen, Christian Schmitt, Frank Fiedler und Volker Büscher — Johannes Gutenberg Universität Mainz

Der Zerfallskanal $H \to WW$ des Higgs-Bosons liefert aufgrund der klaren Signatur der Zerfallsprodukte sowie des hohen Verzweigungsverhältnisses einen geeigneten Zugang zur Untersuchung der Eigenschaften des Teilchens, um die Übereinstimmung mit den Vorhersagen des Standardmodells zu prüfen und mögliche Abweichungen festzustellen. Ereignisse, in denen das Higgs-Boson über Fusion zweier Vektorbosonen erzeugt wird, weisen durch die zwei zusätzlichen Jets eine charakteristische Signatur auf und lassen sich mit einem guten Verhältnis von Signal- zu Untergrundereignissen selektieren. Die spezielle Ereignistopologie kann dazu genutzt werden, die Kopplungsstruktur des Higgs-Bosons an W-Bosonen im Rahmen einer effektiven Lagrange-Dichte zu studieren. Um den multidimensionalen Parameterraum effektiv analysieren zu können, wird die Morphing-Methode benutzt. Im Vortrag wird die Methode präsentiert und erste Ergebnisse aus der Analyse von Proton-Proton-Kollisionen am ATLAS-Experiment am LHC-Beschleuniger bei einer Schwerpunktsenergie von 13 TeV vorgestellt.

T 89.7 Do 18:20 VMP5 HS B1

Suche nach dem Higgs-Boson im Kanal $VH \to VWW^{(*)}$ mit dem ATLAS-Experiment am LHC — Volker Büscher, Frank Fiedler, Christian Schmitt, •Marcel Weirich und Natalie Wieseotte — Johannes Gutenberg-Universität Mainz

Seit der Entdeckung eines Higgs-Bosons im Sommer 2012 werden seine Eigenschaften auf Kompatibilität zur Standardmodell-Vorhersage getestet. Der Prozess der assoziierten Produktion, bei dem das Higgs-Boson zusammen mit einem W- oder Z-Boson entsteht, bietet einen Zugang zur Messung der Kopplung zwischen schwachen Vektorbosonen und dem Higgs-Boson.

Vorgestellt werden Studien der dominanten Untergrund-Prozesse im Kanal $VH \to VWW^{(*)}$ mit 3 geladenen Leptonen im Endzustand. Der für die Analysen verwendete Datensatz stammt aus den 2012 vom ATLAS-Experiment am LHC gesammelten Daten bei einer Schwerpunktsenergie von $\sqrt{s} = 8$ TeV und entspricht einer integrierten Luminosität von etwa $20.3\,\mathrm{fb}^{-1}$. Der Schwerpunkt liegt auf der Optimierung der Untergrundunterdrückung. Hierzu werden multivariate Methoden eingesetzt.

T 89.8 Do 18:35 VMP5 HS B1

Suche nach einem schweren Higgs Boson im $H \to W^+W^-$ Zerfallskanal mit dem ATLAS Experiment am LHC — •Thomas Maier — Ludwig-Maximilians-Universität München

Der Vortrag präsentiert die Suche nach einem schweren Higgs-Boson im $H \to W^+W^-$ Zerfallskanal mit Daten des ATLAS Experiments. Es werden vorläufige Ergebnisse der Analyse für Proton-Proton-Kollisionen bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV präsentiert. Der Fokus liegt hierbei auf Endzustände in denen die beiden W-Bosonen in ein Elektron und ein Myon, mit dem jeweiligen Neutrino, zerfallen.
Die Daten wurden im Rahmen von Erweiterungen des Standardmodells ausgewertet, wobei verschiedene Zerfallsbreiten des Higgs-Bosons in Betracht gezogen sind. Die Suche bezieht sich auf ein Higgs-Boson im Massenbereich 200 GeV $\leq m_H \leq$ 3 TeV.

T 89.9 Do 18:50 VMP5 HS B1

Search for a high mass Higgs boson at 13TeV **using the ATLAS detector** — •Dominik Duda and Pamela Ferrari — Nikhef, Amsterdam

The Higgs sector in the Standard Model has been chosen such that it is as simple as possible. But indeed there is no theoretical restriction to the number of Higgs fields involved in the process of electroweak symmetry breaking and generation of particle masses. Several extensions of the Standard Model lead to an introduction of additional Higgs bosons into the Brout-Englert-Higgs-mechanism and thus predict the existence of a high mass scalar, as for example in Two Higgs Doublets Models, or Composite Higgs Models. The mass value of such particles extend up to the TeV scale. With the increased centre-of-mass energy $\sqrt{s}$ and luminosity of the Run II of the LHC, the sensitivity to search for such particles is significantly enlarged and higher mass ranges become accessible as the size of the collected datasets increases.

This talk presents the results of a search for heavy neutral Higgs bosons decaying via $H \to WW \to \ell\nu q\bar{q}$ using data collected at $\sqrt{s} = 13$TeV by the ATLAS detector. In order to increase the sensitivity to search for particles at the TeV mass scale, boosted event topologies (i.e. events containing a large radius jet that is compatible with the decay of a high-p_T W-boson into a hadronic final state) are studied. The scanned boson mass range extends from 0.5 to 3TeV.

T 90: Suche nach Supersymmetrie IV (langlebige Zustände, RPV)

Zeit: Donnerstag 16:45–18:45 Raum: VMP5 HS B2

T 90.1 Do 16:45 VMP5 HS B2

Suche nach Supersymmetrie mit versetzten Leptonpaaren beim ATLAS-Experiment am LHC — •Dominik Krauss, Mike Flowerdew und Hubert Kroha — Max-Planck-Institut für Physik, Werner-Heisenberg-Institut, München

Supersymmetrie nahe der TeV-Skala ist immer noch eine elegante Möglichkeit, um das Hierarchieproblem zu lösen und die geringe Masse des Higgs-Bosons zu erklären. Die meisten Suchen nach Supersymmetrie am LHC konzentrieren sich auf den Fall, dass das leichteste supersymmetrische Teilchen (LSP) stabil ist und die anderen supersymmetrischen Teilchen kurzlebig sind. In dieser Analyse werden beide Annahmen fallen gelassen und der Fall betrachtet, bei dem das LSP rein leptonisch zerfällt und seine Lebensdauer so lang ist, dass der Zerfallsvertex im Innerdetektor rekonstruiert werden kann. Die Herausforderung bei dieser Suche ist die Tatsache, dass die Standardspurrekonstruktion des ATLAS-Detektors Spuren mit versetztem Ursprung mit relativ niedriger Effizienz rekonstruiert. Daher müssen die Ereignisse einer erneuten Spurrekonstruktion unterworfen werden, die für Spuren mit großen Stoßparametern optimiert ist. Da dies sehr rechenintensiv ist, muss eine Vorauswahl von Ereignissen getroffen werden, die für die Suche von Interesse sind. Die erhöhte Schwerpunktsenergie von 13 TeV stellt eine Herausforderung dar, da die bisherigen Auswahlkriterien aus Run 1 die Datenmenge nicht ausreichend begrenzen.

T 90.2 Do 17:00 VMP5 HS B2

Prospects of a search for charged stable massive particles in LHC Run-2 pp collisions with the ATLAS detector — •Jochen Jens Heinrich and Sascha Mehlhase — Ludwig-Maximilians-Universität München

Many theories beyond the Standard Model predict the existence of new long-lived heavy charged particles that can be produced in LHC proton–proton collisions at $\sqrt{s} = 13$ TeV. If their lifetimes are large enough to enable them to traverse large parts of the detector before decaying we speak of stable massive particles (SMPs). SMPs do not form extensive showers in the calorimeters and therefore present a muon-like signature that propagates much slower than the speed of light. A direct search for SMPs can be conducted, which provides a largely model independent signature with only a small instrumental background. It also expands coverage in new particle searches, as it is an orthogonal approach to generic new particle searches. SMPs are identified by determining their velocity via measurements of their anomalous ionisation energy losses in the inner tracker and time-of-flight measurements carried out in the calorimeter and muon system. All involved subsystems require extensive calibrations. Status and plans of a full-detector SMP search with the ATLAS detector are presented. Further, a new dedicated slow-muon trigger is introduced that takes the delayed arrival of SMP candidates in the muon system into account by considering two consecutive bunch crossings (BCs). It requires a jet or missing energy in the first BC and a muon signature coming from the delayed SMP in the immediately following BC.

T 90.3 Do 17:15 VMP5 HS B2

Suche nach versetzten Dilepton-Vertices mit dem ATLAS Detektor — •Maximilian Goblirsch-Kolb, Hubert Kroha, Michael Flowerdew und Dominik Krauss — Max-Planck-Institut für Physik, München

In supersymmetrischen Modellen mit Verletzung der R-Parität kann es zum Zerfall des leichtesten supersymmetrischen Teilchens (LSP) in geladene Leptonen und Neutrinos kommen. Die Lebensdauer des LSP ist dabei durch die Stärke der beteiligten Kopplungen und die Massen der Superpartner festgelegt. Konventionelle Multilepton-Suchen nach solchen Zerfällen sind auf den Fall verschwindender Lebensdauern des LSP optimiert. Ist diese Annahme nicht erfüllt, verlieren sie dramatisch an Empfindlichkeit. Stattdessen kann nach Leptonpaaren gesucht werden, die von einem gegenüber dem Wechselwirkungspunkt versetzten Vertex ausgehen. Die Spurrekonstruktionsalgorithmen des ATLAS-Experiments sind nicht für derartige Signaturen optimiert, daher ist eine solche Suche technisch anspruchsvoll. Jedoch wird kein Untergrund aus Prozessen des Standardmodells erwartet. Im Vortrag werden die Analysestrategie und Ergebnisse auf Basis des 2012 bei $\sqrt{s} = 8$ TeV aufgezeichneten Datensatzes vorgestellt.

T 90.4 Do 17:30 VMP5 HS B2

Die Suche nach langlebigen schweren geladenen Teilchen mit dem ATLAS Detektor in 3.2 fb^{-1} Proton-Proton Kollisionen bei einer Schwerpunktsenergie von 13 TeV — •Michael Adersberger und Sascha Mehlhase — Ludwig-Maximilians Universität München

Schwere stabile Teilchen werden von vielen Modellen außerhalb des Standardmodells der Teilchenphysik vorhergesagt und sind daher interessante Objekte für Suchen mit dem ATLAS-Detektor. Ihre Signatur unterscheidet sich von Standardmodell-Teilchen vor allem durch ihren hohen Energieverlust durch Ionisation und ihre signifikant niedrigere Geschwindigkeit. Das Standardmodell sagt keine Teilchen mit dieser Signatur voraus, wodurch die Hauptuntergründe von Fehlmessungen des Energieverlustes, der Geschwindigkeit oder des Impulses herrühren. Für die Messung des Energieverlustes wird der Pixel-Detektor verwendet, wohingegen die Geschwindigkeit aus einer Flugzeitmessung mit dem hadronischen Kalorimeter bestimmt wird. Durch die Messungen in zwei unabhängigen Detektorkomponenten können Fluktuationen der Einzelmessungen stark unterdrückt werden. Als Referenzmodelle für die Analyse der ersten 3.2 fb^{-1} Proton-Proton-Kollisionen bei einer Schwerpunktsenergie von 13 TeV dienen Gluino R-Hadronen mit Massen zwischen 400 GeV und 3000 GeV, da für die neue Schwerpunktsenergie eine etwa 25-fache Erhöhung des Wirkungsquerschnittes am momentanen Massenlimit erwartet wird. Erste vorläufige Ergebnisse dieser Suche werden in diesem Vortrag vorgestellt.

T 90.5 Do 17:45 VMP5 HS B2

Search for resonant slepton production in a dilepton and jet final state with CMS — •Sebastian Thüer, Andreas Güth, Thomas Hebbeker, Arnd Meyer, Philipp Millet, Markus Radziej, and Daniel Teyssier — III. Physikalisches Institut A, RWTH Aachen

In many supersymmetric scenarios R-parity is assumed to be conserved. However, abandoning R-parity conservation can result in a variety of new and interesting final states, some of which are not covered by conventional SUSY searches.

In the talk the search for resonant slepton production will be presented. In contrast to R-parity conserving models a single slepton can be resonantly produced. First and second generation slepton production via one of the two R-parity violating couplings λ'_{111} or λ'_{211} is searched for. The final states with either two electrons or two muons and additional jets are analysed. Standard Model backgrounds are substantially reduced by requiring the two leptons to have the same charge. All particles can be reconstructed allowing the measurement of the involved sparticle masses, which can be used to further separate a potential signal from the background.

Results from Run I are shown which can compete with indirect limits from neutrinoless double beta decay and leptonic pion decays.

T 90.6 Do 18:00 VMP5 HS B2

Search for resonant sneutrino production in R-parity violating SUSY scenarios with CMS — •Henning Keller, Sören Erdweg, Andreas Güth, Thomas Hebbeker, Arnd Meyer, and Swagata Mukherjee — III. Physikalisches Institut A, RWTH Aachen

Supersymmetric models are among the most promising extensions of the standard model. In many models R-parity is said to be conserved. However, allowing R-parity violation can permit interesting final states and signatures that are not covered by SUSY scenarios with R-parity conservation. The decay of a resonant sneutrino to two standard model leptons of different flavour is analyzed. The focus lies on the electron-muon final state investigating the R-parity violating couplings and the mass of the resonantly produced sneutrino. The analysis is based on the 2015 data of proton-proton collisions corresponding to an integrated luminosity of 2.5 fb^{-1} at a centre-of-mass energy of 13 TeV recorded with the CMS detector at the LHC.

T 90.7 Do 18:15 VMP5 HS B2

Suche nach Supersymmetry in multileptonischen Endzuständen mit dem ATLAS-Detektor — •Stefan Maschek, Mike Flowerdew und Hubert Kroha — Max-Planck-Institut für Physik, Werner-Heisenberg-Institut, München

In diesem Vortrag werden erste Ergebnisse der Suche nach Ereignissen mit mindestens vier Leptonen im Endzustand mit Daten des LHC bei einer Schwerpunktsenergie von $\sqrt{s} = 13$ TeV vorgestellt.

Solche Ereignisse werden von supersymmetrischen Erweiterungen des Standardmodells mit Verletzung der R-Parität vorhergesagt und besitzen nur sehr geringen Untergrund.

T 90.8 Do 18:30 VMP5 HS B2

Suche nach elektroschwacher Produktion von Gauginos in Endzuständen mit Photonen und $\not{E}_T$ bei CMS — •Johannes Schulz, Lutz Feld und Christian Autermann — 1. Physikalisches Institut B RWTH Aachen

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 fehlender Energie in der transversalen Ebene des Detektors ($\not{E}_T$). Die elektroschwache Produktion der Eichbosonen erzeugt Endzustände mit geringer hadronischer Aktivität.

Die Analyse untersucht sogenannte geparkte Daten, die 2012 bei einer Schwerpunktsenergie von 8 TeV vom CMS Detektor aufgezeichnet wurden. Geparkte Daten zeichnen sich durch geringe Triggerschwellen aus und bieten somit erhöhte Sensitivität auf elektroschwache Prozesse im Vergleich zu Analysen mit Jets. Die Analyse nutzt Daten zur Bestimmung der dominanten Standardmodell-Untergründe durch Monte-Carlo-Normalisierung und vollständig datengetriebener Abschätzung. Prozesse geringfügigeren Beitrags werden durch Monte-Carlo Simulationen abgeschätzt. Ereignisse mit großer, echter $\not{E}_T$ und großen transversalen Massen, rekonstruiert aus der transversalen Energie des höchstenergetischen Photons und $\not{E}_T$, werden selektiert. Die Ergebnisse werden in GMSB und vereinfachten Modellen interpretiert und Ausschlussgrenzen berechnet.

T 91: BSM Suchen VI

Zeit: Donnerstag 16:45–19:00 Raum: VMP5 SR 0077

T 91.1 Do 16:45 VMP5 SR 0077

Model Unspecific Search in CMS - Results at 8 TeV — •Andreas Albert, Deborah Duchardt, Thomas Hebbeker, Simon Knutzen, Jonas Lieb, Arnd Meyer, Tobias Pook, and Jonas Roemer — III. Physikalisches Institut A, RWTH Aachen University

In the year 2012, CMS collected a total data set of approximately 20 fb^{-1} in proton-proton collisions at $\sqrt{s} = 8\,\mathrm{TeV}$.

Dedicated searches for physics beyond the standard model are commonly designed with the signatures of a given theoretical model in mind. While this approach allows for an optimised sensitivity to the sought-after signal, it may cause unexpected phenomena to be overlooked.

In a complementary approach, the Model Unspecific Search in CMS (MUSiC) analyses CMS data in a general way. Depending on the reconstructed final state objects (e.g. electrons), collision events are sorted into classes. In each of the classes, the distributions of selected kinematic variables are compared to standard model simulation. An automated statistical analysis is performed to quantify the agreement between data and prediction.

In this talk, the analysis concept is introduced and selected results of the analysis of the 2012 CMS data set are presented.

T 91.2 Do 17:00 VMP5 SR 0077

Model Unspecific Search in CMS - First Results at 13 TeV — •Jonas Roemer, Andreas Albert, Deborah Duchardt, Thomas Hebbeker, Simon Knutzen, Jonas Lieb, Arnd Meyer, and Tobias Pook — III. Physikalisches Institut A, RWTH Aachen University

Following an upgrade in center of mass energy from $\sqrt{s} = 8$ TeV to 13 TeV, the LHC delivered first proton-proton collisions at this unprecedented energy in 2015. The CMS experiment recorded data corresponding to an integrated luminosity of $3.7 fb^{-1}$. Since many theoretical models predict signal cross sections to increase strongly with the center of mass energy, the data taken at $\sqrt{s} = 13$ TeV are competitive to the previous data taking period even with a lower recorded integrated luminosity.

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

This talk outlines changes to the analysis made necessary by the increased center of mass energy and first results with lepton triggered events.

T 91.3 Do 17:15 VMP5 SR 0077

Model Unspecific Search in CMS - Treatment of Insufficient Monte Carlo Statistics — •Jonas Lieb, Andreas Albert, Deborah Duchardt, Thomas Hebbeker, Simon Knutzen, Arnd Meyer, Tobias Pook, and Jonas Roemer — III. Physikalisches Institut A, RWTH Aachen University

In 2015, the CMS detector recorded proton-proton collisions at an unprecedented center of mass energy of $\sqrt{s} = 13\,\mathrm{TeV}$. The Model Unspecific Search in CMS (MUSiC) offers an analysis approach of these data which is complementary to dedicated analyses: By taking all produced final states into consideration, MUSiC is sensitive to indicators of new physics appearing in final states that are usually not investigated.

In a two step process, MUSiC first classifies events according to their physics content and then searches kinematic distributions for the most significant deviations between Monte Carlo simulations and observed data.

Such a general approach introduces its own set of challenges. One of them is the treatment of situations with insufficient Monte Carlo statistics.

Complementing introductory presentations on the MUSiC event selection and classification, this talk will present a method of dealing with the issue of low Monte Carlo statistics.

T 91.4 Do 17:30 VMP5 SR 0077

Model Unspecific Search in CMS - Model Unspecific Limits — •Simon Knutzen, Andreas Albert, Deborah Duchardt, Thomas Hebbeker, Jonas Lieb, Arnd Meyer, Tobias Pook und Jonas Roemer — III. Physikalisches Institut A, RWTH Aachen University

The standard model of particle physics is increasingly challenged by recent discoveries and also by long known phenomena, representing a strong motivation to develop extensions of the standard model. The amount of theories describing possible extensions is large and steadily growing.

In this presentation a new approach is introduced, verifying if a given theory beyond the standard model is consistent with data collected by the CMS detector without the need to perform a dedicated search. To achieve this, model unspecific limits on the number of additional events above the standard model expectation are calculated in every event class produced by the MUSiC algorithm. Furthermore, a tool is provided to translate these results into limits on the signal cross section of any theory.

In addition to the general procedure, first results and examples are shown using the proton-proton collision data taken at a centre of mass energy of 8 TeV.

T 91.5 Do 17:45 VMP5 SR 0077

Search for new physics in final states with one tau and missing transverse energy with CMS — •Klaas Padeken, Kerstin Hoepfner, Viktor Kutzner, and Thomas Hebbeker — III Phys. Inst. A, Aachen

The first search for new physics beyond the Standard Model in $\sqrt{s} = 13$ TeV pp events with one hadronically decaying tau and missing transverse energy is presented. The tau channel is of theoretical interest in light of the huge difference in mass of taus w.r.t. electrons and muons.

For this search the tau reconstruction has been extended to high energies and the first taus with TeV energies have been reconstructed and observed.

The results will be interpreted in terms of a new heavy charged vector boson W', which decays into a tau and a neutrino and in the framework of a non-universal gauge interaction model with the aim to explain the heaviness of the third generation fermions, with respect to the light first and second generation. The analysis is performed with

the 2015 dataset recorded with CMS at a center of mass energy of $\sqrt{s} = 13$ TeV.

T 91.6 Do 18:00 VMP5 SR 0077

Search for new physics in the final state of a lepton and missing transverse energy with the ATLAS experiment — Stefan Tapprogge and •Markus Zinser — Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudingerweg 7, 55099 Mainz

Some extensions of the Standard Model (SM) predict new massive charged spin-1 gauge bosons, like the W' boson. These bosons can decay into a lepton and neutrino. Such new particles can be searched for by looking for an excess of the data with respect to the SM backgrouns in the transverse mass spectrum. Since 2015 protons collide at a new record energy of $\sqrt{s} = 13$ TeV at the Large Hadron Collider at CERN. Data recorded by the ATLAS experiment from these collisions, corresponding to an integrated luminosity of about 3.3 fb^{-1}, has been analysed to search for such new heavy gauge bosons. No significant excess has been observed and limits on the mass of a W' boson in the context of the Sequential Standard Model (SSM) W' are presented.

T 91.7 Do 18:15 VMP5 SR 0077

Search for new physics, focused on W′ production, in the single electron plus missing-E$_T$ final states using pp collision data at $\sqrt{s} = 13$ TeV — •Fabian Bispinck, Thomas Hebbeker, Kerstin Hoepfner, Klaas Padeken, and Viktor Kutzner — III. Physikalisches Institut A, RWTH Aachen

A search for new physics in the electron + missing transverse energy channel is presented based on proton-proton collisions measured with the CMS detector at the LHC, using 2015 CMS data with an integrated luminosity of 2.1 fb^{-1} recorded at a center of mass energy of 13 TeV.

For this search the focus is set on the potential production of a W′ boson, as described by the Sequential Standard Model (SSM).

T 91.8 Do 18:30 VMP5 SR 0077

Search for High-Mass Resonances of Electron-Positron Pairs at $\sqrt{s} = 13$ TeV with ATLAS — •Holger Herr and Stefan Tapprogge — Universität Mainz

Several extensions of the Standard Model predict new, massive neutral spin-1 bosons. In 2015 the Large Hadron Collider at CERN started to collide protons at $\sqrt{s} = 13$ TeV. These new bosons might show up as narrow resonances in the invariant-mass spectrum of electron-positron pairs. 3.2 fb^{-1} of Data measured by the ATLAS experiment is used. To compare data to Standard Model predictions, the expected background is determined. Contributions of electron-positron pairs which originate from Standard Model processes are estimated using simulation. Background contributions from misidentified objects are calculated using data driven methods. The status of the analysis and results of the search will be presented.

T 91.9 Do 18:45 VMP5 SR 0077

Auswirkungen von Interferenzbeiträgen bei der Suche nach einem W'-Boson mit dem ATLAS-Experiment am LHC — •Julian Fischer, Markus Zinser und Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität, Mainz

Verschiedene Theorien zur Erweiterung des Standardmodells sagen einen schweren Partner des W-Bosons, in der Regel als W'-Boson bezeichnet, voraus.

Betrachtet man die gleichen Endzustände z.B. im leptonischen Zerfall ($W/W' \to l\nu$), so sind prinzipiell auch auftretende Interferenzeffekte zu berücksichtigen. Im Vortrag wird Bezug zum *Sequential Standard Model (SSM)* genommen, bei dem das W'-Boson die gleichen Kopplungen besitzt wie das dominant erzeugte W-Boson des Standardmodells.

Anhand simulierter Ereignisse für die Erzeugung von W-Bosonen und W'-Bosonen (des SSM) wird die Sensitivität der Suche mit pp-Kollisionen im ATLAS-Detektor am LHC bei $\sqrt{s} = 13$ TeV bestimmt. Insbesondere wird die Frage diskutiert, wie sich Interferenzeffekte auf eine Ausschlussgrenze bzw. auf das Entdeckungspotential eines W'-Bosons auswirken.

T 92: Neutrinomasse IV

Zeit: Donnerstag 16:45–19:05 Raum: VMP5 SR 0079

Gruppenbericht T 92.1 Do 16:45 VMP5 SR 0079

Status of the KATRIN experiment — •Florian Fraenkle for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institut für Kernphysik (IKP)

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a large-scale experiment for the model independent determination of the mass of electron anti-neutrinos with a sensitivity of 200 meV/c^2 (90% C.L.). It investigates the kinematics of electrons from tritium β-decay close to the endpoint of the energy spectrum with a high-resolution electrostatic spectrometer ($\Delta E = 0.93$ at 18.6 keV).

The KATRIN measurement setup consists of a high luminosity windowless gaseous tritium source (WGTS), a magnetic electron transport system with differential and cryogenic pumping for tritium retention, and an electro-static spectrometer section (pre-spectrometer and main spectrometer) for energy analysis, followed by a segmented detector system for counting transmitted β-electrons.

In order to investigate the backgrounds and transmission characteristics of the main spectrometer, a dedicated series of commissioning measurements was performed in 2015. The talk will present the current status of the experiment and give an overview on the results of the recent commissioning measurements.

This work has been supported by the German BMBF (05A14VK2).

T 92.2 Do 17:05 VMP5 SR 0079

Performance of the KATRIN spectrometer and detector section — •Thomas Thümmler for the KATRIN-Collaboration — Karlsruher Institute of Technology (KIT), Institute of Nuclear Physics (IKP), Karlsruhe, Germany

Neutrino properties and especially the determination of the neutrino mass play an important role at the intersections of cosmology, particle physics and astroparticle physics. The KArlsruhe TRItium Neutrino experiment (KATRIN) investigates single beta decay electrons close to their kinematic endpoint in order to determine the neutrino mass by a model-independent method.

Applying an ultra-luminous molecular windowless gaseous tritium source and an integrating high-resolution spectrometer of MAC-E filter type, KATRIN allows beta spectroscopy close to the kinematic endpoint with unprecedented precision and will reach a sensitivity of about 200 meV/c^2 (90% C.L.) on the neutrino mass.

The spectrometer and detector section (SDS) of KATRIN has successfully passed three consecutive commissioning phases to confirm the spectroscopic specifications, the long-term operation and stability, as well as the background level. Currently the SDS is being prepared for final commissioning, integration with the source and transport system, and the transition to neutrino mass measurement mode.

This talk will summarize the performance of the spectrometer and detector section, followed by an overview of the final steps towards complete KATRIN commissioning. Supported and funded by the Helmholtz Association, BMBF grant 05A14VK2, and the US DOE.

T 92.3 Do 17:20 VMP5 SR 0079

Near-time modeling of the gas dynamics in the KATRIN tritium source using extensive sensor data — •Florian Heizmann for the KATRIN-Collaboration — KIT Campus Nord, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

The KArlsruhe TRItium Neutrino (KATRIN) experiment - currently under construction at KIT - will determine the neutrino mass with an unprecedented sensitivity of 200 meV at 90 % C.L. by high-precision tritium β-decay spectroscopy. In order to reach this new level of neutrino mass sensitivity it is very important to understand the tritium source properties and the related systematic measurement uncertainties. Since the KATRIN tritium source features several 100 sensors to monitor its operational parameters, the implementation of the sensors into the source modeling is a major task. This talk focuses on the extension of the gasdynamics model to incorporate sensor data from pressure and temperature sensors in a near-time model. Furthermore, the challenge of determining the magnetic field inside the source beamtube by stray field measurements is addressed.

This work is supported by BMBF under grant number 05A14VK2 and

by the Helmholtz-Association.

T 92.4 Do 17:35 VMP5 SR 0079

The KATRIN Forward Beam Monitor Spectral Analysis — •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. This detector is being constructed at the University of Wuppertal and will be transported on-site to the KATRIN experiment in Karlsruhe within the first half of 2016. The working principle of the FBM, in particular the strategy for continuous monitoring of the column density of the tritium source, will be described. The expected β-electron spectra over varying source column densities has been simulated. The observation of such spectra by the FBM, and the statisical criteria for data quality control for the continuous monitoring the tritium source, will be shown.

T 92.5 Do 17:50 VMP5 SR 0079

Status of the KATRIN Focal-Plane Detector — •Agnes Seher for the KATRIN-Collaboration — Karlsruher Institute of Technology (KIT) — Institut für Kernphysik (IKP)

The KArlsruhe TRItium Neutrino (KATRIN) experiment aims to determine the mass of the electron anti-neutrino with a sensitivity of 200 meV/c^2 by measuring the kinematics of tritium β-electrons close to the enpoint of the energy spectrum. The energy analysis of the experiment is performed with a high-resolution electrostatic spectrometer of MAC-E filter type which acts as an integranting high pass filter. Transmitted electrons are counted with a segmented silicon detector system located at the downstream end of the experiment. The detector system consists of two super-conducting solenoids ($B_{max} = 6$T), a post-acceleration electrode, a detector wafer with silicon pixel-diodes, readout electronics as well as a calibration and monitoring devices. This talk will give an overview of the detector system and its current status as well as key performance parameters.

This work has been supported by the U.S. Department of Energy, the Helmholtz Association, and the German BMBF (05A14VK2).

T 92.6 Do 18:05 VMP5 SR 0079

The particle tracking package Kassiopeia — •Stefan Groh for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The Kassiopeia particle tracking framework is an object-oriented software package utilizing modern C++ techniques, written originally to meet the needs of the Katrin collaboration. Kassiopeia's target consists of simulating particle trajectories governed by arbitrarily complex differential equations of motion, continuous physics processes that may in part be modeled as terms perturbing that equation of motion, stochastic processes that occur in flight such as bulk scattering and decay, and potentially stochastic surface processes occurring at interfaces, including transmission and reflection effects. This entire set of computations takes place against the backdrop of a fully-featured geometry package which serves a variety of roles, including initialization of electromagnetic field simulations, gas flow simulations, and the support of state-dependent algorithm-swapping and behavioral changes. Kassiopeia has been well validated and widely used within the Katrin collaboration, playing a primary role in many theses and refereed publications. This talk will give an overview of the latest version of the simulation package. Supported by the German BMBF (05A14VK2).

T 92.7 Do 18:20 VMP5 SR 0079

KATRIN Sensitivity on Right-Handed Currents with eV Scale Sterile Neutrinos — •Nicholas Steinbrink[1,2], Steen Hannestad[2], Kathrin Valerius[3], and Christian Weinheimer[1] — [1]WWU Münster, Institute for Nuclear Physics — [2]Aarhus University, Department of Physics and Astronomy, Denmark — [3]KIT Karlsruhe, Institute for Nuclear Physics

The KATRIN experiment aims to determine the absolute neutrino mass by measuring the endpoint of the Tritium beta spectrum. As a large-scale experiment with a sharp energy resolution, high source luminosity and low background it may also be capable of testing certain theories of neutrino interactions beyond the standard model.

As an example for such an interaction, right-handed currents are introduced in some theories which contain a hidden left-right-symmetry. They have basically the same properties as standard left-handed weak currents but are strongly suppressed. Interference between left- and right-handed currents leads to slightly modified kinematics, thus allowing to boost or weaken certain regions near the endpoint of the beta spectrum. The effect would be even more pronounced in case of the existence of a fourth sterile neutrino since it is proportional to the mass of the neutrino final state. In the talk, that is discussed for the case of a sterile neutrino with a mass of some eV. The qualitative effects on the shape of the spectrum are shown as well as results of sensitivity simulations are presented.

This work is partly funded by BMBF under contract no. 05A11PM2, by DFG RTG 2149 and by the IP@WWU program.

T 92.8 Do 18:35 VMP5 SR 0079

Simulation of Background by Rydberg states in the KATRIN Mainspectrometer — •Nikolaus Trost for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institut für Kernphysik (IKP)

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a large-scale experiment for the model independent determination of the mass of electron anti-neutrinos with a sensitivity of 200 meV/c^2. It investigates the kinematics of electrons from tritium β-decay close to the endpoint of the energy spectrum with a highresolution electrostatic spectrometer (ΔE = 0.93 at 18.6 keV). Due to the low signal rate near the endpoint a low background level is of very high importance. Rydbgerg atoms excited and desorbed from the spectrometer surface can penetrate in the sensitive fluxtube uninfluenced by fields and be ionised by thermal radiation. The talk will present detailed simulation and analysis of this particular background process. This work has been suported by the German BMBF (05A14VK2).

T 92.9 Do 18:50 VMP5 SR 0079

Optimization of metallic magnetic calorimeters with embedded ^{163}Ho — •Ch. Fischer[1], H. Dorrer[2], Ch. E. Düllmann[2], K. Eberhardt[2], Ch. Enss[1], A. Fleischmann[1], L. Gastaldo[1], C. Hassel[1], D. Hengstler[1], S. Hähnle[1], K. Johnston[3], S. Kempf[1], T. Kieck[2], M. Krantz[1], U. Köster[4], F. Schneider[2], A. Türler[5], M. Wegner[1], and K. Wendt[2] — [1]Kirchhoff-Institut für Physik, Heidelberg — [2]Johannes Gutenberg-Universität, Mainz — [3]Physics Department CERN, Geneva — [4]Institut Laue-Langevin, Grenoble — [5]Laboratory of Radiochemistry and Environmental Chemistry, Paul Scherrer Institut, Villigen

The Electron Capture in ^{163}Ho (ECHo) collaboration plans to reach sub-eV sensitivity on the electron neutrino mass by the analysis of high statistics of ^{163}Ho electron capture spectra. Large arrays of metallic magnetic calorimeters (MMCs) with enclosed ^{163}Ho read out using microwave SQUID multiplexing will be used for the measurement of the spectrum. With first prototypes of MMCs having the ^{163}Ho source ion-implanted in the absorbers, operated at 25 mK, an energy resolution $\Delta E_{FWHM} = 7.6$ eV and a signal rise time $\tau = 130$ ns have been achieved, paving the way to the first stage of the experiment (ECHo 1k). We present the optimization of MMCs and of the methods to embed the high purity ^{163}Ho source in detector absorbers. In particular we discuss how to define the optimal activity per pixel considering the limits coming from the allowed unresolved pileup fraction and from the additional contribution of detector heat capacity related to the magnetic moments of ^{163}Ho.

T 93: Andere Gebiete der Theorie

Zeit: Donnerstag 16:45–18:00 Raum: VMP6 HS D

T 93.1 Do 16:45 VMP6 HS D

QCD und die kosmische Deutung der LHC-Signale — •Norbert Sadler — Wasserburger Str, 25a ; 85540 Haar

Es kann gezeigt werden, dass die QCD ein Fraktal der überlagerten Energiedichteverteilung des Universums, bei der primordinalen Nukleosynthese, ist.

alfa(QCD)=2x(E.bar. 5%)x(E.grav. 29%)x(E.dkl. 71%)=0.0206. Die gesamte Energiedichteverteilung des Universums wird auf den QCD-Mikrokosmos der Nukleonen selbstähnlich abgebildet.

Die gemessenen LHC-Signale resultieren aus der Kollision zweier Protonenenergieäquivalente von je (0.9384GeV). Dabei wird das Protonen-Confinement (2.5 GeV) angeregt und über das 57-dimensionale Objekt der E8-Symmetriegruppe perkoliert, gefiltert und in zwei Jets abgestrahlt.

57o((0.9384)x(2.5 GeV-Confinement)x(0.9384))= 125.6 GeV. Durch Anwendung der Faktorenanalyse auf das LHC-Signal kann dieses als Sublimentierung der 5% baryonischer Materie auf 2Pi verstanden werden: 2Pi/(5%bar.Mat.)=125.6. Im Umkehrschluss bedeutet dies, dass die Materiebildung und die Gravitation die Entropie der Nukleosynthese ist. Weitere Information: www.cosmology-harmonices-mundi.com

T 93.2 Do 17:00 VMP6 HS D

On the role of the fine structure constant in the alpha/beta rule for calculation of particle masses. — •Karl Otto Greulich — Fritz Lipmann Institut, Beutenbergstr.11, 07745 Jena

The masses of essentially all elementary particles are given almost exactly by the alpha/beta rule:

m = alpha to power of -n divided by or times beta*27,2 eV/c2

(K.O.Greulich, Spring meeting 2014 German Phys Society T 99.4), i.e. particle masses depend on the fine structure (Sommerfeld) constant alpha = 1/137). This is somewhat surprising since alpha is rather known as a spectroscopic constant than as a mass ratio. One key to understand this is the observation that the Bohr energy is exactly the 1 / alpha fold of the ionization energy of the hydrogen atom (Rydberg energy, 13.6 eV). Thereby the Bohr energy is the de Broglie energy of the electron in the ground state (on the Bohr radius). A second mass * or energy ratio, the ratio between the energy at rest of the electron and the Bohr energy can be derived analytically to be alpha to the power -2. Both results together suggest a general dependence of rest energies or rest masses on alpha. Simply by the hypothesis that this observation can be extrapolated to higher values of n, the alpha / beta rule follows immediately. Only the beta (1 or 1836,12) term has to be added empirically.

T 93.3 Do 17:15 VMP6 HS D

De Broglie's matter-waves are based on a logical bug — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

The postulation of matter waves by Louis de Broglie in 1923 was one of the basic starting points in the development of quantum mechanics. However, his deduction contains a serious logical error.

De Broglie deduced his central formula from considerations about the relativistic behaviour of a particle. He saw a conflict in the fact that a particle set into motion increases its internal frequency, f, according to E=h*f, whereas on the other hand its frequency has to decrease due to dilation. To solve this, he assigned a new "de Broglie wave" to a particle, which is related to the momentum of the particle. Scattering experiments seemed to confirm this approach.

However, if such a scattering process is observed from a moving system, it turns out that the relationship between the wavelength and the momentum yields nonsensical results. - De Broglie's deduction is based on an incorrect understanding of relativity with respect to dilation.

We will show which results are achieved if a correct understanding is applied. And we will show why, in a normal scattering experiment, de Broglie's incorrect formula nevertheless yields the expected results.

We will further explain some of the impacts of this error on the equations of Schrödinger and Dirac, who used de Broglie's formula as a starting point. Heisenberg's uncertainty principle is also affected.

T 93.4 Do 17:30 VMP6 HS D

The origin of mass - without Higgs — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

The detection of the "Higgs" boson has caused great excitement in the physical community. However, most physicists overlook the fact that the corresponding theory is in no way able to explain inertial mass.

On the one hand, the theory does not provide a means to determine the mass of an individual particle. The necessary Youkawa coupling does not follow from the theory. On the other hand, cosmological investigations show that the Higgs field needed is at least 57 orders of magnitude stronger than any actual existing vacuum field.

The inertial mass follows very simply from the fact that any extended object necessarily displays inertial behaviour. This is a consequence of the finiteness of the speed of light, by which binding forces propagate. If this mechanism is applied to existing particles, it yields the mass of the electron, for example, with a precision of better than 10^{-5}, using the size of the particle. It also covers the relativistic increase of mass due to motion, and as a consequence the famous equation $E = mc^2$.

T 93.5 Do 17:45 VMP6 HS D

Notational invariance of the standard model — •Lello Boscoverde — Istituto della Fava Pazza, Garching, Germany

We present our first investigations into the notational invariance of the standard model, including: an introduction to the principles of notational invariance, algorithms for implementing changes of notation, and examples demonstrating the invariance.

T 94: Kalorimeter III (SiPM)

Zeit: Donnerstag 16:45–18:30 Raum: VMP6 HS E

T 94.1 Do 16:45 VMP6 HS E

Optimization of a readout board for mass assembly and light yield measurements with a cosmic ray test stand — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz, Institut für Physik, Germany

We have built a readout board prototype, equipped with SiPMs, scintillators and readout electronics for an highly granular calorimeter. The design was optimized for mass assembly due to about 8 million channels in the final detector. The prototype showed good performance in several test beams and in a cosmic ray test stand, which was built to characterize the MIP response of these kinds of boards. We show an overview of the cosmic ray test stand and measurement results for the readout board and plans for an improved 2nd generation prototype.

T 94.2 Do 17:00 VMP6 HS E

Studies on surface-mounted SiPMs in 2015 testbeam of a highly granular hadron calorimeter — •Sascha Krause for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz, Mainz, Germany

To achieve excellent jet energy resolution, a highly granular hadronic calorimeter is being developed within the CALICE collaboration. Therefore, about 8 million detector units consisting of scintillator tiles and silicon photomultipliers (SiPMs) will be installed in the final HCAL design. The usage of surface-mounted (SMD) SiPMs allows an automated mass assembly. During CERN SPS testbeam 2015, data for a prototype consisting of up to 11 layers of HCAL base units (HBU) was collected using electron, muon and pion beams. One of the layers was equipped with the first SMD HBU. Results and performance, especially of the SMD HBU will be presented.

T 94.3 Do 17:15 VMP6 HS E

Studies on scintillator tiles and surface-mounted SiPMs for the mass assembly of a highly granular hadron calorimeter — •Yong Liu for the CALICE-D-Collaboration — Institut für Physik,

Johannes Gutenberg-Universität Mainz, Mainz, Germany

A technological prototype of a highly granular sampling hadron calorimeter (HCAL) based on scintillator tiles and silicon photomultipliers (SiPMs) is being developed within the CALICE collaboration. Driven by the need of an automated mass assembly of around 8 million channels of the final HCAL, we developed a design of scintillator tiles directly coupled to surface-mounted SiPMs and successfully built an HCAL readout unit with 144 channels via mass assembly. Results of extensive performance tests will be shown. Further studies on the characterisation of a novel SiPM with extremely low noise as well as tile design optimisations for the next generation of HCAL readout units will also be presented.

T 94.4 Do 17:30 VMP6 HS E

Scintillator tiles with SiPM readout for calorimetry and fast timing in SuperKEKB commissioning — •Hendrik Windel for the CALICE-D-Collaboration — Max-Planck-Institut for Physics

The CALICE collaboration is studying plastic scintillators coupled to silicon photomultipliers as sensors for calorimeters for future linear colliders like ILC and CLIC. Current detector concepts foresee up to ten million channels for the hadronic calorimeter. A larger number of different types of SiPMs and scintillator materials exist and their properties have to be investigated to provide best results. For these purposes a dedicated laboratory setup has been developed to provide high resolution scanning of the scintillator tiles with a radioactive source. The data acquisition of this setup as well as a fast online analysis has been implemented in LABVIEW. A modified version of this setup, together with hardware previously used for measuring timing properties of hardronic showers, will be used in the commissioning phase of the SuperKEKB accelerator. This contribution will discuss results from detailed investigations of different scintillator tiles, including the study of different materials. Key performance criteria for their application in calorimetry and in background measurements with high time resolution at SuperKEKB will also be presented.

T 94.5 Do 17:45 VMP6 HS E

Dark noise rates in irradiated silicon photomultiplier arrays — Sebastian Bachmann, Albert Comerma, •David Gerick, Xiaoxue Han, Stephanie Hansmann-Menzemer, Matthieu Kecke, Blake Leverington, José Mazorra de Cos, Dominik Mitzel, Max Neuner, and Ulrich Uwer for the LHCb-Collaboration — Physikalisches Institut, Universität Heidelberg

The planned downstream tracking system - the Scintillating Fibre Tracker - for the LHCb upgrade uses silicon photomultiplier (SiPM) arrays of 128 channels to read out mats made of 250 μm diameter scintillating fibres. In the LHCb environment the neutron flux degrades the silicon detectors to the edge of an acceptable performance in terms of DCR. Studies have shown that the dark count rate (DCR) of the SiPMs increases linearly with the neutron flux. Towards the end of the designed lifetime of the experiment the DCR per SiPM channel operated at $T = -40°C$ is expected to reach a few MHz after partial annealing.

To reduce the impact of the DCR - while at the same time provide efficient hit reconstruction - a clustering algorithm is developed to separate signal from noise. A brief introduction into the custom designed read-out ASIC and the cluster algorithm will be presented along with the studies of the dark count cluster rate dependency on the neutron flux, the DCR per channel and the effects of the applied signal thresholds for the clustering algorithm.

T 94.6 Do 18:00 VMP6 HS E

Study of the radiation damage of silicon photomultipliers — •Michael Nitschke, Valery Chmill, Erika Garutti, Robert Klanner, and Jörn Schwandt — Institute for Experimental Physics, Hamburg University, Luruper Chaussee 149, D-22761 Hamburg, Germany

Radiation damage significantly changes the performance of silicon photomultipliers (SiPM). In this work, we first have characterized KETEK SiPMs with a pixel size of 15x15 μm^2 using I-V (current-voltage), C/G-V/f (capacitance/impedance-voltage/frequency) and Q-V (charge-voltage) measurements with and without illumination with blue light of 470 nm from an LED. The SiPM parameters determined are DCR (dark count rate), $relative\ PDE$ (photon detection efficiency), G (Gain), XT (cross-talk), Geiger breakdown characteristics, C_{pix} (pixel capacitance) and R_q (quenching resistance).
Following this first characterization, the SiPMs were irradiated using reactor neutrons with fluences of 10^9, 10^{10}, 10^{11}, $5 \cdot 10^{11}$, and 10^{12} n/cm^2. Afterwards, the same measurements were repeated, and the dependence of the SiPM parameters on neutron fluence was determined. The results are used to optimize the radiation tolerance of SiPMs.

T 94.7 Do 18:15 VMP6 HS E

Teststand zur elektrischen und optischen Charakterisierung von SiPMs — Thomas Hebbeker, •Carsten Heidemann und Markus Merschmeyer — RWTH Aachen, III. Physikalisches Institut A

Silizium-Photomultiplier (SiPMs) sind Lichtdetektoren, die sehr empfindlich für Photonen, aber leider auch für Änderungen der Umgebungsbedingungen sind. Die verschiedenen experimentellen Anwendungen stellen unterschiedliche Anforderungen an die SiPMs. Es wird ein Teststand vorgestellt, der zur Charakterisierung von SiPMs dient. Der Teststand bietet eine temperaturstabilisierte Umgebung für einen großen Temperaturbereich, um die verschiedenen Einsatzszenarien simulieren zu können. Eine spezielle Multifunktionslichtquelle liefert ein breites Spektrum von UV bis Rot mit einstellbarem Photonenfluss, sowohl kontinuierlich als auch gepulst. Mittels Monochromator lassen sich auch schmale Wellenlängenbreiche abgreifen. Der Teststand bestimmt u.a. die folgenden Eigenschaften vollautomatisch: Rauschraten (thermisch), Noise-Effekte (Crosstalk, Nachpulsen), absolute und relative Photondetektionseffizienz (PDE), Erholungszeit. Der Teststand ermöglicht die Charakterisierung von SiPMs im 4D Parameterraum von Temperatur, Betriebsspannung, Lichtwellenlänge und Lichtintensität.

T 95: Flavour-Physik

Zeit: Donnerstag 16:45–18:30 Raum: VMP6 HS F

T 95.1 Do 16:45 VMP6 HS F

Yet another partial wave calculator — •Daniel Greenwald and Johannes Rauch — TUM, Munich, Germany

We will present a new C++ library for partial wave analysis: YAP—yet another partial wave calculator. YAP is intended for amplitude analyses of the decays of spin-0 heavy mesons (principally B and D) to multiple (3, 4, etc.) pseudoscalar mesons but is not hard coded for such situations and is flexible enough to handle other decay scenarios. The library allows for both model dependent and model independent analysis methods. We will introduce the software, and demonstrate examples for generating Monte Carlo data efficiently, and for analyzing data (both with the aid of the Bayesian Analysis Toolkit).

T 95.2 Do 17:00 VMP6 HS F

Die Suche nach den seltenen Zerfällen $B_q^0 \to \mu^+\mu^-\mu^+\mu^-$ mit Daten des LHCb-Experimentes — Johannes Albrecht und •Tobias Tekampe für die LHCb-Kollaboration — TU Dortmund

Seltene Zerfälle von B-Mesonen bieten eine vielversprechende Möglichkeit des Nachweises Neuer Physik. Das für den Zerfall $B_q^0 \to \mu^+\mu^-\mu^+\mu^-$ vom Standardmodell (SM) vorhergesagte Verzweigungsverhältnis ist von der Ordnung 10^{-10}. In Erweiterungen zum SM, in denen der Zerfall über skalare und pseudoskalare Teilchen stattfinden kann, ist dieses Verzweigungsverhältnis stark erhöht. Das LHCb Experiment hat den weltgrößten Datensatz an B-Meson Zerfällen aufgezeichnet, mit dem die präzise Messung dieser seltenen Zerfälle möglich ist. In diesem Vortrag werden die Ergebnisse der Messung des Verzweigungsverhältnisses des Zerfalls $B_q^0 \to \mu^+\mu^-\mu^+\mu^-$ auf einem mit dem LHCb-Detektor aufgezeichneten Datensatz entsprechend einer integrierten Luminosität von $3\,\text{fb}^{-1}$ vorgestellt.

T 95.3 Do 17:15 VMP6 HS F

Suche nach neuer Physik in $B \to D^* l\nu$ bei Belle — •Saskia Moenig, Florian Bernlochner und Jochen Dingfelder für die Belle-Kollaboration — Universität Bonn

Der Zerfallskanal $B \to D^* \ell\nu$ ($\ell = e, \mu$) bietet eine hohe Signalreinheit, ein gutes Verzweigungsverhältnis und kann präzise gemessen werden. Aus diesem Grund eignet er sich gut für die Suche nach Abweichungen vom Standardmodell, die ein Anzeichen für neue Physik darstellen könnten. In den Verteilungen kinematischer Variablen, insbesondere dreier Helizitätswinkel und des Rückstoßparameters w, soll in einer Modell-unabhängigen Analyse danach gesucht werden. Die Analyse beruht auf dem gesamten Belle-Datensatz aus den e^+e^--Kollisionen am KEKB-Beschleuniger in Japan. Es wurden nur Ereignisse untersucht, in denen das 2. B-Meson im $B\bar{B}$-Ereignis vollständig in einem hadronischen Zerfall rekonstruiert wurde.

Zuerst werden die Optimierung der Rekonstruktion des Signalzerfalls und die Selektion der Ereignisse präsentiert. Ziel der Analyse ist die Messung der differentiellen Verzweigungsverhältnisse des Zerfalls als Funktion der oben genannten Variablen. Dazu wird das Signal aus den Verteilungen der fehlenden Masse im Ereignis in Bins dieser Variablen extrahiert; es werden jeweils ihre Projektionen benutzt. Eine Untersuchung der Korrelationen zwischen den Variablen und eine Entfaltung der Detektoreffekte ermöglicht den Vergleich der experimentellen Daten mit den Vorhersagen der Theorie.

T 95.4 Do 17:30 VMP6 HS F

Untersuchung von $B \to \pi\tau\nu$ Zerfällen mit semileptonischem Tag am Belle-Experiment — •Stephan Duell, Florian Bernlochner und Jochen Dingfelder — Universität Bonn

Analysen von Zerfällen von $B \to D\tau\nu$ und $B \to D^*\tau\nu$ an den B-Fabriken zeigen Abweichungen von der Erwartung des Standardmodells in der Größe von 3.9σ. Hierdurch motiviert ist es von großem Interesse, auch den charmlosen semileptonischen Zerfall $B \to \pi\tau\nu$ zu untersuchen. Eine bestehende Analyse dieses Zerfallskanals, bei dem das zweite B-Meson im $B\overline{B}$-Ereignis in einem hadronischen Zefall rekonstruiert wurde, weist eine Signifikanz von 2.4σ von der Nullhypothese auf. In der hier vorgestellten komplementären Analyse wird das zweite B-Meson im $B\overline{B}$-Ereignis in einem semileptonischen Zerfall rekonstruiert. Das Tau-Lepton im $B \to \pi\tau\nu$ Zerfall wird in den 1-prong Kanälen $\tau \to \ell\nu_\ell\nu_\tau$, $\tau \to \pi\nu_\tau$ und $\tau \to \rho\nu_\tau$ rekonstruiert. Eine große Herausforderung der Analyse liegt darin, dass zwei beziehungsweise drei Neutrinos im Endzustand auftreten. Die kinematischen Einschränkungen durch den bekannten Anfangszustand an einem $e^+ - e^-$-Collider sowie durch die semileptonische Rekonstruktion des zweiten B-Mesons helfen bei der Trennung von Signal- und Untergrundprozessen. In diesem Vortrag wird der aktuelle Stand der Analyse präsentiert.

T 95.5 Do 17:45 VMP6 HS F

Untersuchung des inklusiven B-Mesonzerfalls $B \to X\tau\nu$ am Belle-Experiment — Jan Hasenbusch, •Florian Bernlochner und Jochen Dingfelder für die Belle-Kollaboration — Universität Bonn

Zerfälle von B-Mesonen mit einem τ-Lepton im Endzustand, wie der inklusive semileptonische Zerfall $B \to X\tau\nu_\tau$, sind besonders interessant, da sie sensitiv auf den möglichen Austausch eines geladenen Higgs-Bosons sind, das z. B. in supersymmetrischen Erweiterungen des Standardmodells auftritt. Exklusive Messungen von $B \to D^{(*)}\tau\nu_\tau$ Zerfällen von LHCb, BABAR und Belle zeigen interessante Abweichungen von 3.9σ von den Vorhersagen des Standardmodells. Die erste Untersuchung des inklusiven Zerfalls $B \to X\tau\nu_\tau$ an einer der B-Fabriken stellt eine wichtige Gegenprobe zu den exklusiven Messungen dar.

Das Belle-Experiment am KEK in Tsukuba, Japan hat einen großen Datensatz an B-Mesonen mit einer integrierten Luminosität von 711 fb^{-1} aus e^+e^- Kollisionen auf der $\Upsilon(4S)$-Resonanz aufgenommen.

In jedem Ereignis wird eines der B-Mesonen aus dem $\Upsilon(4S) \to B\bar{B}$ Zerfall in einem hadronischen Zerfallskanal vollständig rekonstruiert (hadronisches B-Tagging), das andere auf den Signalzerfall $B \to X\tau\nu_\tau$ hin untersucht. Der Vortrag beschreibt die erste Analyse von $B \to X\tau\nu_\tau$ Zerfällen mit einem Leptonen im Endzustand, das aus dem leptonischen Zerfällen des τ-Leptons stammt. Die Auswahl geeigneter Variablen, die Extraktion des Signals sowie eine Abschätzung der erwarteten Unsicherheiten wird vorgestellt.

T 95.6 Do 18:00 VMP6 HS F

Branching fraction measurement of the very rare decay $K^\pm \to \mu^\pm\nu_\mu e^+e^-$ — •Radoslav Marchevski for the NA62-Collaboration — Johannes Gutenberg Universität, Mainz, Germany

The rare decay $K^\pm \to \mu^\pm\nu_\mu e^+e^-$ proceeds via a $K^\pm \to \mu^\pm\nu_\mu$ decay with a radiated photon, which subsequently undergoes an internal conversion. While the biggest part of the decay rate is due to final state radiation from the outgoing muon, events with high invariant e^+e^- masses give access to direct photon emission from the weak vertex.

The NA48/2 Collaboration has collected the world largest sample on $K^\pm$ decays. We report the measurement of the branching fraction for $m_{ee} > 140$ MeV/c^2 and compare the result to the predictions of Chiral Perturbation Theory. The simultaneous collection of K^+ and K^- decays in the NA48/2 experiment in addition allows the search for CP violation in this decay.

T 95.7 Do 18:15 VMP6 HS F

Bestimmung der Isospin Aufspaltung des $\Sigma_c(2455)$-Baryonen — •Nis Meinert für die LHCb-Kollaboration — University of Rostock, Institute of Physics

Die starke Isospin Aufspaltung von Baryonen ist hinsichtlich dem Verständnis der starken Wechselwirkungen bei geringen Energien eine interessante Größe. Ziel dieser Analyse ist daher die Bestimmug der Isospin Aufspaltung der Massen der $\Sigma_c(2455)$-Baryonen, für welche bis jetzt nur wenige genaue Messungen und nur sehr unpräzise theoretische Ergebnisse vorliegen. Die Messung der Isospin Aufspaltung erfolgt über die Massendifferenz

$$m(\Sigma_c^{0/++}) - m(\Lambda_c)$$

wobei das Λ_c-Baryon über den Dreikörperzerfall $\Lambda_c \to pK\pi$ rekonstruiert wird. Zur Analyse werden die Messdaten des LCHb Experimentes am CERN aus den Jahren 2011 und 2012 verwendet.

T 96: Halbleiterdetektoren V (DEPFET)

Zeit: Donnerstag 16:45–18:45 Raum: VMP8 HS

T 96.1 Do 16:45 VMP8 HS

First large DEPFET pixel modules for the Belle II Pixel Detector — •Felix Müller[1], Ladislav Andricek[2], Paola Avella[1], Christian Kiesling[1], Christian Koffmane[1], Hans-Günther Moser[1], Rainer Richter[2], and Manfred Valentan[1] for the Belle II-Collaboration — [1]Max-Planck-Institut für Physik, München — [2]Halbleiterlabor der Max-Planck-Gesellschaft, München

DEPFET pixel detectors offer excellent signal to noise ratio, resolution and low power consumption with a low material budget. They will be used at Belle II and are a candidate for an ILC vertex detector. The pixels are integrated in a monolithic piece of silicon which also acts as PCB providing the signal and control routings for the ASICs on top. The first prototype DEPFET sensor modules for Belle II have been produced. The modules have 192000 pixels and are equipped with SMD components and three different kinds of ASICs to control and readout the pixels. The entire readout chain has to be studied; the metal layer interconnectivity and routings need to be verified. The modules will be fully characterized and the operation voltages and control sequences of the ASICs will be investigated. An overview of the DEPFET concept and first characterization results will be presented.

T 96.2 Do 17:00 VMP8 HS

Testmessungen an der Ausleseelektronik des Belle II Pixeldetektors — Jochen Dingfelder, Leonard Germic, Tomasz Hemperek, •Jan Cedric Hönig, Hans Krüger, Florian Lütticke, Carlos Marinas, Botho Paschen und Norbert Wermes für die Belle II-Kollaboration — Physikalisches Institut, Universität Bonn

Die e+e- Fabrik KEKB in Japan erfährt momentan ein Upgrade hin zum neuen SuperKEKB Beschleuniger, der vielfach höhere Luminosität erreichen wird als sein Vorgänger, was auch ein Upgrade des Belle Detektors notwendig macht. Der verbesserte Belle II Detektor wird einen neu gestalteten Vertex Detektor enthalten, dessen innerste beiden Lagen werden aus Pixelsensoren bestehen, die auf DEPFET (engl.: depleted p-channel field-effect transistor) Technologie basieren.Testmessungen mit den neusten Pixeldetektor-Modulen werden im Moment durchgeführt, um sicherzustellen, dass der Detektor allen Anforderungen gewachsen ist. Eine wichtige Rolle spielt die Ausleseelektronik der Pixelmodule. Eine wesentliche Komponente dieser Ausleseelektronik ist der ADC (Analog-Digital-Converter). In diesem Vortrag

wird der für die Belle II Pixelmodule genutzte ADC kurz vorgestellt, die Methoden zur Optimierung des ADCs diskutiert und entsprechende Tests der aktuellen Pixelmodulgeneration vorgestellt. Eine weitere gewünschte Eigenschaft des Detektors ist die Fähigkeit den Detektor blind zu schalten (genannt: gated Modus). Es werden Grundlagen dieses Modus erklärt und aktuelle Ergebnisse vorgestellt.

T 96.3 Do 17:15 VMP8 HS

Teststrahlmessungen an großen DEPFET Pixelsensoren für den Belle II Vertexdetektor — Jochen Dingfelder, Leonard Germic, Jan Cedric Hönig, Hans Krüger, •Florian Lütticke, Carlos Marinas, Botho Paschen und Norbert Wermes für die Belle II-Kollaboration — SiLab, Physikalisches Institut, Rheinische Friedrich-Wilhelms-Universität Bonn, Deutschland

Der Super-KEKB Beschleuniger am KEK Forschungszentrum in Tsukuba, Japan wird nach dem momentan durchgeführten Upgrade eine um den Faktor 40 höhere Luminosität liefern. Um die 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 sind, 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 Messungen einer Teststrahlkampagne und ortsaufgelöste Messungen mit einem Lasersystem verglichen, die an großen DEPFET Pixelsensoren mit mehreren ASICs vorgenommen wurden. Dabei wurden die Operationsparameter des Sensors verändert und damit die Ladungssammlungseigenschaften überprüft.

T 96.4 Do 17:30 VMP8 HS

Optimierung des Drain Current Digitizer Chips für den Belle II DEPFET Sensor — •Philipp Wieduwilt, Benjamin Schwenker und Ariane Frey — Universität Göttingen, II. Physikalisches Institut

Der zukünftige Belle II Detektor am SuperKEKB Beschleuniger in Japan wird mit einem hochauflösenden, zentralen Pixeldetektor für genaue Track- und Vertexauflösungen ausgestattet sein. Dieser zweilagige innere Siliziumdetektor basiert auf der DEPFET-Technologie. Die zur Auslese einer DEPFET-Pixelmatrix nötige Digitalisierung von Signalströmen wird in einem speziell entwickelten ASIC-Chip, dem Drain Current Digitizer (DCD), realisiert. Der DCD digitalisiert 256 Eingangsströme in 256 parallel arbeitenden Analog-Digital-Wandlern (ADC). Verschiedene Parameter, Spannungen und Ströme, steuern die Funktionsweise der ADCs. Es ist notwendig, den Arbeitspunkt für die ADCs mithilfe dieser Parameter zu optimieren. In diesem Vortrag wird eine Optimierungsstrategie für den DCD präsentiert und diskutiert. Sie basiert auf der Erkennung spezifischer Fehler in den ADC Kurven, die durch ungünstig gesetzte Parameterwerte entstehen.

T 96.5 Do 17:45 VMP8 HS

The BEAST II Experiment at Belle II: Characterization of the commissioning detector system for SuperKEKB — Patrick Ahlburg, Andreas Eyring, Viacheslav Filimonov, Hans Krueger, •Laura Mari, Carlos Marinas, David-Leon Pohl, Norbert Wermes, and Jochen Dingfelder — University of Bonn

Before the upgraded vertex detector for the Belle II experiment at the SuperKEKB collider in Japan will be installed, a dedicated detector system for machine commissioning (BEAST II) will be employed. One of its main objectives is to measure and characterize the different background types in order to ensure a safe environment before the installation of the actual silicon detector systems close to the interaction point.

FANGS, a detector system at BEAST II, based on ATLAS-IBL front-end electronics and planar silicon sensors is currently being developed for this purpose. The unique feature of this detector system is the high energy resolution achieved by using an external FPGA clock to sample the time-over-threshold signal, while keeping the excellent timing properties. The complete detector system will be presented in this talk.

T 96.6 Do 18:00 VMP8 HS

Charakterisierung von DEPFET-Teststrukturen der Pilotserie für den Belle II-Pixeldetektor — Jochen Dingfelder, Leonard Germic, Tomasz Hemperek, Cedric Hönig, Hans Krüger, Florian Lütticke, Carlos Marinas, •Botho Paschen und Norbert Wermes für die Belle II-Kollaboration — Universität Bonn

Die derzeit stattfindende Aufrüstung der B-Fabrik am KEK in Japan wird die Luminosität am Belle-Experiment um einen Faktor 40 auf $8{\cdot}10^{35}$ $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ erhöhen. Aufgrund der erwarteten höheren Datenrate ist ein Neudesign des Vertexdetektors notwendig. Zusätzlich zu einem vierlagigen Streifendetektor wird ein neuer Pixeldetektor bestehend aus zwei Lagen von Siliziumsensoren am nächsten am Interaktionspunkt eingebaut werden. Der Pixelsensor besteht aus Feldeffekttransistoren mit verarmtem p-Kanal (DEPFET). Seit 2015 ist eine Pilotserie (PXD9) der Belle II-Pixelmatrizen mit einer Pixelfläche von 55×50 $\mu\mathrm{m}^2$ und einer Dicke von 75 μm verfügbar. Für die Signalauslese und -verarbeitung im Experiment werden anwendungsspezifische integrierte Schaltungen (ASICs) entwickelt und eine kleine PXD9-Matrix mit 80x32 Pixeln wurde erfolgreich in einem Gesamtsystem mit den aktuellen ASIC-Prototypen getestet. Wichtige Parameter für das Verhalten sind die Spannungen zwischen den verschiedenen Siliziumimplantaten des DEPFET-Sensors und die optimalen Einstellungen müssen experimentell ermittelt werden. Die aktuellen Ergebnisse von Messungen zur Sensor- und Systemcharakterisierung des Testsystems mit Elektronen und Photonen aus radioaktiven Quellen und am Teststrahl des Deutschen Elektronen Synchrotron (DESY) werden präsentiert.

T 96.7 Do 18:15 VMP8 HS

Optimization of ADC Transfer Curves for the Belle II Pixel Detector — •Jakob Haidl[1], Felix Müller[1], Christian Koffmane[2], Hans-Günther Moser[1], Christian Kiesling[1], and Manfred Valentan[1] for the Belle II-Collaboration — [1]Max-Planck-Institut für Physik, München — [2]Halbleiterlabor der Max-Planck-Gesellschaft, München

The Super-KEKB accelerator at the KEK high energy research center in Tsukuba in Japan will provide a 40 times higher luminosity. To cope with this high luminosity the Belle detector is improved to Belle II, which includes the integration of a two layer DEPFET pixel detector (PXD) resulting in a higher vertex resolution. The task of the readout electronics is to process the high data rate of the PXD. To fulfill these requirements three different types of ASICs were designed. The foremost of them called Drain Current Digitizer (DCD) converts the drain currents of the DEPFET pixel sensors into digital code. Since the PXD will be equipped with 160 DCDs automatic testing of the chips is needed. Analog to digital transfer curves are an appropriate tool for error recognition and optimization of the digitization process within the DCD. An overview of measurements and optimization strategies will be presented.

T 96.8 Do 18:30 VMP8 HS

JTAG Boundary-Scan of the Belle II Pixel Vertex Detector — •Philipp Leitl for the Belle II-Collaboration — Max-Planck-Institut für Physik

For the upgrade of the Vertex Detector at the Belle II experiment, DEPFET sensors will be used. This new technology requires specific electronics for controlling and readout. Therefore three different kinds of Application-Specific Integrated Circuits (ASICs) are mounted very close to the sensors. Because of space limitations ball grid arrays (BGAs) are used for the contacts to the electronic circuitry.

After the mounting process this results in a lack of physical access to the electrical connections. With Boundary-Scan tests, following the IEEE Std 1149.1, it is possible to regain access to the pins for interconnection tests. In this way a quality assurance (QA) is possible to verify that the integration was done correctly and that the circuitry and the electronics are working properly.

The present user-friendly system is presented, including the description of additionally developed hardware as well as necessary adjustments to the netlist files and Boundary-Scan Description Language (BSDL) Files of the ASICs. Achieved measurement results from the so far produced detector modules are shown.

T 97: Grid-Computing

Zeit: Donnerstag 16:45–19:00 Raum: VMP8 SR 05

T 97.1 Do 16:45 VMP8 SR 05

Initial validation of ATLAS software on the ARM architecture — Gen Kawamura[1], Arnulf Quadt[1], Rolf Seuster[2], •Joshua Wyatt Smith[1], and Graeme Stewart[3] — [1]II. Physikalisches Institut, Georg-August Universität Göttingen — [2]TRIUMF — [3]University of Glasgow

In the early 2000's the introduction of the multi-core era of computing helped industry and experiments such as ATLAS realize even more computing power. This was necessary as the limits of what a single-core processor could do where quickly being reached. Our current model of computing is to increase the number of multi-core nodes in a server farm in order to handle the increased influx of data. As power costs and our need for more computing power increase, this model will eventually become non-realistic. Once again a paradigm shift has to take place. One such option is to look at alternative architectures for large scale server farms. ARM processors are such an example. Making up approximately 95 % of the smartphone and tablet market these processors are widely available, very power conservative and constantly becoming faster. The ATLAS software code base (Athena) is extremely complex comprising of more than 6.5 million lines of code. It has very recently been ported to the ARM 64-bit architecture. The process of our port as well as the first validation plots will be presented and compared to the traditional x86 architecture.

T 97.2 Do 17:00 VMP8 SR 05

Daten-intensive Arbeitsflüsse in der Cloud — Gen Kawamura[1], Oliver Keeble[2], Arnulf Quadt[1] und •Gerhard Rzehorz[1,2] — [1]II. Physikalisches Institut, Georg-August Universität Göttingen — [2]IT Department, CERN

Cloud Computing, insbesondere von kommerziellen Anbietern, wird für die Experimente des LHC fast ausschließlich für wenig Daten-intensive Arbeitsflüsse verwendet. In der Regel sind dies Monte-Carlo Simulationen die einen sehr geringen Dateneingang und einen geringen Datenausgang verzeichnen. Dies kommt daher, dass nur Computingpower, nicht aber permanenter Speicher in der Cloud genutzt wird. Um zu untersuchen, ob es rentabel wäre, datenintensivere Arbeitsflüsse (z.B. Rohdaten Rekonstruktion) in der Cloud auszuführen, müssen mehrere Dinge untersucht werden. Dies beginnt mit der Frage, wie genau man einen datenintensiveren Arbeitsfluss am besten in der Cloud ausführt. Fügt man permanenten Speicher hinzu (in Analogie zu einem Grid Computingzentrum)? Streamt man die Daten am besten von den existierenden Datenzentren mit globalen Zugriffsmethoden (z.B. Federated Access in ATLAS, SRM)? Wie stark beeinflusst die Nähe zu den Daten die Effizienz (Wallclock Zeit)? Kann eine erhöhte Effizienz durch Latenzzeit-Verschleierungsmethoden (z.B. Overcommittment für die CPU-Ressourcennutzung) erreicht werden? Um diese Fragen zu beantworten, werden Tests zunächst an lokalen virtuellen Maschinen und dann bei unterschiedlichen Cloud Anbietern durchgeführt und verglichen.

T 97.3 Do 17:15 VMP8 SR 05

Distributed analysis challenges in ATLAS — Günter Duckeck, •Federica Legger, Christoph Anton Mitterer und Rodney Walker — Ludwig-Maximilians-Universität München

The ATLAS computing model has undergone massive changes to meet the high luminosity challenge of the second run of the Large Hadron Collider (LHC) at CERN. The production system and distributed data management have been redesigned, a new data format and event model for analysis have been introduced, and common reduction and derivation frameworks have been developed. We report on the impact these changes have on the distributed analysis system, study the various patterns of grid usage for user analysis, focusing on the differences between the first and the second LHC runs, and measure performances of user jobs.

T 97.4 Do 17:30 VMP8 SR 05

Dynamische Bereitstellung von gemeinschaftlich genutzten Computerressourcen mit Hilfe von Virtualisierungs- und Containertechnologien — •Matthias J. Schnepf, Günther Erli, Georg Fleig, Manuel Giffels, Thomas Hauth und Günter Quast — Karlsruher Institut für Technologie

Heutzutage ist der Bedarf an Computerressourcen in viele Wissenschaftsbereichen enorm. Die Auslastung der verfügbaren Ressourcen ist dabei nicht immer konstant. Um eine optimale Auslastung zu gewährleisten, ist es sinnvoll, dass mehrere Gruppen die verfügbaren Ressourcen gemeinsam nutzen. Jedoch haben die verschiedenen Wissenschaftsgruppen stark unterschiedliche Anforderungen z.B. Betriebssystem, Experimentsoftware, etc.. Zur Lösung dieser Problematik ist Virtualisierung bzw. die Verwendung von Containertechnologie ein geeignetes Mittel.

Das Institut für Experimentelle Kernphysik (IEKP) hat zur weiteren Untersuchung eine Testumgebung aus Desktop-PCs und Servern eingerichtet. Auf diesen Systemen werden in Abhängigkeit des Bedarfs und der freien Ressourcen, dynamisch virtuelle Maschinen und Docker-Container gestartet und in das Batch-System HTCondor eingebunden.

Mit diesem dynamischen Ressourcenmanagement sollen in Zukunft auch verfügbare Ressourcen von externen Rechenzentren in das bestehendes HTCondor- System eingebunden werden. Im Vortrag wird über die gemachten Erfahrungen, sowie mögliche zukünftige Anwendungen berichtet.

T 97.5 Do 17:45 VMP8 SR 05

Dynamic integration of remote cloud resources into local computing clusters — •Georg Fleig, Günther Erli, Manuel Giffels, Thomas Hauth, Günter Quast, and Matthias Schnepf — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie

In modern high-energy physics (HEP) experiments enormous amounts of data are analyzed and simulated. Traditionally dedicated HEP computing centers are built or extended to meet this steadily increasing demand for computing resources. Nowadays it is more reasonable and more flexible to utilize computing power at remote data centers providing regular cloud services to users as they can be operated in a more efficient manner. This approach uses virtualization and allows the HEP community to run virtual machines containing a dedicated operating system and transparent access to the required software stack on almost any cloud site.

The dynamic management of virtual machines depending on the demand for computing power is essential for cost efficient operation and sharing of resources with other communities. For this purpose the EKP developed the on-demand cloud manager ROCED for dynamic instantiation and integration of virtualized worker nodes into the institute's computing cluster. This contribution will report on the concept of our cloud manager and the implementation utilizing a remote OpenStack cloud site and a shared HPC center (bwForCluster located in Freiburg).

T 97.6 Do 18:00 VMP8 SR 05

Analysen mit Datenlokalität durch Koordiniertes Caching — •Max Fischer, Manuel Giffels, Marcus Schmidt, Christoph Heidecker und Günter Quast — Karlsruhe Institute of Technology, Karlsruhe, Germany

Moderne Cluster zur Datenanalyse nutzen vielfach Datenlokalität, um eine hochperformante Datenverarbeitung zu ermöglichen. Hierdurch werden Datentransfers auf ein Minimum reduziert. Damit können Analysen auf beliebiger verteilter, vertikal skalierbarer Infrastruktur durchgeführt.

Existierende Lösungen für Datenlokalität setzen Anforderungen, die nur mit weitgehenden Änderungen von HEP-Workflows erfüllt werden können. Deshalb hat die KIT CMS Gruppe eine Middleware entwickelt, welche in regulären Batchsystemen Daten lokal zur Verfügung stellt. Dies wird durch eine Reihe von gezielt koordinierten und für den Benutzer transparenten Caches erreicht. Hierdurch kann das System nahtlos in bestehende Batchsysteme integriert werden, ohne dass Workflows verändert werden müssen.

Dieser Beitrag gibt einen Überblick über unsere bisherigen Erfahrungen mit dem Einsatz unserer Middleware für Endnutzeranalysen. Nutzbarkeit, Leistung und Stabilität werden mit Fokus auf HEP-Analysen dargestellt. Ferner diskutieren wir die Möglichkeiten zur Optimierung und Anwendbarkeit in anderen Umgebungen, z.B im Cloud-Computing zur Nutzung von opportunistischen Ressourcen.

T 97.7 Do 18:15 VMP8 SR 05

JEM: Ein Werkzeug zur automatisierten Monte-Carlo Validierung — Frank Ellinghaus, Torsten Harenberg, •Nicolas Lang, Peter Mättig, Marisa Sandhoff und Frank Volkmer —

Bergische Universität Wuppertal, Deutschland

Aus der Idee heraus entstanden, Live Monitoring für Gridjobs zu ermöglichen, ist der an der Bergischen Universität Wuppertal entwickelte Job Execution Monitor (JEM) inzwischen zu einem Multi-Purpose Tool herangereift, welches insbesondere zur automatisierten Erzeugung und zum Vergleich von Referenzhistogrammen für die Monte-Carlo Validierung genutzt wird. JEM bietet eine intuitive Weboberfläche, welche auf dem Django Framework basiert. Es unterstützt Analysen mit HepMc Analysis und Rivet, der Vergleich der Histogramme wird mittels DCube durchgeführt. JEM ermöglicht sowohl die explizite Generierung der Referenzdateien auf dem lokalen Server sowie die verteilte Erzeugung auf dem Grid. Es ist daher äußerst skalierbar. Weitere Anwendungen, wie der Vergleich von Analyseergebnissen auf Detektorlevel, wären in der Zukunft denkbar.

T 97.8 Do 18:30 VMP8 SR 05

An automated meta-monitoring mobile application and front-end interface for the ATLAS computing model — •Gen Kawamura and Arnulf Quadt — II. Physikalisches Institut, Georg-August-Universität Göttingen

Efficient administration of computing centres requires advanced tools for the monitoring and front-end interface of the infrastructure. Providing the large-scale distributed systems as a global grid infrastructure, like the Worldwide LHC Computing Grid (WLCG) and ATLAS computing, is offering many existing web pages and information sources indicating the status of the services, systems and user jobs at grid sites. A meta-monitoring mobile application which automatically collects the information could give every administrator a sophisticated and flexible interface of the infrastructure. We describe such a solution; the MadFace mobile application developed at Göttingen. It is a HappyFace compatible mobile application which has a user-friendly interface. It also becomes very feasible to automatically investigate the status and problem from different sources and provides access of the administration roles for non-experts.

T 97.9 Do 18:45 VMP8 SR 05

Experience of Google's latest Deep Learning library, TensorFlow, in a large-scale WLCG cluster — •Gen Kawamura, Joshua Wyatt Smith, and Arnulf Quadt — II. Physikalisches Institut, Georg-August-Universität Göttingen

The researchers at the Google Brain team released their second generation's Deep Learning library, TensorFlow, as an open-source package under the Apache 2.0 license in November, 2015. Google has already deployed the first generation's library using DistBlief in various systems such as Google Search, advertising systems, speech recognition systems, Google Images, Google Maps, Street View, Google Translate and many other latest products. In addition, many researchers in high energy physics have recently started to understand and use Deep Learning algorithms in their own research and analysis. We conceive a first use-case scenario of TensorFlow to create the Deep Learning models from high-dimensional inputs like physics analysis data in a large-scale WLCG computing cluster. TensorFlow carries out computations using a dataflow model and graph structure onto a wide variety of different hardware platforms and systems, such as many CPU architectures, GPUs and smartphone platforms. Having a single library that can distribute the computations to create a model to the various platforms and systems would significantly simplify the use of Deep Learning algorithms in high energy physics. We deploy TensorFlow with the Docker container environments and present the first use in our grid system.

T 98: Experimentelle Methoden III

Zeit: Donnerstag 16:45–19:10 Raum: VMP8 SR 105

Gruppenbericht T 98.1 Do 16:45 VMP8 SR 105

Track reconstruction for the *Mu3e* experiment — •Alexandr Kozlinskiy for the Mu3e-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

The *Mu3e* experiment is designed to search for the lepton flavour violating decay $\mu^+ \to e^+e^-e^+$. To reach the sensitivity of 10^{-16}, the experiment will be performed at a beam line at the Paul-Scherrer Institute (Switzerland) providing 10^9 muons per second. The muons with a momentum of about 28 MeV/c are stopped on a target and decay at rest. The target is placed inside two double layers of 50 μm thin pixel sensors with a pixel size of 80×80 μm^2. Timing information is provided by three layers of scintillating fibres, placed just before the outer double layers, and a scintillating tile detector. To improve momentum resolution, the detector geometry allows to record additional hits when particles bend back in the 1 T magnetic field. A fast track reconstruction is needed to cope with the high occupancy environment, reaching 100 tracks per readout frame of 50 ns. The implementation of a track reconstruction with a fast multiple scattering fit, where spatial uncertainties are ignored, is described. The performance of the track reconstruction and the use of timing information from fibre and tile detector is presented.

Gruppenbericht T 98.2 Do 17:05 VMP8 SR 105

The MuSun experiment: muon capture on the deuteron — •Frederik Wauters[1,2], Peter Kammel[2], Claude Petitjean[3], Alexander Vasilyev[4], Rachel Ryan[2], Daniel Salvat[2], Ethan Muldoon[2], Michael Murray[2], David Hertzog[2], Robert Carrey[5], Frederick Gray[6], and Tim Gorringe[7] — [1]Johannes Gutenberg University of Mainz, Mainz, Deutschland — [2]University of Washington, Seattle, USA — [3]Paul Scherrer Institute, Villigen, Switzerland — [4]Petersburg Nuclear Physics Institute , Gatchina, Russia — [5]Boston University, Boston, USA — [6]Regis University, Denver, USA — [7]University of Kentuky, Lexington. USA

The MuSun experiment measures the muon capture rate on the deuteron via a precise measurement of the lifetime of negative muons in deuterium, determining unambiguously the low energy constant (LEC) related to the strengths of the axial coupling to the two nucleon-system. LEC's are part of recently developed QCD-based effective field theories, which provide a first-principles description with predictive power for few-body nuclear systems. A quantitative relationship is established between astrophysical processes which cross sections can not be measured in the laboratory, such as the pp fusion in our sun, and muon capture rates. The MuSun experiment finished data taking at the Paul Scherrer Institute (Villigen, CH) in the summer of 2015. In this talk, I will present the experimental program of the last 4 years and the progress of the data analysis towards a first physics result. I will focus on our active-target time projection chamber, which provides the event selection for the 10 ppm lifetime analysis.

T 98.3 Do 17:25 VMP8 SR 105

Track reconstruction for the P2 experiment — •Alexey Tyukin for the P2-Collaboration — JGU, Mainz, Deutschland

The P2 experiment at the future MESA accelerator in Mainz will measure elastically scattered electrons from a hydrogen or lead target in order to determine the parity violating asymmetry for different beam polarisations, which is created due to the weak charge of the target. The asymmetry can provide access to the Weinberg angle and the neutron skin of heavy nuclei. These quantities depend heavily on the momentum transfer Q^2, thus a reconstruction of single electron tracks in an inhomogeneous magnetic field is necessary. For this, the P2 detector will have four tracking planes of thin high voltage monolithic active pixel sensors (HV-MAPS).

The scattered electrons propagate through a magnetic field and hit all four planes. In order to fit the hit positions the General Broken Lines method is used. As a fast propagator, a variation of the Runge-Kutta algorithm is applied, which solves the equation of motion in an inhomogeneous magnetic field numerically, such that the final state momentum and scattering angle can be reconstructed. The initial momentum and incident angle can vary strongly due to the thickness of the target, limiting the reconstruction quality. The average single track Q^2 value of 0.006 GeV$^2/c^2$ can be reconstructed with about 4% uncertainty in a first analysis of the Geant4 simulation, leading to a high total precision due to large electron numbers in the experiment.

T 98.4 Do 17:40 VMP8 SR 105

Parameterization-based tracking for the P2 experiment — •Iurii Sorokin for the P2-Collaboration — Institut für Kernphysik and PRISMA cluster of excellence, Mainz, Deutschland

The P2 experiment at the new MESA accelerator in Mainz aims to determine the weak mixing angle by measuring the parity-violating asymmetry in elastic electron-proton scattering at low momentum transfer. To achieve an unprecedented precision an order of 10^{11} scattered electrons per second have to be acquired. Whereas the tracking system is not required to operate at such high rates, every attempt is made to achieve as high rate capability as possible.

The P2 tracking system will consist of four planes of high-voltage monolithic active pixel sensors (HV-MAPS). With the present preliminary design one expects about 150 signal electron tracks and 20000 background hits (from bremsstrahlung photons) per plane in every 50 ns readout frame at the full rate.

In order to cope with this extreme combinatorial background in online mode, a parameterization-based tracking is considered as a possible solution. The idea is to transform the hit positions into a set of weakly correlated quantities, and to find simple (e.g. polynomial) functions of these quantities, that would give the required characteristics of the track (e.g. momentum). The parameters of the functions are determined from a sample of high-quality tracks, taken either from a simulation, or reconstructed in a conventional way from a sample of low-rate data.

T 98.5 Do 17:55 VMP8 SR 105

Track Based Alignment of the Mu3e Detector — •Ulrich Hartenstein — Institut für Kernphysik, Universität Mainz

The Mu3e emperiment searches for the lepton flavor violating decay $\mu^+ \to e^+e^-e^+$ with a sensitivity goal for the branching fraction of better than 10^{-16}. This process is heavily supressed in the standard model of particle physics (BR $< 10^{-50}$) which makes an observation of this decay a clear indication of new physics.

For track reconstruction, four barrel shaped layers consisting of about 3000 high-voltage monolithic active pixel sensors (HV-MAPS) are used. The position, orientation and possible deformations of these sensors must be known to greater precision than the assembly tolerances. A track based alignment via the General Broken Lines fit and the Millepede-II algorithm will be used to achieve this precision in the final detector.

The talk will discuss a study of the required alignment precision and preparations for aligning the detector using a detailed simulation.

T 98.6 Do 18:10 VMP8 SR 105

Design of a tritium compatible spectroscopy experiment for hydrogen istopologues for temperatures between 15-293 K — •Sebastian Mirz, Tim Brunst, Robin Grössle, and Bennet Krasch — Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

The Karlsruhe Tritium Neutrino Experiment (KATRIN) investigates the energy spectrum of the tritium β decay near its energetic endpoint in order to determine the electron anti-neutrino mass with a sensitivity of $200\,\mathrm{meV/c^2}$ (90% C.L.). Therefore, molecular tritium gas is decaying in a windowless gaseous tritium source (WGTS). The physical properties of the gas in the WGTS, like composition, ortho/para ratio or rotational population, need to be stabilised on a 10^{-3} level due to their direct impact on the initial state distribution of the investigated β decay. The new experiment T_2ApIR is designed to be fully tritium compatible to perform IR and Raman spectroscopic measurements on all six hydrogen isotopologues under conditions similar to the KATRIN WGTS. Therefore, T_2ApIR will provide a combination of a chemical and a coolable ortho/para catalyst, in order to produce isotope mixtures with non-equilibrium chemical and ortho-para compositions. The produced gas mixtures are examined with a second Raman analysis system, able to simultaneously determine the chemical and ortho/para composition in the gas phase. This contribution presents the design of the new T_2ApIR experiment with the focus on the investigation of molecular processes, as e.g. the formation of van-der-Waals clusters.

T 98.7 Do 18:25 VMP8 SR 105

Energy reconstruction methods for large coplanar quad-grid CdZnTe detectors — •Jan-Hendrik Arling, Claus Gössling, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV, Dortmund, D

The COBRA experiment will search for neutrinoless double beta-decay ($0\nu\beta\beta$) using CdZnTe semiconductor detectors. Currently a demonstrator setup consisting of 64 coplanar-grid (CPG) CdZnTe detectors with a volume of $(1 \times 1 \times 1)\,\mathrm{cm^3}$ each is under operation at the Gran Sasso Underground Laboratory (LNGS). The next step for the experiment will be the installation of an array of nine CdZnTe detectors with a volume of $(2 \times 2 \times 1.5)\,\mathrm{cm^3}$ and four CPG sectors with parallel readout each. Advantages of these larger detectors are a higher full-energy detection efficiency and a better surface-to-volume ratio. Up to now, the reconstruction schemes developed for the $1\,\mathrm{cm^3}$ detectors are also used for the $6\,\mathrm{cm^3}$ detectors. Consequentially the potential of improvements on the energy reconstruction will be investigated. An important topic in this context is the reconstruction of the interaction depth which is possible due to the coplanar-grid design. In this talk the newest results of the investigation of the reconstruction methods for $6\,\mathrm{cm^3}$ CdZnTe detectors will be presented and discussed.

T 98.8 Do 18:40 VMP8 SR 105

Stress evaluation at the ILC positron source — •Andriy Ushakov[1], Gudrid Moortgat-Pick[1], Sabine Riemann[2], Felix Dietrich[2], Kurt Aulenbacher[3], Valery Tyukin[3], and Philipp Heil[3] — [1]Universität Hamburg, II. Institut für Theoretische Physik, Luruper Chaussee 149, 22761 Hamburg — [2]Deutsches Elektronen-Synchrotron DESY, Standort Zeuthen, Platanenallee 6, 15738 Zeuthen — [3]Johannes Gutenberg-Universität Mainz, Institut für Kernphysik, Johann-Joachim-Becher-Weg 45, 55128 Mainz

High luminosity is required at future Linear Colliders which is particularly challenging for all corresponding positron sources. At the International Linear Collider (ILC), polarized positrons are obtained from electron-positron pairs by converting high-energy photons produced by passing the high-energy main electron beam through a helical undulator. The conversion target undergoes cyclic stress with high peak values. To distribute the thermal load, the target is designed as wheel spinning in vacuum with 100 m/s. However, the cyclic stress over long time at high target temperatures could exceed the fatigue stress limit. In the talk, an overview of the ILC positron source is given. The prospects to study material parameters under conditions as expected at the ILC are discussed.

T 98.9 Do 18:55 VMP8 SR 105

Bestimmung der Strahlpolarisation am International Linear Collider (ILC) — •Robert Karl[1,2] und Jenny List[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestraße 85, 22607 Hamburg — [2]Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Der ILC ist ein geplanter Elektron-Positron Collider mit Schwerpunktenergien von bis zu 500 GeV (Upgrade 1 TeV). Dabei werden der Elektronenstrahl zu 80% und der Positronenstrahl bis zu 60% polarisiert sein. Dies ermöglicht einzigartige Untersuchungen der chiralen Kopplungen von Standardmodell-Teilchen (z.B. von Top-Quarks) oder auch von potentiellen neuen Teilchen. Um das Potential des ILC voll auszuschöpfen, muss die Genauigkeit der Polarisation im Promillebereich liegen. Dies bedeutet ungefähr einen Faktor 2 bis 5 genauer als bisher bei vergleichbaren Beschleunigern erreicht wurde. Am ILC wird die Polarisation direkt im laufenden Betrieb vor und hinter deren Kollisionspunkt gemessen und anschließend durch Spintracking zum Kollisionspunkt extrapoliert. Doch die Polarisation kann auch direkt am Kollisionspunkt aus der Langzeitmessung von Wechselwirkungsquerschnitten bekannter Standardmodellprozesse, die polarisationsabhängig sind, bestimmt werden. In diesem Beitrag wird die Sensitivität verschiedener Standardmodellprozesse in Hinblick auf die erreichbaren Genauigkeiten der Polarisationsmessung diskutiert. Dabei werden sowohl statistische als auch systematische Unsicherheiten betrachtet und eine Gesamtstrategie zur Bestimmung der luminositätsgewichteten mittleren Polarisation entwickelt.

T 99: Detektorsysteme IV

Zeit: Donnerstag 16:45–19:00 Raum: VMP8 SR 205

T 99.1 Do 16:45 VMP8 SR 205

Building a Tracking Detector for the P2 Experiment — •Marco Zimmermann for the P2-Collaboration — Institute of 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 assymetry 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 150 MeV electrons.

While the main asymmetry measurement is performed with integrating Cherenkov detectors, the tracking system is developed in order to determine the average momentum transfer of the electron and to reconstruct individual electron tracks for systematic studies. It will be built using the new technology of High Voltage Monolithic Active Pixel Sensors (HV-MAPS) made of silicon thinned to 50 μm.

The main challenge for the tracking system are very high expected particle rates. The expected rate of electrons that are scattered in the liquid hydrogen target and hit the tracking system is of the order $10^5 \mathrm{mm}^{-2}\mathrm{s}^{-1}$ and is overwhelmed by more than 10^7 $\mathrm{mm}^{-2}\mathrm{s}^{-1}$ bremsstrahlung photons.

Each of the tracking layers is envisaged to have a disc-like geometry. They are arranged as two double layers. Since only limited sensor area is affordable, each layer is divided into four segments with about 15 degree azimutal coverage. This layout is presented and motivated by investigations on the expected hit rates and the sensor response.

T 99.2 Do 17:00 VMP8 SR 205

The Dortmund Low Background Facility — Current Status and Recent Developments — Claus Gössling, Kevin Kröninger, and •Christian Nitsch — Experimentelle Physik IV, TU Dortmund, 44221 Dortmund

The Dortmund Low Background Facility (DLB) is a low-background gamma ray spectrometry system with an artificial overburden. The overburden of ten meters of water equivalent, in combination with a multi-layer lead castle and an active muon veto are shielding a high-purity germanium detector of 60 % relative efficiency. The background level is remarkably low compared to a conventional spectrometer system without special shielding and enables sensitivities well below 1 Bq/kg. Thus, material screening measurements as well as environmental monitoring measurements are possible on an easy-accessible location above ground at the campus of the Technische Universität Dortmund. The integral background count rate between 40 keV and 2700 keV is 2.528±0.004 counts/kg/min, which is comparable to systems that are situated below ground.

In the talk, an overview of the current status of the DLB is given and recent developments are presented.

T 99.3 Do 17:15 VMP8 SR 205

Track Parameter Resolution Study of a Pixel Only Detector for LHC Geometry and Future High Rate Experiments — Michele Piero Blago, •Tamasi Rameshchandra Kar, and Andre Schöning — Physikalisches Institut, Universität Heidelberg, Germany

Recent progress in pixel detector technology, for example using High Voltage-Monolithic Pixel Sensors (HV-MAPS), makes it feasible to construct an all-silicon pixel detector for large scale particle experiments like ATLAS and CMS or other future collider experiments. Preliminary studies have shown that nine layers of pixel sensors are sufficient to reliably reconstruct particle trajectories. The performance of such an all-pixel detector is studied based on a full GEANT simulation for high luminosity conditions at the upgraded LHC.

Furthermore, the ability of an all-pixel detector to form trigger decisions using a special triplet pixel layer design is studied. Such a design could be used to reconstruct all tracks originating from the proton-proton interaction at the first hardware level at 40 MHz collision frequency.

T 99.4 Do 17:30 VMP8 SR 205

Simulation of an all silicon tracker for CLIC — •Magdalena Muenker[1,2] and Andreas Nuernerg[1,2] — [1]CERN — [2]University of Bonn

CLIC is a proposed future electron-positron linear collider with a centre-of-mass energy up to 3 TeV. The aim of high precision measurements at CLIC is driving the design of the detector for CLIC. To perform a precise measurement of the Higgs recoil mass a momentum resolution of $\sigma_{\mathrm{p_T}}/\mathrm{p_T^2} \sim 2 \cdot 10^{-5}\mathrm{GeV}^{-1}$ is required. This imposes a single point tracking resolution of $\sim 7\,\mu$m. To reach this aim an all silicon tracker is foreseen for CLIC. A simulation chain has been set up to study the performance of different silicon sensor designs. This simulation chain consists of a GEANT4 simulation to model the energy deposit in silicon, a finite element simulation of the charge drift and signal formation with TCAD and a fast parametric modelling of the front-end electronics. By that energy fluctuations, electronic noise and the digitalisation of the readout signal are taken into account. Furthermore this tool is used to predict the sensor performance in terms of efficiency, cluster-size and resolution. This framework is used to study the performance of e.g. sensors with different pitch and thickness. Various incident angles of charged particles with respect to the sensor surface and the effect of a magnetic field are taken into account. The simulation chain is validated with data.

T 99.5 Do 17:45 VMP8 SR 205

The MuPix Telescope - Tracking Low Momentum Particles at High Rates — •Lennart Huth for the Mu3e-Collaboration — Physikalisches Institut Universität Heidelberg

New physics beyond the Standard Model as predicted by several models includes charged lepton flavor violation (cLFV). The search for cLFV decays requires high statistics to be sensitive to small branching ratios (BRs). The Mu3e experiment will search for the cLFV decay $\mu^+ \to e^+ e^- e^+$ with a sensitivity in BR of 10^{-16}. The required high rate and the low momentum of the decay particles are the biggest challenges. To reduce multiple Coulomb scattering, the dominant measurement uncertainty thin detectors are needed. For Mu3e, the novel concept of **H**igh **V**oltage **M**onolithic **A**ctive **P**ixel **S**ensors (HV-MAPS) is chosen.
To test the scalability, data acquisition, control and online monitoring of Mu3e and for sensor characterization at test beams, a particle tracking telescope has been developed. It is optimized to handle high rates of low momentum particle of over 1 MHz.
This talk introduces the concept and setup of the telescope. Efficiency, timing and noise results from test beam campaigns at PSI and DESY are also shown.

T 99.6 Do 18:00 VMP8 SR 205

A CAD Based Geometry Model for Simulation and Analysis of Particle Detector Data — •Michael Milde, Martin Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

The development of a new particle detector requires a good understanding of its setup. A detailed model of the detector's geometry is not only needed during construction, but also for simulation and data analysis. To arrive at a consistent description of the detector geometry a representation is needed that can be easily implemented in different software tools used during data analysis. We developed a geometry representation based on CAD files that can be easily used within the Geant4 simulation framework and analysis tools based on the ROOT framework. This talk will present the structure of the geometry model and show its implementation using the example of the event reconstruction developed for the Multi-purpose Active-target Particle Telescope (MAPT). The detector consists of scintillating plastic fibers and can be used as a tracking detector and calorimeter with omnidirectional acceptance. To optimize the angular resolution and the energy reconstruction of measured particles, a detailed detector model is needed at all stages of the reconstruction. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 99.7 Do 18:15 VMP8 SR 205

Characterization of a large CdZnTe coplanar quad-grid semiconductor detector — •Robert Theinert, Claus Gössling, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV, 44221 Dortmund, D

The COBRA collaboration aims to search for the neutrinoless dou-

ble beta-decay of ^{116}Cd. For this purpose, it operates a demonstrator setup with 64 CdZnTe detectors, each with a volume of 1 cm^3, at the LNGS underground laboratory in Italy. Double beta-decays are associated with half-lifes of more than 10^{25} years. To be sensitive to those half-lifes, a high detection efficiency and an ultra low-background setup are, among other aspects, important requirements.

The usage of larger detectors is expected to improve the sensitivity. Detectors with a larger volume have a higher detection efficiency than the smaller ones. In addition, the background is reduced due to the lower surface-to-volume ratio.

A large $(2 \times 2 \times 1.5)$ cm^3 CdZnTe detector with a new coplanar-grid design is characterized for applications in γ-ray spectroscopy and low-background operation. The four coplanar-grids on the anode side offer the possibility of separating the detector in four single sectors. The electric properties as well as the spectrometric performance, like energy response and resolution, are investigated in several measurements. Furthermore, studies concerning the operational stability and the possibility to identify multiple-scattered photons, are conducted.

T 99.8 Do 18:30 VMP8 SR 205

Discrimination of Alpha Particles in CdZnTe Detectors with Coplanar Grid for the COBRA Experiment — •Henning Rebber for the COBRA-Collaboration — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The aim of the COBRA experiment is the search for neutrinoless double beta decay using CdZnTe semiconductor detectors. A background rate in the order of 10^{-3} counts per keV, kg and year is intended in order to be sensitive to a half-life larger than 10^{26} years. Measurements from a demonstrator setup and Monte Carlo simulations indicate that a large background component is due to alpha particles. These generate charge clouds of only few μm in diameter in the detector, leading to characteristic pulse features.

Parameter-based cut criteria were developed to discriminate alpha events by means of their pulse shapes. The cuts were tested on data from alpha and beta irradiation of a $(1 \times 1 \times 1)$ cm^3 CdZnTe detector with coplanar grid. The pulse shapes of all event signals were read out by FADCs with a sampling rate of 100 MHz. The signals were reproduced by a detector simulation which hence was used to study the cuts for energies up to 3 MeV and different detector regions.

T 99.9 Do 18:45 VMP8 SR 205

Germanium Detektor Entwicklung: SegBEGe — •Martin Schuster — Max Planck Institut für Physik, München, Deutschland

Hochreine Germanium Detektoren (HPGe) spielen seit einiger Zeit eine fundamentale Rolle in der Teilchenphysik, vor allem bei der Suche nach neutrinolosem Doppelbetazerfall und nach dunkler Materie. Im Bezug auf die Energieauflösung und die Erkennung von Untergrundstrahlung - dies sind Schlüsselfaktoren für derartige Experimente - wurden in den letzten Jahren zwei neue Typen von HPGes entwickelt, der Broad Energy Range Germanium Detektor (BEGe) und der segmentierte HPGe. Beide Typen stellen eine Verbesserung im Bezug auf die Untergrunderkennung dar, indem sie es ermöglichen zwischen sogenannten single-site Ereignissen und multi-site Ereignissen zu unterscheiden. Das Schwellenverhalten des BEGe wird zudem durch die viel kleinere Detektorkapazität verbessert. Der segmentierte HPGe ist dagegen im Stande die Phi-Entartung für multi-site Ereignisse zu brechen. Mit dem Ziel beide Technologien zu vereinen hat die GeDet Gruppe am MPI einen neuartigen segmentierten BEGe entworfen, der in Folge von CANBERRA France hergestellt wurde. Mit den Signalen aus den Segmenten wird ein besseres Verständnis der Ereignistopologie erwartet, inklusive des präzisen Ereignisortes sowie der physikalischen Prozesse und somit eine verbesserte Untergrunderkennung. Die Segmentierung wird auch dazu beitragen die Pulseigenschaften des BEGe wie zum Beispiel die Ladungsdrift besser zu verstehen. Vorgestellt werden erste Ergebnisse des Betriebs des segmentierten BEGe.

T 100: Elektroschwache Wechselwirkung (Experiment) III

Zeit: Donnerstag 16:45–18:45 Raum: VMP8 SR 206

T 100.1 Do 16:45 VMP8 SR 206

Combined QCD and electroweak analysis of HERA data — •Volodymyr Myronenko — DESY, Hamburg, Germany

A simultaneous fit of PDFs and electroweak parameters to HERA deep inelastic scattering data is presented. The input data are the neutral current, NC, and charged current, CC, inclusive cross sections that were previously used in the QCD analysis providing the HERAPDF2.0 PDFs. The NLO QCD plus LO electroweak analysis uses information on polarisation of the electron beam for the ZEUS data taken between 2004 and 2007. Results on the vector and axial-vector couplings of the Z boson to u- and d-type quarks, on the value of the electroweak mixing angle and the mass of the W boson are presented. The values obtained for the electroweak parameters are in agreement with Standard Model predictions.

T 100.2 Do 17:00 VMP8 SR 206

Differential cross section measurements in events with two photons and N jets at $\sqrt{s} = 8$ TeV with the ATLAS detector — •Martin Bessner and Kerstin Tackmann — DESY

Isolated prompt photons allow to probe the physics of proton-proton collisions as they are sensitive to the gluon parton distribution functions.

Preliminary measurements of cross sections of pairs of isolated prompt photons with and without additional jets are presented. Collision data from the ATLAS detector at the LHC is used, corresponding to an integrated luminosity of 20.3 fb^{-1} collected in 2012 at a center-of-mass energy of 8 TeV. The cross sections have been measured differentially as function of different observables and the number of jets at the same time. Background subtraction and sources of systematic uncertainties are discussed. A focus is put on the unfolding procedure, where SVD unfolding has been generalized to work with two-dimensional distributions. The measurements of cross sections are compared to theory predictions.

T 100.3 Do 17:15 VMP8 SR 206

Differentielle Messung des Dijet Wirkungsquerschnitts und PDF Studien — •Georg Sieber, Klaus Rabbertz und Günter Quast — EKP, KIT

Bei QCD-Präzisionsstudien an Proton-Beschleunigern stellt die innere Struktur des Protons eine der dominierenden Unsicherheitsquellen dar. Das Proton lässt sich über Partonverteilungsfunktionen (PDFs) beschreiben. Die PDFs können nicht störungstheoretisch berechnet werden, sondern müssen aus experimentellen Messungen abgeleitet werden.

Die Produktion von hadronischen Jets ist einer der dominierenden Prozesse am Large Hadron Collider (LHC). Mit dem CMS-Detektor wurde der differentielle Wirkungsquerschnitt der Dijet-Produktion bei einer Schwerpunktsenergie von 8 TeV gemessen.

Mit Hilfe dieser Messung können die Proton PDFs, insbesondere die PDF des Gluons, bei hohen Partonimpulsanteilen x verbessert werden.

T 100.4 Do 17:30 VMP8 SR 206

PDF constraints from CMS measurement of W charge asymmetry and inclusive jet cross sections at 8 TeV — •Engin Eren and Katerina Lipka — Notkestraße 85, 22607 Hamburg

In this talk, the impact of the CMS measurements on the knowledge of the proton structure is discussed. The measurements of the W-boson charge asymmetry and of inclusive jet cross sections at a center-of-mass energy of 8 TeV are used in a QCD analysis to determine the parton distribution functions. For this purpose, the open-source framework HERAFitter is used. A significant reduction of the uncertainties on the gluon and valence-quark distributions is observed.

T 100.5 Do 17:45 VMP8 SR 206

Bestimmung der PDFs des Protons durch Präzisionmessungen des Z+Jet-Wirkungsquerschnitts — •Dominik Haitz, Klaus Rabbertz und Günter Quast — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie

Die Messung des Wirkungsquerschnitts der Z-Boson-Produktion am LHC bietet einen hervorragenden Test für die Vorhersagen des Standardmodells. Durch die präzise Messung von Z-Bosonen können zusätzlich die Parameter der Partonverteilungsfunktionen (PDFs) des Pro-

tons weiter eingeschränkt werden.

Das Z-Boson wird im Elektron-Zerfallskanal rekonstruiert. Dies erfordert ein genaues Verständnis von Rekonstruktionseffizienz und Energieskala der Elektronen. Verschiedene Untergrundprozesse werden betrachtet und ihre Beiträge zur finalen Ereignisauswahl abgeschätzt. Die gemessenen kinematischen Verteilungen werden entfaltet; systematische und statistische Unsicherheiten werden bestimmt.

Mithilfe von Monte-Carlo-Simulationen und Interpolationsprogrammen werden Vorhersagen des Wirkungsquerschnitts der Z+Jet-Produktion für verschiedene PDFs berechnet.

Aus dem Vergleich der Daten mit den Theorievorhersagen werden die Parameter der Proton-PDFs genauer bestimmt.

T 100.6 Do 18:00 VMP8 SR 206

Measurement of the Z boson cross section at $\sqrt{s} = 13$ TeV — •Artur Trofymov — DESY, Hamburg, Germany

Measurements of the $Z \to l^+l^-$ (where $ll = e^+e^-, \mu^+\mu^-$) production cross sections in proton-proton collisions at $\sqrt{s} = 13$ TeV are presented using data recorded by the ATLAS experiment at the LHC, corresponding to a total integrated luminosity of approximately $85\ pb^{-1}$. The total inclusive Z boson production cross section within the invariant mass window $66 < m_{ll} < 116$ GeV was measured. The Z boson production cross section and its ratios to $W^{\pm}$ and $t\bar{t}$ production cross sections are measured within a fiducial region defined by the detector acceptance. Theoretical predictions based on NNLO and NLO QCD calculations using different PDF sets and predictions from different Monte Carlo generators are compared to the measurements.

T 100.7 Do 18:15 VMP8 SR 206

Measurement of Z boson production cross section in the dilepton channels and the ratio of $t\bar{t}$ to Z boson production cross sections in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Nataliia Zakharchuk — Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

A measurement of Z boson production cross sections σ_Z in pp collisions at a centre-of-mass energy $\sqrt{s} = 13$ TeV is presented. Results are obtained in both $Z \to \mu\mu$ and $Z \to ee$ channels, based on data corresponding to an integrated luminosity of 3,3 fb^{-1} collected with the ATLAS detector at the LHC during the year 2015. The selection criteria of the measurement are optimized to be as close as possible to the measurement of the $t\bar{t}$ production cross section $\sigma_{t\bar{t}}$, using the same data. This leads to a 13 TeV cancellation of the systematic uncertainties for the cross section ratio $R^{13TeV}_{t\bar{t}/Z} = \sigma_{t\bar{t}}/\sigma_Z$. The experimental results are compared to the predictions of perturbative QCD calculations at next-to-next-to-leading orders using various sets of parton distribution functions.

T 100.8 Do 18:30 VMP8 SR 206

Measurements of Z boson plus jet production cross section with the ATLAS detector using $\sqrt{s} = 8$ TeV data — •Nataliia Kondrashova — DESY, Hamburg, Germany

The $Z \to ee$+jet production provides an important test of perturbative Quantum Chromodynamics and is an important background for many Standard Model processes and beyond Standard Model searches. In addition, the measurement of the $Z \to ee$+jet cross-section as a function of the absolute rapidity and the transverse momentum of jets can provide constraints on the uncertainties in the parton distribution functions. Preliminary results of the double-differential $Z \to ee$+jet production cross-section measurement are presented. The data of 21.3 fb^{-1} collected with the ATLAS detector at the Large Hadron Collider in 2012 at the centre-of-mass energy $\sqrt{s} = 8$ TeV are used. Main sources of the systematic uncertainties in the measurement are studied. The measured cross-section is compared to the predictions from Monte Carlo generators based on the leading order matrix elements supplemented by the parton showers.

T 101: Top Quark V (Wirkungsquerschnitte)

Zeit: Donnerstag 16:45–18:45 Raum: VMP9 HS

T 101.1 Do 16:45 VMP9 HS

Measurements of jets produced in top quark events using the di-lepton final state with 2 b-tagged jets in pp collisions at a centre-of-mass energy of 13 TeV with the ATLAS detector — •Christoph Eckardt — DESY, Zeuthen, Deutschland

In this talk the measurements of the normalized differential cross-sections of top-quark pair production are presented at a centre-of-mass energy of 13 TeV with the ATLAS detector. The tt production with additional jets is a dominant background to the measurements of certain Higgs boson production processes and decay modes and to many searches for new physics phenomena. The aim of this analysis is to test Monte Carlo predictions by making a direct measurement of jet activity in tt events. The measurements use events with a pair of oppositely charged leptons and two b-tagged jets in the final state. The data are corrected to obtain the particle-level fiducial cross sections.

T 101.2 Do 17:00 VMP9 HS

$t\bar{t}$ cross section measurement in the semi-leptonic channel at 8 TeV with the ATLAS Experiment — •Arwa Bannoura and Peter Mättig — Bergische Universität Wuppertal, Wuppertal, Germany

A precise measurement of the top quark properties is of great importance. In this analysis, the top pair production cross section in the semi-leptonic channel is measured using event shape based observables that discriminate $t\bar{t}$ events from the backgrounds. These variables are fed into an artificial neural network (ANN) in order to improve the separation strength between the signal and the backgrounds. The ANN output templates for all processes are then fitted to data using a binned maximum likelihood method. In this context, the main background which is W + jets is estimated completely from data using a new approach. Also, new ideas are proposed to constrain systematic uncertainties in order to improve the precision of the measurement.

T 101.3 Do 17:15 VMP9 HS

Messung des $t\bar{t}$-Wirkungsquerschnitts bei 13 TeV am LHC — •Andre Schmalfeld, Peter Schleper, Hartmut Stadie, Fred Stober, Christoph Garbers und Nataliia Kovalchuk — Institut für Experimentalphysik, Hamburg, Deutschland

Die Messung des differentiellen Wirkungsquerschnitts von Topquarkpaaren ist von großer Bedeutung für die Überprüfung von Vorhersagen der Quantenchromodynamik (QCD) und für die Suche nach Physik jenseits des Standardmodells (SM). Die Bestimmung des inklusiven und differentiellen Wirkungsquerschnitts von Topquarkpaaren im semileptonischen Zerfallskanal bei einer Schwerpunktsenergie von 13 TeV wird in diesem Vortrag präsentiert. Die untersuchten Daten wurden mit dem Compact Muon Solenoid (CMS) Experiment am Large Hadron Collider (LHC) aufgenommen und mit einem kinematischen Fit rekonstruiert. Um eine hohe Reinheit zu gewährleisten, wird die Güte des Fits als Selektionskriterium verwendet.

T 101.4 Do 17:30 VMP9 HS

Measurement of the top-quark pair production cross section in the dilepton channel at a center of mass energy of 13 TeV with the CMS detector — •Till Arndt, Maria Aldaya, Carmen Diez Pardos, Alexander Grohsjean, Ali Harb, Johannes Hauk, Jan Kieseler, Andreas Meyer, Eleni Ntomari, and Mykola Savitskyi — Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, D-22607 Hamburg

Since the discovery of the top quark in 1995 at the Fermilab Tevatron collider, the top-quark pair production cross section has been measured with ever higher precision. Until now, no deviation from the standard model prediction has been found. However, the ttbar cross section remains one of the most important parameters to be measured in top physics. We present results for the top-quark pair production cross section at a center of mass energy of $\sqrt{s} = 13$ TeV using data taken by the CMS detector in 2015. Special attention will be given to the discussion of experimental uncertainties.

T 101.5 Do 17:45 VMP9 HS

Measurement of the inclusive top-quark pair cross section in the dilepton channel at 13 TeV with the CMS experiment — •Ali Harb, Maria Aldaya, Till Arndt, Carmen Diez Pardos, Alexander Grohsjean, Johannes Hauk, Eleni Ntomari, and

Mykola Savitskyi — Deutsches Elektronen Synchrotron (DESY), Hamburg, Germany

The top quark is the heaviest known fundamental particle which is primarily produced in quark-antiquark pairs ($t\bar{t}$) at the Large Hadron Collider (LHC). It decays almost exclusively to a b quark and a W boson. The final-state topology in the $t\bar{t}$ system is governed by the W boson decay mode. In this talk, the measurement of the top quark pair cross-section in the dilepton channel using a cut-and-count method will be presented. The dataset used for this measurement corresponds to an integrated luminosity of 2.1 fb^{-1} collected by the Compact Muon Solenoid (CMS) experiment at a center-of-mass energy $\sqrt{s} = 13$ TeV.

T 101.6 Do 18:00 VMP9 HS

Measurements of differential top cross-sections in the dilepton channel at 13 TeV with the ATLAS experiment — •Abigail O'Rourke — DESY, Hamburg, Deutschland

Run 2 of the LHC allows the top quark pair production cross section to be measured at a centre of mass energy of 13 TeV. The higher centre of mass energy allows more precise measurement of differential cross-sections. These differential cross-section measurements provide a test of the Standard Model and are sensitive to possible beyond the Standard Model physics. The 3.2 fb^{-1} of data provided by the ATLAS experiment in 2015 allows the measurement of the differential cross-section as functions of the kinematic variables of the $t\bar{t}$ system. Studies of these differential cross-section measurements are presented here in the dilepton channel.

T 101.7 Do 18:15 VMP9 HS

Measurement of the differential $t\bar{t}$ production cross section as a function of the jet mass in fully merged top quark decays in CMS — •Torben Dreyer, Johannes Haller, and Roman Kogler — Institut für Experimentalphysik, Universität Hamburg

The decay products of hadronically decaying top quarks are collimated into a single jet, if the top quarks are produced with high transverse momenta. In this case it is possible to reconstruct large jets containing a full hadronic top quark decay. The invariant mass of such jets is sensitive to the mass of the top quark itself and is calculable theoretically. A comparison to theory calculations could lead to an extraction of the top quark mass in a well defined renormalization scheme.

In this contribution a measurement of the differential $t\bar{t}$ production cross section as a function of the jet mass is presented. The measurement is performed in the lepton+jets decay channel with data collected by the CMS detector in proton-proton collisions at a center of mass energy of 8 TeV. Events are selected with transverse jet momenta greater than 400 GeV to select fully merged top quark decays. To allow a comparison to theory calculations the data is corrected for detector effects using a regularized unfolding method.

T 101.8 Do 18:30 VMP9 HS

Measurement of the differential cross section for top-quark pair production in the dilepton channel at 13 TeV with the CMS detector — •Mykola Savitskyi, Maria Aldaya, Till Arndt, Carmen Diez Pardos, Alexander Grohsjean, Ali Harb, Johannes Hauk, and Eleni Ntomari — Deutsches Elektronen-Synchrotron (DESY), Notkestrasse 85, D-22607 Hamburg

In this talk we present measurements of the normalized differential top quark pair ($t\bar{t}$) production cross section at 13 TeV with the CMS detector using final states with two leptons (e^+e^-, $\mu^+\mu^-$, and $e^\pm\mu^\mp$). The $t\bar{t}$ production cross section is measured as a function of kinematic properties of the top quarks and the $t\bar{t}$ system in the full phase space, as well as of the jet multiplicity in the event in the fiducial phase space. Several Standard Model Monte Carlo predictions are confronted with the data.

T 102: Niederenergie-Neutrinophysik III

Zeit: Donnerstag 16:45–19:05 Raum: VMP9 SR 07

Gruppenbericht T 102.1 Do 16:45 VMP9 SR 07

Latest results from the Double Chooz experiment — •Marianne Göger-Neff for the Double Chooz-Collaboration — Physik Department E15, Technische Universität München

Double Chooz aims at a precise measurement of the neutrino mixing angle θ_{13} through the disappearance of reactor electron antineutrinos. The experiment relies on the measurement of neutrino flux and spectrum with two identical detectors at 400 m and 1000 m from the reactor cores of two nuclear power reactors. $\bar{\nu}_e$ are detected by inverse beta decay on free protons in 8.3 tons of Gd-loaded liquid scintillator, providing a unique delayed coincidence signature. Double Chooz has been running since 2011 with the far detector only, providing the first indication for non-zero θ_{13} with reactor antineutrinos. With a rate+shape analysis of 467.90 live days from 2011 - 2013 we obtain a value of $\sin^2 2\theta_{13} = 0.090^{+0.032}_{-0.029}$. Data taking with the near detector has started beginning of 2015, allowing a significant reduction of both reactor and detector related systematic uncertainties. The talk will review the most recent results obtained with the far detector only and discuss first data from the near detector.

This work was supported by the DFG (GO 1729/1-1).

T 102.2 Do 17:05 VMP9 SR 07

Sterile Neutrino Search with the Double Chooz Experiment — •Denise Hellwig, Ilja Bekman, Philipp Kampmann, Stefan Schoppmann, Michael Soiron, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B - RWTH Aachen

The Double Chooz experiment is a reactor neutrino disappearance experiment located at the Chooz nuclear power plant, France. It measures the electron-antineutrino flux of the two nuclear reactors with two 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 the end of 2014. The combination of the two detectors 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 talk describes the search for sterile neutrinos and the sensitivity of Double Chooz to the mixing angle θ_{14}.

T 102.3 Do 17:20 VMP9 SR 07

Measurements of the Proton Quenching Effect in Various Organic Liquid Scintillators — •Vincenz Zimmer, Dominikus Hellgartner, Lothar Oberauer, and Stefan Schönert — Physik-Department and Excellence Cluster Universe, Technische Universität München, D-85747 Garching

Understanding the quenching effect for protons in organic liquid scintillators is important for both signal and background detection in present and future neutrino experiments, like Double Chooz, Borexino, LENA and JUNO. This effect defines the energy scale for proton recoil events in the scintillator, which is of particular importance for the detection of neutrinos from a galactic core collapse supernova by elastic ν-p-scattering.

A time-of-flight based experiment has been established at the Maier-Leibnitz-Laboratorium in Garching. Using a pulsed ^{11}B-beam and a fixed H_2-target, monoenergetic neutrons with different energies between $\sim$ 4.7 and $\sim$ 11.2 MeV were produced to induce proton recoils in the scintillator samples. To quantify the quenching effect for protons the semi-empiric Birks quenching model was utilized. The final results on the Birks quenching factors kB, obtained from the performed measurements for various scintillator samples, including the Borexino and Double Chooz scintillators and different LAB-based mixtures, will be presented.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe' and the Maier-Leibnitz-Laboratorium (MLL), Garching.

T 102.4 Do 17:35 VMP9 SR 07

The Reactor Antineutrino Anomalies — •Julia Haser, Christian Buck, and Manfred Lindner — Max-Planck-Institut für Kernphysik, Heidelberg

Major discoveries were made in the past few years in the field of neutrino flavour oscillation. Nuclear reactors produce a clean and intense flux of electron antineutrinos and are thus an essential neutrino source for the determination of oscillation parameters. Most currently the reactor antineutrino experiments Double Chooz, Daya Bay and RENO have accomplished to measure θ_{13}, the smallest of the three-

flavour mixing angles. In the course of these experiments two anomalies emerged: 1) the reanalysis of the reactor predictions revealed a deficit in experimentally observed antineutrino flux, known as the "reactor antineutrino anomaly". 2) The high precision of the latest generation of neutrino experiments resolved a spectral shape distortion relative to the expected energy spectra. Both puzzles are yet to be solved and triggered new experimental as well as theoretical studies, with the search for light sterile neutrinos as most popular explanation for the flux anomaly.
This talk will outline the two reactor antineutrino anomalies. Discussing possible explanations for their occurrence, recent and upcoming efforts to solve the reactor puzzles will be highlighted.

T 102.5 Do 17:50 VMP9 SR 07

Correlated background induced by radioimpurities in Double Chooz — •Michael Franke for the Double Chooz-Collaboration — Physik Department E15, Technische Universität München

The Double Chooz reactor antineutrino experiment, located at the Chooz nuclear power plant in France, provides a precise measurement of the θ_{13} parameter. After data taking with the far detector since April 2011, the near detector was finished in October 2014 and data taking started within this year. Although this enables a significant reduction of both reactor and detector related systematics uncertainties, several sources of background have to be taken into account to allow a measurement of the neutrino mixing angle θ_{13} with the desired precision. The talk will focus on the background induced by radioactivity in the near detector. Events coming from the decay of ^{214}Bi and ^{212}Bi followed by the α-decay of ^{214}Po and ^{212}Po, referred to as BiPo coincidences, provide a fast coincidence signal between β^- and α signal, which is also spatially correlated. It can be easily distinguished from other background. Therefore it provides tagging of the number of decays within the U decay chain and the Th decay chain. This provides a tool to prove the radiopurity of the Double Chooz Detector. It shows that the radiopurity in Double Chooz is well within the specifications of less than $10^{-13}\ \frac{g}{g}$ of U and Th in all parts of the inner detector. However, these events cannot be neglected for a measurement of θ_{13} and have to be addressed in further ongoing studies.

This work has been supported by the DFG (GO 1729/1-1).

T 102.6 Do 18:05 VMP9 SR 07

Meeting the future of coherent neutrino scattering - A feasibility study for upcoming reactor experiments — Marco Salathe and •Thomas Rink — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

Due to ongoing progress in detector development and background suppression techniques first evidence of neutrino coherent scattering seems reachable in future experiments. In recent years efforts have been enhanced to detect this effect with germanium detectors. This work aims at summarizing and improving past studies on the potential of an experiment at a reactor site to a new level of accuracy by using the most recent neutrino spectra, knowledge gained in recent detector developments and in contrast to prior studies an energy-dependent quenching factor. The influence of the main parameters (background suppression, detector resolution and threshold, reactor spectra, different isotopes) of a germanium detector experiment is presented and the sensitivities regarding the main reaction channels are calculated. The results were obtained through two independent methods; an algebraic computation and a numerical simulation. Both methods reveal the most important experimental parameters and clarify the state of the art challenges that research has to meet in such an experiment.

T 102.7 Do 18:20 VMP9 SR 07

Results of the Nucifer reactor neutrino experiment — •Christian Buck and Manfred Lindner — MPIK Heidelberg

Nuclear reactors are a strong and pure source of electron antineutrinos. With neutrino experiments close to compact reactor cores new insights into neutrino properties and reactor physics can be obtained. The Nucifer experiment is one of the pioneers in this class of very short baseline projects. Its detector to reactor distance is only about 7m. The data obtained in the last years allowed to estimate the plutonium concentration in the reactor core by the neutrino flux measurement. This is of interest for safeguard applications and non proliferation efforts.

The antineutrinos in Nucifer are detected via the inverse beta decay on free protons. Those Hydrogen nuclei are provided by 850 liters of organic liquid scintillator. For higher detection efficiency and background reduction the liquid is loaded with Gadolinium. Despite all shielding efforts and veto systems the background induced by the reactor activity and cosmogenic particles is still the main challenge in the experiment.

The principle of the Nucifer detector is similar to the needs of upcoming experiments searching for sterile neutrinos. Therefore, the Nucifer results are also valuable input for the understanding and optimization of those next generation projects. The observation of sterile neutrinos would imply new physics beyond the standard model.

T 102.8 Do 18:35 VMP9 SR 07

Measurement of Reactor Neutrino Oscillations with Double Chooz — •Stefan Schoppmann, Ilja Bekman, Denise Hellwig, Philipp Kampmann, Michael Soiron, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B - RWTH Aachen University

The Double Chooz experiment is a reactor neutrino disappearance experiment located at the nuclear power plant in Chooz, France. The aim of the Double Chooz experiment is the precise measurement of the neutrino mixing angle θ_{13}, a neutrino oscillation parameter. The experiment consists of two identical liquid scintillator detectors and measures the electron-antineutrino flux of the two nuclear reactors. The 1 km distant far detector started operation in 2011. The 400 m distant near detector started operation in 2015. The reactor neutrinos are detected by the signature of an inverse beta decay (IBD). The neutrino energy spectrum is extracted from the spectrum of the IBD-produced positrons. The IBD-produced neutrons can be captured by Gadolinium or Hydrogen, which provides two independent data samples. Both samples allow the utilisation of the neutrino rate and energy spectral shape information in a combined fit. This contribution presents the first oscillation results derived from the full two-detector setup.

T 102.9 Do 18:50 VMP9 SR 07

Reactor Neutrino Oscillation Measurement with Double Chooz Hydrogen Data — •Philipp Kampmann, Ilja Bekman, Denise Hellwig, Stefan Schoppmann, Michael Soiron, Achim Stahl, and Christopher Wiebusch — III. Physikalisches Institut B - RWTH Aachen

The Double Chooz experiment is a reactor neutrino experiment with the purpose of a precise measurement of the neutrino mixing angle θ_{13}. The setup consists of two identical liquid scintillator detectors at an average baseline of 400m and 1km to two nuclear reactor cores in Chooz, France. The neutrinos are detected by the signature of the inverse beta decay, which consists of a positron signal and a delayed neutron capture signal. From the positron measurement the neutrino energy is extracted. Neutrons are captured either by gadolinium or hydrogen in the scintillator. Due to different capture energies, two independent data samples are obtained. This presentation describes the determination of the neutrino mixing angle θ_{13} using a likelihood fit approach of hydrogen capture data.

T 103: Neutrinoastronomie V

Zeit: Donnerstag 16:45–19:05 Raum: VMP9 SR 08

Gruppenbericht T 103.1 Do 16:45 VMP9 SR 08

Ergebnisse des Neutrinoteleskops ANTARES — Thomas Eberl und •Steffen Hallmann für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP / Universität Erlangen-Nürnberg

Das ANTARES Experiment ist das derzeit größte Neutrinoteleskop in der nördlichen Hemisphäre und nimmt seit 2008 Daten in seiner finalen Konfiguration. Nach der Entdeckung eines diffusen kosmischen Neutrinoflusses durch den IceCube Detektor ist die Suche nach dessen Ursprung eine zentrale Aufgabe in der Hochenergie-Astrophysik geworden. Mit verschiedenen Analysen wird daher in ANTARES der Südhimmel auf ein Neutrinosignal von Punktquellen, transienten und ausgedehnten Quellen untersucht. Daneben liefert ANTARES auch Er-

gebnisse zum atmosphärischen Neutrinofluss, sowie der Suche nach Dunkler Materie und exotischen Teilchen (wie magnetischen Monopolen und Nukleariten) und beteiligt sich an Multimessenger-Analysen in Kombination mit verschiedenen Experimenten.

Der Vortrag geht auf den gegenwärtigen Status des Detektors und der Datenanalyse ein und gibt einen Überblick über die erzielten Ergebnisse. *Gefördert durch das BMBF (05A11WEA).*

T 103.2 Do 17:05 VMP9 SR 08

Simulation of atmospherics in KM3NeT — •Thomas Heid for the ANTARES-KM3NeT-Erlangen-Collaboration — ECAP - FAU Erlangen-Nürnberg, Erlangen

With the installation of the first KM3NeT line, a new facility for neutrino astronomy started operation at the end of 2015. KM3NeT detectors are built of several thousands of digital optical modules(DOM) deployed in a three-dimensional grid. The DOMs receive light from particles passing the detector or created in neutrino interactions in the vicinity of the detector. A primary physics goal is to detect point-like neutrino sources. An important step in understanding the signal of astrophysical sources, is to understand the background to the measurement originating in the atmosphere. It consists of muons and neutrinos. Dedicated simulations optimized for KM3NeT have been performed. This contribution describes the simulation chain, starting with an atmospheric air shower simulation and propagating particles from the sea surface to the detector at a depth of 2.5 to 3.5 km. The nature of the background expected to most strongly affect KM3NeT's sensitivity to astrophysical neutrino fluxes is presented, as are methods for dealing with it. Besides their role as background, studying atmospheric particles can improve the understanding of particle creation in the atmosphere, especially the charm production mechanism.

T 103.3 Do 17:20 VMP9 SR 08

Observation and characterization of an astrophysical muon neutrino flux from the Northern Hemisphere with IceCube — Christian Haack, •Leif Rädel, René Reimann, Sebastian Schoenen, and Christopher Wiebusch for the IceCube-Collaboration — 3. Physikalisches Institut B, RWTH Aachen

IceCube has observed a high-energy astrophysical neutrino flux based on neutrinos of all flavors interacting within the instrumented volume. Here, a complementary measurement based on muon neutrinos where the interaction vertex can be outside the instrumented volume is presented. Due to the large muon range the effective area is significantly larger but the field of view is limited to the Northern Hemisphere. IceCube data from 2009 through 2015 have been analyzed by a likelihood approach with reconstructed muon energy and zenith angle as observables. The analyzed data consist of about 340,000 muon neutrinos with a negligible background of atmospheric muons. The majority of these events are atmospheric neutrinos. However, this analysis finds a significant astrophysical contribution, excluding the atmospheric-only hypothesis at the level of 6 standard deviations. In this talk we will present the analysis results including the characterization of the astrophysical flux properties.

T 103.4 Do 17:35 VMP9 SR 08

Search for Muon Neutrino Emission from the Galactic Plane with IceCube — •Christian Haack, Leif Rädel, René Reimann, Sebastian Schoenen, Lisa Schumacher, and Christopher Wiebusch for the IceCube-Collaboration — III. Physikalisches Institut B, RWTH Aachen

The IceCube Neutrino Observatory has observed a diffuse all-sky all-flavor astrophysical neutrino flux above 30TeV. This flux has also been confirmed using up-going muon neutrinos above 200TeV from the Northern Hemisphere. Although no point sources have been discovered so far, IceCube is able to probe realistic models for neutrino emission from the galactic plane. In the galactic plane neutrinos are produced by the interaction of cosmic rays with the interstellar medium. The resulting neutrino energy spectrum depends strongly on the cosmic ray propagation model and the presence of cosmic ray accelerators. In this talk, we will present results of a likelihood-based search for neutrino emission from the galactic plane, using 6 years of IceCube up-going muon neutrino data.

T 103.5 Do 17:50 VMP9 SR 08

Unterscheidung hadronischer und elektromagnetischer Teilchenschauer in IceCube — •Anna Steuer für die IceCube-Kollaboration — Johannes Gutenberg-Universität, Mainz, Deutschland

In diesem Vortrag wird eine neue Methode vorgestellt, um Teilchenschauer, die vollständig im IceCube-Detektor nachgewiesen werden, näher zu untersuchen. Hierbei soll der Nachweis von zeitverzögerten Tcherenkow-Photonen, die als Folge des Einfangs von Neutronen in hadronischen Kaskaden erzeugt werden, genutzt werden, um die elektromagnetischen und hadronischen Anteile an den Kaskaden zu quantifizieren. Die Grundidee der experimentellen Implementierung wird erläutert und erste Resultate von GEANT-Simulationen werden vorgestellt. Gegen Ende des Vortrags gehe ich kurz auf die Anwendung dieses Verfahrens in zukünftigen IceCube-Analysen, wir zum Beispiel bei der Suche nach hoch-relativistischen, sekundären Dunkle-Materieteilchen, ein.

T 103.6 Do 18:05 VMP9 SR 08

Search for O(100 GeV) neutrinos of all flavors in GRBs — •Volker Baum for the IceCube-Collaboration — Johannes Gutenberg-Universität Mainz, Germany

In the talk I will present the plans and recent efforts for a stacked all-flavor search for low energy neutrinos from collisionally heated GRBs with the IceCube neutrino telescope. The talk will focus on the event selection including the results from the BDT training at final level.

T 103.7 Do 18:20 VMP9 SR 08

Search for weak neutrino sources with an energy dependent autocorrelation analysis with IceCube in the northern sky — •Lisa Schumacher, Christian Haack, Martin Leuermann, Leif Rädel, René Reimann, Michael Schimp, Sebastian Schoenen, and Christopher Wiebusch — III. Physikalisches Institut B, Physikzentrum RWTH Aachen, Otto-Blumenthal-Straße, 52074 Aachen

The IceCube Neutrino Observatory located at the South Pole discovered a flux of astrophysical neutrinos. However, the sources of this flux have not been identified yet and strong sources are disfavored. Hence, this analysis searches for a distribution of weak, but numerous sources by employing an angular auto-correlation analysis using multipole expansion coefficients of spherical harmonics. It is optimized by using energy information to improve the significance of clustered astrophysical events with respect to diffuse backgrounds. Results from analyzing multiple years of muon neutrino data from IceCube are presented.

T 103.8 Do 18:35 VMP9 SR 08

Sensitivity studies for blazar stacking searches with the IceCube Neutrino Observatory — •Matthias Huber[1] and Stefan Coenders[2] for the IceCube-Collaboration — [1]TU Munich Germany — [2]TU Munich Germany

Located at the South Pole, the IceCube Neutrino Observatory is the world largest neutrino telescope. It instruments one cubic kilometer of Antarctic ice at a depth of about 1500m to 2500m including 5160 light detecting Digital Optical Modules. Since its construction the IceCube neutrino detector experienced remarkable success. Besides the detection of the highest energy neutrinos worldwide, IceCube is the first experiment to observe an astrophysical high-energy neutrino flux. Although in the meantime the collaboration detected more than 50 high energy neutrino events, the origin of these neutrinos is still not identified. Blazars, being a subclass of Active Galactic Nuclei and consequently one of the most powerful objects in the universe are supposed to be one of the most likely sources of high energy neutrinos. The sensitivities and discovery potentials for the point source stacking of five different blazar samples are evaluated on seven years of IceCube data and ultimately compared to a theoretically predicted neutrino flux from all blazars. We present here the results obtained using the second WISE High Synchrotron Peaked (2WHSP) catalog.

T 103.9 Do 18:50 VMP9 SR 08

Konstruktion eines Myonvetos für ORCA — •Marco Volkert, Jannik Hofestädt und Thomas Eberl für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP, Friedrich-Alexander-Universität Erlangen-Nürnberg

Durch die Vermessung der energie- und zenitwinkelabhängigen Oszillationswahrscheinlichkeiten von atmosphärischen Neutrinos beim Durchgang durch die Erde lässt sich die bisher unbekannte Hierarchie der Neutrinomassen bestimmen. Mit dieser Zielsetzung wird in der Tiefsee des Mittelmeeres derzeit der Wasser-Cherenkov-Detektor ORCA (Oscillation Research with Cosmics in the Abyss) von der KM3NeT - Kollaboration aufgebaut.

Der Myonenfluss aus der Atmosphäre, der den Detektor aus Rich-

tung der Wasseroberfläche durchquert, stellt den hauptsächlichen Teilchenuntergrund für die Messung der Neutrinos dar. Einerseits verfälschen inkorrekt rekonstruierte oder inkorrekt identifizierte Myonspuren die Bestimmung des Neutrinoflusses, der die Erde passiert hat. Andererseits erschwert der Untergrund wesentlich die Messung des unoszillierten Neutrinoflusses aus der Atmosphäre über dem Detektor, der zur Reduktion von Systematiken der Messung benutzt werden kann.

Im Vortrag werden die bislang für ORCA entwickelten Methoden zur Erkennung, Rekonstruktion und Unterdrückung von atmosphärischen Myonen vorgestellt. Weiterhin wird auf die Ideen und ersten Schritte in der Entwicklung eines neuen Myonvetos eingegangen.

T 104: Gammaastronomie V

Zeit: Donnerstag 16:45–18:00 Raum: VMP9 SR 27

T 104.1 Do 16:45 VMP9 SR 27

The grid-scan: a novel method for a less biased broadband SED modeling — •Marlene Doert[1] and David Paneque[2] — [1]Ruhr-Universität Bochum — [2]Max-Planck-Institut für Physik, München

We present a novel strategy for the modeling of blazar SEDs in the scope of current emission models: the grid-scan modeling. With an unbiased and uniform scan of the multi-dimensional parameter space of current emission models, e.g. the SSC model, and an a posteriori evaluation of the model-to-data agreement, independent sets of equally good model representations can be found. This variety of models generally includes different valid physical scenarios, which offer a more complete picture than single "best" solutions found by minimizers or the often-practised "eyeball-fit". Additionally, the grid-scan also allows to quantify how well the individual model parameters get constrained by any given experimental data set. The method will be introduced using the example of multi-wavelength spectral measurements of the blazar Markarian 501.

T 104.2 Do 17:00 VMP9 SR 27

Search for high confidence AGN candidates and its counterparts in the *Fermi*-LAT unassociated sample using machine learning — Sabrina Einecke[1] and •Marlene Doert[2] — [1]Technical University Dortmund, Germany — [2]Ruhr-University Bochum, Germany

The third *Fermi*-LAT source catalog (3FGL) is the deepest all-sky survey in gamma-rays and comprises 3033 point sources. While for 2023 sources plausible associations have been found, 1010 remain unassociated. A search for active galactic nuclei (AGN) will help to reduce the number of unassociated sources, and will increase our knowledge of the population of gamma-ray emitting AGN.

Several machine learning approaches applied to *Fermi* data have shown the capability of this method. The extension to multiwavelength data improves these studies, and at the same time offers the possibility to determine the most likely corresponding counterpart. As the 95% confidence region of the localization by the *Fermi* measurement is in the order of several arcminutes, generally multiple point sources at different wavelengths are located within this region and the association is ambigous. To figure out the most likely counterpart, the associated sample is used to train machine learning classifiers as e.g. the random forest. Therefore, all possible combinations of the *Fermi* measurement and the measurements at a second wavelength are considered for a particular source. In this talk, the statistical model to obtain high confidence AGN counterpart candidates will be described as well as the validation of the model to estimate the performance.

T 104.3 Do 17:15 VMP9 SR 27

Implication of the detection of very hard spectra from the TeV blazar Mrk 501 — •Amit Shukla[1], Karl Mannheim[2], Varsha R. Chitnis[3], Jayashree Roy[4], Bannanje Sripathi Acharya[4], Daniela Dorner[2], Gareth Hughes[1], and Adrian Biland[1] — [1]ETH Zurich, Institute for Particle Physics, Otto-Stern-Weg 5, 8093 Zurich, — [2]Institute for Theoretical Physics and Astrophysics, Universität Würzburg, 97074 — [3]Department of High Energy Physics, Tata Institute of Fundamental Research, Mumbai — [4]Center for Excellence in Basic Sciences, UM-DAE Mumbai 400005, India

The emission from active galactic nuclei ranges from radio to TeV energies and shows high variability. The origin of the high energy emission is highly debated. The observed emission could be due to a complex superposition of emission from multiple zones. New evidence of the detection of very hard intrinsic gamma-ray spectra obtained from Fermi-LAT observations have challenged the theories about origin of VHE gamma-rays. We have used the 7 years of Fermi-LAT data to search for time intervals with unusually hard spectra from the nearby TeV blazar Mrk 501. In the presentation, we discuss a few possible explanations for the origin of these hard spectra within a leptonic scenario.

T 104.4 Do 17:30 VMP9 SR 27

The long-term broadband monitoring of the high-peaked BL Lac Mrk 501 in 2014 including the most extreme X-ray flaring activity — •Kazuma Ishio[1], Josepha Becerra Gonzalez[2], Koji Noda[1], David Paneque[1], and Fabrizio Tavecchio[3] for the MAGIC-Collaboration — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]NASA Goddard Space Flight Center, Maryland, USA — [3]INAF Osservatorio Astronomico di Brera, Milan, Italien

Blazars emit over the entire electromagnetic spectrum and are variable on various timescales, from years down to minutes. Therefore, long and dense coverage over a wide energy range is needed for characterizing and unraveling the dynamics of blazars.

Markarian 501, a BL Lac type blazar object, located in our extragalactic neighborhood (z=0.034), is an ideal source, because of its proximity and high brightness, which allows significant detections in short observing times. I will report results from the campaign in 2014, including the very high activity in July 2014, during which the source displayed the highest X-ray fluxes detected in 10 years of operation with Swift, together with very hard spectra at X-rays and gamma-ray energies with substantial variability on day timescales.

T 104.5 Do 17:45 VMP9 SR 27

Multi-TeV Gamma ray and cosmic ray astrophysics with TAIGA — •Martin Tluczykont[1] and TAIGA Kollaboration[2] — [1]Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg — [2]taiga-experiment.info

The very high energy gamma-ray regime is the key to several questions in high energy astrophysics, the most prominent being the search for the origin of cosmic rays. Observations of gamma rays up to several 100 TeV are particularly important to spectrally resolve the cutoff regime of the long-sought Pevatrons, the accelerators of PeV cosmic rays. TAIGA is an international collaboration that has, in the past 3 years, installed the air Cherenkov timing array HiSCORE on an area of 0.25 square-km, and are currently installing a first 4m diameter imaging air Cherenkov telescope (IACT), to be operated in parallel with the timing array. Our aim is to combine the timing and imaging techniques on a large scale in order to optimize the air Cherenkov detection technique for energies above 10 TeV and up to several 100 TeV. Simulations show a clear potential of the planned hybrid event reconstruction, especially in the energy regime from 10 TeV to 100 TeV. The TAIGA experiment will be complemented by scintillator based particle detectors for a measurement of the muon content of the air shower at higher energies. The status of our experiment and the planned 1 square-km stage of TAIGA will be disussed.

T 105: Kosmische Strahlung V

Zeit: Donnerstag 16:45–19:00 Raum: VMP9 SR 29

T 105.1 Do 16:45 VMP9 SR 29

Simulation eines abbildenden Luft-Tscherenkow-Teleskops, IceAct, für eine zukünftige IceCube-Gen2 Oberflächenerweiterung — •Bengt Hansmann[1], Jan Auffenberg[1], Thomas Bretz[2], Tim Hansmann[1], Julian Kemp[1,2], Tim Niggemann[2], Leif Rädel[1], Martin Rongen[1], Merlin Schaufel[1], Sebastian Schoenen[1], Johannes Schumacher[2], Martin Stahlberg[1], Ansgar Werhahn[1] und Christopher Wiebusch[1] für die IceCube-Kollaboration — [1]III. Physikalisches Institut B RWTH Aachen, Aachen, Deutschland — [2]III. Physikalisches Institut A RWTH Aachen, Aachen, Deutschland

IceAct ist ein kompaktes abbildendes Luft-Tscherenkow-Teleskop mit Silizium-Photomultipliern, das auf dem Design des Fluoreszenz-Teleskops FAMOUS basiert und für den Einsatz am Südpol optimiert wurde. Ziel ist es, kosmische Luftschauer über dem IceCube Neutrino Observatorium effizient und mit niedriger Energieschwelle zu detektieren. Damit wird es möglich, in IceCube gemessene Signale aus Luftschauern zu identifizieren und von astrophysikalischen Neutrinos zu unterscheiden. Ein erster Prototyp wurde im Dezember 2015 am Südpol installiert. Zur Analyse der in situ Daten und zur Ermittlung des Leistungsvermögens dieses Teleskops, wurde eine CORSIKA-Simulation des Tscherenkowlichts von Luftschauern mit Südpol Bedingungen durchgeführt und Eigenschaften des Teleskops über ein detailliertes GEANT4-Modell evaluiert.

T 105.2 Do 17:00 VMP9 SR 29

HAWC Highlights — •Armelle Jardin-Blicq for the HAWC-Collaboration — Max Planck Institut für Kernphysik

The High-Altitude Water Cherenkov (HAWC) Observatory was completed and began full operation on March 20, 2015. The detector consists of an array of 300 water tanks, each containing 200 tons of purified water and instrumented with 4 PMTs. Located at an elevation of 4100m a.s.l. near the Sierra Negra volcano in central Mexico, HAWC observes gamma rays in the 0.1-100 TeV range and has a sensitivity to TeV-scale gamma-ray sources an order of magnitude better than previous air-shower arrays. It has 2 sr field-of-view and >90% duty cycle make HAWC an ideal instrument for surveying the high-energy sky. We will describe the HAWC detector and its performance characteristics and report initial results from the first months of operation.

T 105.3 Do 17:15 VMP9 SR 29

The upgrade of the HAWC observatory — •Harm Schoorlemmer for the HAWC-Collaboration — Max-Plank-Institut für Kernphysik, Heidelberg, Germany

The High Altitude Water Cherenkov (HAWC) high-energy gamma-ray observatory has recently been completed near the Sierra Negra volcano in central Mexico. HAWC consists of 300 Water Cherenkov Detectors, each containing 200 tons of purified water, that cover a total surface area of 20,000 m^2. HAWC observes gamma rays in the 0.1-100 TeV range and has a sensitivity to TeV-scale gamma-ray sources an order of magnitude better than previous air-shower arrays. The HAWC trigger for the highest energy gamma rays reaches an effective area of 10^5 m^2 but many of them are poorly reconstructed because the shower core falls outside the array. An upgrade that increases the present fraction of well reconstructed showers above 10 TeV by a factor of 3-4 can be done with a sparse outrigger array of small water Cherenkov detectors that pinpoint the core position and by that improve the angular resolution of the reconstructed showers. Such an outrigger array would be of the order of 300 small water Cherenkov detectors of 2.5 m^3 placed over an area four times larger than HAWC. The Max Planck Institute für Kernphysik in Heidelberg just joined the collaboration and will provide the FADC electronics for the readout of the outrigger tanks. Detailed simulations are being performed to optimize the performance of the upgrade.

T 105.4 Do 17:30 VMP9 SR 29

Photomultipliertests für das AugerPrime Upgrade* — •Sven Querchfeld für die Pierre-Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Das Pierre-Auger-Observatorium in Argentinien misst kosmische Strahlung bei den höchsten Energien. Insgesamt 1660 Wasser-Cherenkov-Detektoren und 27 Fluoreszenzteleskope vermessen induzierte Luftschauer. Im Rahmen des AugerPrime Upgrades werden die Bodenstationen mit weiteren Szintillationsdetektoren ausgestattet. Durch die Ergänzung mit einer durch die elektromagnetische Komponente dominierten Messung kann eine genauere Bestimmung des Primärteilchens erfolgen. Die Szintillationszähler besitzen eine Fläche von jeweils 2 m^2 und werden auf den bestehenden Detektoren angebracht. Sie sind mit wellenlängenschiebenden Fasern durchzogen, die über einen Photosensor ausgelesen werden.
In diesem Vortrag wird die Entwicklung und Charakterisierung von Photomultipliern als Auslesesensor der neuen Detektorkomponente vorgestellt. Insbesondere wird die Spannungsteileroptimierung hinsichtlich hoher Linearität, von einzelnen Photonen bis hin zu mehreren 10^5 Photonen pro Ereignis, diskutiert und eine aktive Hochspannungserzeugung mit niedrigem Stromverbrauch gezeigt.
**Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 105.5 Do 17:45 VMP9 SR 29

Optimierungen des Datensatzes für den Oberflächendetektor des Pierre-Auger-Observatoriums* — •Philipp Papenbreer für die Pierre-Auger-Kollaboration — Bergische Universität Wuppertal

Die Wasser-Cherenkov-Detektoren des Pierre-Auger-Observatoriums werden verwendet, um die Sekundärteilchen der kosmischen Strahlung zu messen. Dabei treten unter den insgesamt 4980 Photoelektronenvervielfachern, während einer Betriebsdauer von mehreren Jahren, immer wieder Perioden auf, in denen einige wenige Detektoren Instabilitäten aufweisen. Für Messungen von bisher nicht nachgewiesenen Primärteilchen, die sehr sensitiv auf die genaue Signalform sind, müssen solche Fehlfunktionen zuverlässig ausgeschlossen werden. Dadurch werden künstliche Ereigniskandidaten vermieden, welche in Abwesenheit eines Signals einen großen Einfluss auf die Ausschlussgrenzen ausüben würden. In diesem Vortrag werden Wege gezeigt instabile Perioden der Detektorkomponenten mithilfe der aufgenommenen Daten ausfindig zu machen, um für die Suche nach Photonen als Primärteilchen der kosmischen Strahlung einen optimalen Datensatz zur Verfügung zu haben.
*Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik

T 105.6 Do 18:00 VMP9 SR 29

Silicon Photomultipliers in AMIGA muon counters — •Ana Martina Botti for the Pierre-Auger-Collaboration — Institut für Kernphysik, Karlsruher Institut für Technologie — Instituto de Tecnologías en Detección y Astropartículas (ITeDA), Argentina.

The project AMIGA (Auger Muons and Infill for the Ground Array) aims to extend the energy range at the Pierre Auger Observatory to observe cosmic rays of lower energies (down to $\sim 10^{17}$ eV) and to study the transition from extragalactic to galactic cosmic rays. AMIGA is compounded by an infill of surface detectors (employing Cherenkov radiation detection in water) and muon counters. The AMIGA muon counters consist of an array of buried modules composed of 64 scintillator bars, a multi-pixel Photo Multiplier Tube (PMT) and the corresponding electronic of acquisition which works along with the surface detector.

Currently, ITeDA is evaluating the feasibility of replacing PMTs with silicon photomultipliers (SiPM) without performing any substantial modification in the digital readout nor in the mechanical design. I present calibration results of a prototype module associated to the surface detector Toune of the Pierre Auger Observatory using a SiPM Hamamatsu S1257-100C plugged to the standard AMIGA front-end electronics. In addition, a study concerning gain stability and temperature variation has also been performed and will be reported. I finally discuss a comparison between traces measured by both photo detectors (PMT and SiPM) for modules associated to the surface detector Toune.

T 105.7 Do 18:15 VMP9 SR 29

Optimization of the coupling of optical fibers to an SiPM for a scintillator upgrade of the Pierre Auger Observatory — •Julian Kemp, Thomas Bretz, Thomas Hebbeker, Rebecca Meissner, Lukas Middendorf, Tim Niggemann, Christine Peters, and Johannes Schumacher for the Pierre-Auger-Collaboration — III. Physikalisches Institut A, RWTH Aachen University

The Pierre Auger Observatory successfully measures cosmic-ray air-

showers at the highest energies by detecting both the fluorescence light produced in the atmosphere and the particle density of the shower at the ground. Nevertheless, this procedure does not allow for a precise measurement of the muon to electron ratio of a single shower. As this quantity is connected to the mass of the primary particle, it allows for a cosmic-ray mass composition measurement. To improve the ability of separating muons from the electromagnetic component, scintillator based detectors will be added to each surface detector station. The basic design will consist of several scintillator bars feeding the produced light into a bundle of wavelength shifting fibers. The light can be detected by photomultipliers (PMTs) or by silicon photomultipliers (SiPMs). The latter benefit from their higher photon detection efficiency and robustness. Due to the smaller area of the SiPMs compared to a PMT, the light detection efficiency of this system strongly depends on the quality of the optical coupling of the fiber bundle to the SiPM. Possible solutions are compared.

T 105.8 Do 18:30 VMP9 SR 29

A SiPM-based scintillator prototype for the Upgrade of the Pierre Auger Observatory — •Johannes Schumacher, Thomas Bretz, Thomas Hebbeker, Julian Kemp, Rebecca Meissner, Lukas Middendorf, Tim Niggemann, and Christine Peters for the Pierre-Auger-Collaboration — III. Physikalisches Institut A, RWTH Aachen University, Germany

Plastic scintillator-based detectors are simple and yet powerful instruments, commonly used in particle physics experiments. These detectors are also planned to be installed at the Pierre Auger Observatory as part of the upgrade called AugerPrime. Here, a single detector module will consist of several large-sized scintillator bars. Embedded wavelength shifting fibres read out the scintillation light and are coupled to a single photo-sensitive device.

We investigate the application of silicon photomultipliers (SiPMs) in this scope, which benefits from high photon detection efficiency and stability. We show the performance of a SiPM-based prototype device installed in the $2\,\mathrm{m}^2$ detector ASCII - an early prototype of the scintillating detector planned for AugerPrime. We focus on the electronics, the optical coupling and the in situ calibration. As ASCII has been operating with SiPMs for several months now, we also highlight first high-energy events seen in coincidence with the Surface Detector of the Pierre Auger Observatory.

T 105.9 Do 18:45 VMP9 SR 29

Calibrating the Auger Engineering Radio Array at the Pierre Auger Observatory using an Octocopter — •Florian Briechle, Martin Erdmann, and Raphael Krause — III. Physikalisches Institut A, RWTH Aachen University, Germany

With the Auger Engineering Radio Array (AERA) at the Pierre Auger Observatory radio emission of extensive air showers induced by ultra high energy cosmic rays is observed. Characteristics of the primary cosmic ray, e.g., arrival direction, mass or energy, can be measured this way. To produce high quality data, the detector needs to be well understood and calibrated. A useful tool for calibration campaigns is an octocopter. With it, a calibration source can be placed above the array, which makes this a very flexible method useful for different types of calibrations. Special focus is put on the position reconstruction and the position accuracy of the octocopter during the calibration flights. A new optical method using two cameras for these position reconstructions is presented. Results of a measurement campaign in spring 2015 are presented. In this campaign, the sensitivity of the AERA stations as well as timing characteristics were measured. The results of the sensitivity measurement are compared to simulations.

T 106: Kosmische Strahlung VI (Radio)

Zeit: Donnerstag 16:45–19:10 Raum: VMP9 SR 30

Gruppenbericht T 106.1 Do 16:45 VMP9 SR 30

Das Auger Engineering Radio Array - AERA * — •Sebastian Mathys für die Pierre-Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Das Auger Engineering Radio Array (AERA) ist eine Erweiterung des Pierre-Auger-Observatoriums zum Nachweis der Radioemission von kosmischer Strahlung im Frequenzbereich von 30 - 80 MHz. Diese wird seit 2011 mit der Möglichkeit der Kombination und Kalibration mit den anderen etablierten Detektortypen gemessen. Seitdem konnten mehr als 7200 Ereignisse koinzident detektiert werden. Das Ziel dieser Messung ist das Verständnis des Radio-Emissionsmechanismus ultrahochenergetischer kosmischer Strahlung, sowie die Bestimmung der Rekonstruktionspräzision von Richtung, Energie und Masse des Primärteilchens.

AERA besteht nach Fertigstellung der dritten Ausbauphase im Frühjahr 2015 aus 153 autonomen Radiostationen, die sich auf einer Fläche von 17 km^2 mit einem Abstand von 150 m bis zu 750 m zueinander befinden und ist sensitiv für kosmische Strahlung oberhalb einer Energie von 10^{17} eV.

In diesem Gruppenbericht wird der Aufbau von AERA diskutiert und eine Übersicht aktueller Ergebnisse vorgestellt.

* *Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

Gruppenbericht T 106.2 Do 17:05 VMP9 SR 30

Status, results and plans after 3 years of Tunka-Rex operation — •Roman Hiller for the Tunka-Rex-Collaboration — Karlsruher Institut für Technologie

The Tunka Radio Extension (Tunka-Rex) is a radio detector for air showers from cosmic rays around 10^{17} eV close to Lake Baikal in Russia. It currently consists of 44 antenna stations, distributed over $3\,\mathrm{km}^2$, and will be extended by another 19 antenna stations this year. As most radio experiments, it is hosted by another air-showers detector, providing trigger and an independed reconstruction. This has been Tunka-133, an air-Cherenkov detector at the site, limited to operation during moonless nights. From winter 2015 on, Tunka-Rex also jointly operates with Tunka-Grande, a newly installed scintillator detector at the site, capable of 24 h operation. The goal of the first stage of Tunka-Rex was to develop methods for competetive air shower measurements and detemine the achievable precision for the most important air shower parameters, the energy and depth of the shower maximum. In the next stage, with the now available full duty cycle and powerful combination of radio and scintillator detector, the goal will be to contribute to measurements of the energy spectrum and mass composition of cosmic rays from 10^{17} eV to 10^{18} eV. Latest results and plans for Tunka-Rex will be reported. This includes an energy reconstruction with a single antenna station and the comparison of the absolute energy scale via radio measurements.

T 106.3 Do 17:25 VMP9 SR 30

Studien zur Massenkomposition hochenergetischer kosmischer Strahlung mittels Radiodetektion von ausgedehnten Luftschauern mit SKA1-Low — •Anne Zilles für die SKA - High Energy Cosmic Particles Focus Group-Kollaboration — EKP, Karlsruher Institut für Technologie, Deutschland

Im Jahr 2020 wird das Niederfrequenz-Antennenfeld der ersten Phase des Square Kilometre Array (SKA1-Low) in Westaustralien schon vor der geplanten Fertigstellung im Jahr 2023 in Betrieb genommen werden. In der ersten Phase wird der SKA1-Low-Kern bereits einen Durchmesser von ca. 700 m haben und aus ungefähr 70.000 doppel-polarisierten Antennen bestehen. Neben der noch nie dagewesenen Leistungsfähigkeit für diverse wissenschaftliche Fragestellungen im Bereich der Astronomie kann SKA durch moderate Modifizierungen auch zur Radiodetektion von ausgedehnten Luftschauern, ausgelöst durch Kosmische Strahlung, genutzt werden. Durch die sehr dichte und gleichmäßige Verteilung der Antennen auf einer Fläche von ca. $0,5\,\mathrm{km}^2$ und die große Frequenzbreite von 50-350 MHz wird SKA1-Low im Stande sein, sehr präzise Messungen von individuellen Luftschauern zu liefern. Diese Präzisionsmessungen erlauben u.a. eine detaillierte Studie der Massenkomposition der Kosmischen Strahlung im Energiebereich des Übergangs vom galaktischen zum extragalaktischen Ursprung. Dieser Vortrag gibt einen Überblick über das geplante Projekt zur Radiodetektion von ausgedehnten Luftschauern mit SKA1-Low und die ersten Ergebnisse der Simulationsstudie zur Messung der Massenkomposition.

T 106.4 Do 17:40 VMP9 SR 30

Radioemission von Luftschauern bei starken, atmosphäri-

schen elektrischen Feldern mit dem Auger Engineering Radio Array* — Jens Neuser und •Julian Rautenberg für die Pierre-Auger-Kollaboration — Bergische Universität Wuppertal, Gaußstr. 20, 42119 Wuppertal

Das Auger Engineering Radio Array ist mit 153 Radio-Detektor- Stationen auf 17 km^2 das weltweit größte Experiment zur Untersuchung der Radioemission aus Luftschauern. Die Kombination mit den anderen Detektoren am Pierre-Auger-Observatorium in Argentinien ermöglicht eine bisher einzigartige Möglichkeit der Untersuchung verschiedenster Aspekte der kosmischen Strahlung.

Starke atmosphärische E-Felder beeinflussen den Emissionsmechanismus der Radiostrahlung, der auf der Beschleunigung von Elektronen/Positronen basiert. Ein Kriterium für eine Beeinflussung basierend auf den E-Feld Messungen am Boden wurde bestimmt. Die Erhöhung der Radioemission wurde für die so selektierten Ereignisse untersucht. Zusätzlich wurde die Polarisation der Radiosignale für dieses Ereignissample mit den thoretischen Erwartungen verglichen und mit einem modifizierten Model beschrieben. Zu ausgesuchten Ereignissen wurden Ereignisse simuliert, bei denen ein zweilagiges E-Feld in der Atmosphäre vorgegeben wurde.

**Gefördert durch die BMBF-Verbundforschung Astroteilchenphysik*

T 106.5 Do 17:55 VMP9 SR 30

Event reconstruction using the radio-interferometric technique in the frame of AERA — •Dmytro Rogozin for the Pierre-Auger-Collaboration — Institut für Experimentelle Kernphysik, Karlsruher Institut für Technologie (KIT)

It is a well-known fact that there is coherent radio emission induced by extensive air-showers. This fact is exploited in the Auger Engineering Radio Array (AERA), the radio extension of the Pierre Auger Observatory. This is a unique radio experiment due to its world-largest size of 17 km^2, and due to its precise nanosecond timing calibration. These features become crucial for detection of highly inclined air-showers with their very large foot-prints, and for the ability to apply interferometric reconstruction techniques.

The standard reconstruction techniques typically treat all radio stations as separate detectors. Nevertheless there is a possibility to do an interferometric analysis. This means combining all detected signals from all antennas in a specific way. In this talk we present a beam-forming interferometric technique and its application to AERA. According to the definition of the beam-forming quantities one can expect its correlation with the shower parameters such as energy of the primary particle and distance to the shower maximum. At the first step, Monte-Carlo simulations of AERA events including the noise from measured events were used to test these dependencies. The results and the future perspectives of this method are discussed with a particular emphasis on very inclined air-showers where the aforementioned correlations are assumed to be strongest.

T 106.6 Do 18:10 VMP9 SR 30

Joint measurements of Tunka-Rex, Tunka-133 and Tunka-Grande — •Dmitriy Kostunin for the Tunka-Rex-Collaboration — KIT, Karlsruhe, Germany

The Tunka Radio Extension (Tunka-Rex) is an array of radio antennas deployed in the Tunka Valley near Lake Baikal, Siberia. It measures the radio emission from extensive air showers created by cosmic-ray primary particles of energies greater than 0.1 EeV. In 2012-2014 Tunka-Rex has been triggered by the air-Cherenkov array Tunka-133. A cross-check between the radio and air-Cherenkov detectors has shown, that Tunka-Rex has precisions of about 15% and 40 g/cm^2 for the reconstruction of the primary energy and shower maximum, respectively. The scintillator array Tunka-Grande has been deployed recently at the same site. This makes the Tunka facility a unique instrument, which performs combined air-Cherenkov, radio and particle measurements. We present the first results of joint operation of these three detectors and discuss the possibilities of studying the cosmic-ray composition by combining different techniques of detection.

T 106.7 Do 18:25 VMP9 SR 30

Zeitsynchronisation des Tunka-Rex-Experiments — •Viktoria Kungel für die Tunka-Rex-Kollaboration — Institut für Kernphysik, Karlsruher Institut für Technologie (KIT)

Tunka-Rex ist eine Erweiterung des Tunka-133-Experiments in der Baikalregion von Russland zur Messung der Radiostrahlung von Luftschauern hochenergetischer kosmischer Strahlung. Tunka-Rex besteht mittlerweile aus 44 Antennen. Es wird sowohl von dem Photomultiplier-Array Tunka-133 für Čerenkovlicht-Messung als auch von dem Szintillator-Array Tunka-Grande getriggert. Während der letzten Jahre wurde eine Kreuzkalibrierung zwischen den Čerenkovlicht-Messungen von Tunka-133 und der Radiomessung des Tunka-Rex-Experimentes erfolgreich durchgeführt. Jedoch eröffnen sich durch diese Messungen neue Fragen in Hinblick auf die exakte Signalkorrelation zum Trigger und der Zeitgenauigkeit des Experimentes. Die Zeitgenauigkeit wird mit Hilfe eines Referenzsenders „Beacon“ und über eine Wellenfront-Analyse untersucht. Durch eine Offline-Auswertung der Tunka-133-Wellenfront soll die Zeitgenauigkeit von Tunka-Rex auf etwa 1 ns verbessert werden.

T 106.8 Do 18:40 VMP9 SR 30

Hybridmessung von Myonen und Radioemission ausgedehnter Luftschauer am Pierre-Auger-Observatorium — •Ewa Marlen Holt für die Pierre-Auger-Kollaboration — Institut für Kernphysik, Karlsruher Institut für Technologie (KIT)

Wenn ein Teilchen der kosmischen Strahlung auf die Erde trifft, kommt es zu Wechselwirkungen mit Molekülen in der Atmosphäre. Durch diese inelastischen Stöße werden Teilchenschauer ausgelöst. Abhängig von der Energie und Masse des primären kosmischen Teilchens werden dabei bis zu Milliarden an Sekundärteilchen erzeugt, die den Erdboden über mehrere Kilometer verteilt erreichen und dort nachgewiesen werden können. Diese Sekundärteilchen sind unter anderem Elektronen, Positronen und Myonen. Das Verhältnis der Anzahl an Elektronen und Positronen zu der Anzahl an Myonen im Luftschauer hängt von der Masse des Primärteilchens ab. Am Pierre-Auger-Observatorium in Argentinien werden die ausgedehnten Luftschauer mit verschiedenen Detektionstechniken nachgewiesen. Das 'Auger Engineering Radio Array' (AERA) misst dabei die von den Elektronen und Positronen in der Atmosphäre erzeugte Radioemission. Die Myonen werden von Szintillatoren des 'Auger Muons and Infill for the Ground Array' (AMIGA) in 2.3 m Tiefe im Boden gemessen. Eine Kombination dieser komplementären Messungen ermöglicht unter anderem eine Abschätzung der Masse des Primärteilchens. In diesem Vortrag werden neue Ergebnisse einer gemeinsamen Analyse der Daten dieser beiden Detektoren vorgestellt.

T 106.9 Do 18:55 VMP9 SR 30

Radiodetektion horizontaler ausgedehnter Luftschauer mit AERA — Olga Kambeitz und •Ewa Holt für die Pierre-Auger-Kollaboration — IKP, KIT

AERA, das Auger Engineering Radio Array, ist ein Teil des Pierre-Auger-Observatoriums und befindet sich in Malargüe, Argentinien. Die Installation der AERA Stationen wurde 2011 begonnen und ist in drei Phasen zu einem Antennenfeld von 153 Stationen mit einer Gesamtfläche von 17 km^2 erweitert worden. Obwohl AERA für einen Zenitwinkelbereich bis 55 Grad optimiert wurde, können durch die kombinierte Messung mit dem Auger Oberflächenarray auch horizontale Luftschauer analysiert werden.

In diesem Vortrag werden die Ergebnisse der Analyse von horizontalen Luftschauern im Zenitwinkelbereich von 62 bis 80 Grad vorgestellt.

T 107: Trigger und DAQ IV

Zeit: Donnerstag 16:45–19:00 Raum: VMP11 HS

T 107.1 Do 16:45 VMP11 HS

Triggerstudien zu KM3NeT/ARCA — •Sebastian Eichie für die ANTARES-KM3NeT-Erlangen-Kollaboration — ECAP - Uni Erlangen

Derzeit befindet sich das KM3NeT Neutrinoteleskop in der Aufbauphase. Als nächster Projektschritt wird der KM3NeT/ARCA-Aufbau angestrebt, der ein Kubikkilometer-großes Neutrinoteleskop zur Untersuchung von hochenergetischen kosmischen Neutrinoquellen und diffusen Neutrinoflüssen umfasst.

Dieser Vortrag beschreibt die Ergebnisse der Analyse und Opti-

mierung der eingesetzten Trigger zur Unterscheidung von Neutrino-Signalen vom Hintergrund aus Kalium-40-Zerfällen im Meerwasser und atmosphärischen Myonen hinsichtlich ihrer erwarteten Triggerraten, Effizienzen und Signalreinheiten basierend auf Daten ausführlicher Simulationen.

T 107.2 Do 17:00 VMP11 HS

The Neural Network z-vertex Trigger for the Belle II Detector — •Sebastian Skambraks[1], Sara Neuhaus[1], Yang Chen[2], and Christian Kiesling[2] for the Belle II-Collaboration — [1]Technische Universität München — [2]Max-Planck-Institut für Physik, München

We present a neural network based first level track trigger for the upcoming Belle II detector at the high luminosity SuperKEKB flavor factory. Using hit and drift time information from the Central Drift Chamber (CDC), neural networks estimate the z-coordinates of single track vertex positions. Especially beam induced background, with vertices outside of the interaction region, can clearly be rejected. This allows to relax the track trigger conditions and thus enhances the efficiency for events with a low track multiplicity.

In the CDC trigger pipeline, the preceding 2D pattern recognition enables a unique per track input representation and a sectorization of the track parameter phase space. The precise z-vertices are then estimated by an ensemble of sector-specific local expert neural networks. After an introduction to the neural trigger system, the benefits of an improved 3D pattern recognition will be discussed.

T 107.3 Do 17:15 VMP11 HS

Online data reduction with FPGA-based track reconstruction for the Belle II DEPFET Pixel Detector — •Bruno Deschamps, Christian Wessel, Carlos Marinas, and Jochen Dingfelder — Physikalisches Institut, Universität 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 (DATCON). 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 extrapolation to the PXD. The goal is to achieve a data reduction of at least 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 presented system. The planned hardware design is based on a distributed set of Advanced Mezzanine Cards (AMC) each equipped with a Field Programmable Gate Array (FPGA) and 4 optical transceivers.

In this talk, the status and plans for the DATCON prototype and the FPGA-based tracking algorithm are introduced as well as the plans for their test in the upcoming test beam at DESY.

T 107.4 Do 17:30 VMP11 HS

Firmwareimplementation der Triggeralgorithmen des neuen topologischen Prozessors als Teil des ATLAS Level-1 Triggerausbaus — •Sebastian Artz, Volker Büscher, Alexandra Schulte und Ulrich Schäfer — ETPA, Institut für Physik, Mainz

Im ATLAS Detektor am LHC werden hochenergetische Teilchen - entstanden aus Protonkollisionen - nachgewiesen. Mit dem Ausbau des Colliders 2015 wurden die Schwerpunktsenergie auf 13 TeV sowie die Luminosität angehoben. Um die Triggerrate ohne Effizienzverluste stabil zu halten wurde im Rahmen des Triggerausbaus ein topologischer Prozessor entwickelt, der erstmals ermöglicht Triggerinformationen von Jets, Myonen und Em/Tau-Teilchen auf einem Modul zu nutzen. Somit können schon auf unterster Triggerebene Winkelschnitte, Massenberechnungen sowie weitere Algorithmen basierend auf topologischen Informationen durchgeführt werden. Inhalt dieses Vortrages ist eine Übersicht der Algorithmen, deren Firmwareimplementation sowie deren Inbetriebnahme.

T 107.5 Do 17:45 VMP11 HS

Timing Calibration and Performance of the ATLAS Level-1 Calorimeter Trigger — •Claire Antel — Universität Heidelberg, Heidelberg, DE

The level-1 calorimeter (L1Calo) trigger is part of the first, and fastest-working, stage of online event selection at the ATLAS experiment at CERN. The system is required to process analogue signals, so-called trigger towers, from the calorimeter and identify and count particle candidates as well as missing and total transverse energy above configurable energy thresholds. The final acceptance decision is subsequently made by the central trigger processor using the combined information sent by all level-1 systems. The entire process is limited to 2.5 microseconds. One of the many aspects of the commissioning and performance checks of the ATLAS calorimeter trigger to ensure correct functionality is the input timing of the trigger tower signals. Signals, once received by L1Calo, have undergone several delays - time-of-flight delays as well as cable delays - and are different for each trigger tower. It is essential to synchronise the system so that signals from the same collision arrive simultaneously and the correct bunch crossing can thus be identified. Further fine-tuning of the signal delay, of 1 nanosecond precision, ensures that pulses are digitised at the pulse peak for optimum energy resolution. The procedure for the timing commissioning and findings in performance for Run 2 of the LHC will be hereby presented.

T 107.6 Do 18:00 VMP11 HS

Studien zur Verwendung des äußeren Hadronkalorimeters im Level-1-Trigger bei CMS — Günter Flügge[1], Thomas Hebbeker[2], •Andreas Künsken[1], Markus Merschmeyer[2], Oliver Pooth[1], Florian Scheuch[2] und Achim Stahl[1] — [1]III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen — [2]III. Physikalisches Institut A, RWTH Aachen University

Mit dem Upgrade des äußeren Hadronkalorimeters (HO) von CMS auf SiPM-Auslese besteht dank eines besseren Signal-zu-Rausch-Verhältnisses die Möglichkeit, die Detektorinformation in den Level-1-Myontrigger von CMS zu integrieren. Wir erwarten, dass die Myonidentifikation verbessert werden kann, insbesondere bei höheren Luminositäten. Es werden Simulationen durchgeführt um die Effizienz abzuschätzen. Diese werden mit ersten Daten aus dem Run II des LHC verglichen.

T 107.7 Do 18:15 VMP11 HS

Optimierung der softwarebasierten Myonenidentifikation am LHCb-Experiment — •Kevin Dungs[1,2], Johannes Albrecht[2] und Francesco Dettori[1] — [1]CERN — [2]Experimentelle Physik 5, TU Dortmund

Das LHCb-Experiment beschäftigt sich mit Präzisionstests des Standardmodells der Teilchenphysik. Ein wichtiger Teil des Physikprogramms sind dabei Teilchenzerfälle deren Endzustände Myonen enthalten. Eine verbesserte Rekonstruktionseffizienz bedeutet direkt größere Signalausbeuten für einige der wichtigsten Zerfallskanäle.

In diesem Vortrag wird die Leistungsfähigkeit der Myonenrekonstruktion des LHCb-Experimentes in der ersten Datennahmephase des LHC untersucht. Mit Hilfe simulierter $B^0 \to K^{*0}\mu^+\mu^-$ Zerfälle wird die relative Ineffizienz der ersten Stufe des Softwaretriggers relativ zur Offlinerekonstruktion ermittelt. Dank einer verbesserten Computerfarm kann mehr CPU-Zeit für die Rekonstruktion verwendet werden. Durch eine Optimierung der Rekonstruktionssoftware werden die gefundenen Ineffizienzen fast vollständig eliminiert. Die Effizienz der Myonenrekonstruktion im Softwaretrigger konnte so um etwa 8.5 % verbessert werden und ist nun nahezu identisch zur Effizienz der Offlinerekonstruktion.

T 107.8 Do 18:30 VMP11 HS

Untersuchung der Selektivität des auf den MDT-Präzisionskammern beruhenden Level-0-Myontriggers für das ATLAS-Experiment am HL-LHC — •Philipp Gadow, Felix Müller, Oliver Kortner, Hubert Kroha und Robert Richter — Max-Planck-Institut für Physik, München

Das ATLAS-Experiment wird einen mehrstufigen Trigger für die Datennahme am HL-LHC verwenden. Um niederenergetische Myonen aus Zerfällen von Hadronen mit gleichzeitig hoher Effizienz für hochenergetische Myonen aus schwachen Eichbosonzerfällen zu verwerfen, wird eine hochselektive erste Triggerstufe (Level-0) mit hoher Myonimpulsauflösung benötigt.

Die Impulsauflösung der bisherigen ersten Myontriggerstufe ist durch die moderate Ortsauflösung der Triggerkammern begrenzt. Es ist daher geplant, die hochauflösenden MDT-Myonspurdetektoren des ATLAS-Myonspektrometers in die Level-0-Entscheidung am HL-LHC einzubeziehen. Mit Hilfe der pp-Kollisionsdaten des ATLAS-Experiments aus dem Jahr 2012 wurde die Verwendung der MDT-Daten für die Level-0-Triggerentscheidung untersucht und die Selektivität des Level-0-Myontriggers bestimmt.

T 107.9 Do 18:45 VMP11 HS

Test eines Prototyps für den ATLAS Level-0-Myontrigger am HL-LHC — Philipp Gadow, Oliver Kortner, Sandra Kortner, Hubert Kroha, •Felix Müller, Sebastian Nowak, Robert Richter, and Korbinian Schmidt-Sommerfeld — Max-Planck-Institut für Physik, München

Der Ausbau des LHC für hohe Luminositäten (HL-LHC) macht eine verbesserte Triggerselektion für das ATLAS-Experiment erforderlich. Die Anhebung der Latenzzeit der ersten Triggerstufe auf etwa 6μs erlaubt es, die präzise Spurinformation der Myondriftrohrkammern (MDT-Kammern) bereits auf er der ersten Triggerstufe zu nutzen. Damit kann eine substantielle Verbesserung der Impulsauflösung des Triggers erreicht werden. Die Umsetzung erfolgt mittels einer neuen Ausleseelektronik, die eine Spurrekonstruktion auf Basis eines FPGAs und einen dedizierten, schnellen Übertragungsweg für die Triggerdaten vorsieht. Zur Demonstration der Realisierbarkeit des Triggerkonzepts wurde ein Prototyp entwickelt. Der Testaufbau besteht aus drei MDT-Kammern mit unterschiedlichen Rohrdurchmessern, die mit dem Prototyp der neuen, schnellen Ausleseelektronik für den Triggerdatenpfad ausgestattet sind. Der Prototyp wurde in einem Myonstrahl am CERN bei unterschiedlichen Untergrundraten von einer starken 137Cs-Gammastrahlungsquelle getestet. In diesem Beitrag wird zunächst das Triggerkonzept erläutert und die Ergebnisse des Prototypentests vorgestellt. Anschliessend wird ausserdem eine Messung der Hochratenfähigkeit der MDT-Kammern mit verkleinertem Rohrdurchmesser in Bezug auf Effizienz und Auflösung gezeigt.

T 108: Hauptvorträge

Zeit: Freitag 8:45–10:45 Raum: VMP4 Audimax 1

Hauptvortrag T 108.1 Fr 8:45 VMP4 Audimax 1

Standardmodellphysik am LHC: Präzisionsmessungen bei höchsten Energien — •Matthias Mozer — Institut für Experimentelle Kernphysik (IEKP), KIT

Nachdem der LHC noch keine Entdeckungen jenseits des Standardmodells hervorgebracht hat, liegt das Augenmerk wieder vermehrt auf Standardmodellmessungen. Mit dem vertieften Detektorverständnis nach mehreren Jahren der LHC-Datennahme sind die Experimente jetzt in der Lage, Messungen von vorher unerreichter Präzision durchzuführen. Damit tragen die LHC-Experimente jetzt signifikant zu unserem Verständnis der Protonstruktur bei. Die hohe Schwerpunktsenergie des LHC erlaubt außerdem eine systematische Untersuchung der Wechselwirkung der elektroschwachen Eichbosonen untereinander. Während die aktuellen Resultate noch kompatibel mit den Vorhersagen des Standardmodells sind, könnten Abweichungen davon Hinweise auf neue Physik liefern, die nicht direkt am LHC zugänglich ist.

Der Vortrag gibt einen Überblick über jüngere Ergebnisse der LHC-Experimente zur QCD und elektroschwachen Wechselwirkung mit einer vertieften Diskussion einiger ausgewählter Beispiele.

Hauptvortrag T 108.2 Fr 9:25 VMP4 Audimax 1

Precision theory simulations for the LHC — •Stefano Pozzorini — Zurich University

Recent technical progress in higher-order perturbative calculations, as well as in the matching of matrix elements to parton showers, has opened the door to precision theory simulations for an unprecedented range of scattering processes. This talk presents recent examples of precision simulations for non-trivial processes and discusses their relevance for the high-energy and high-luminosity phase of the LHC.

Hauptvortrag T 108.3 Fr 10:05 VMP4 Audimax 1

New results from flavour physics — •Christoph Langenbruch — Department of Physics, University of Warwick, UK

Flavour physics provides stringent tests of the Standard Model and plays a crucial role in the search for new phenomena. The LHC offers a unique opportunity to perform precision measurements of flavour observables due to the vast numbers of charm- and beauty hadrons produced in pp collisions. This endeavour is led by LHCb, the dedicated flavour physics experiment at the LHC. Of particular interest are flavour observables related to rare decays and meson-antimeson mixing, which are highly sensitive to contributions from particles beyond the Standard Model and can probe scales far exceeding the LHC collision energy. Flavour observables therefore give important information that is complementary to direct searches for the production of new particles at the general purpose detectors ATLAS and CMS.

A selection of new results from flavour physics will be presented, with focus on results from the LHCb experiment. This includes precision measurements of CP violation and results from rare decays, where some interesting tensions with Standard Model predictions recently appeared. In addition, future prospects of flavour physics at the LHC will be briefly discussed.

T 109: Hauptvorträge

Zeit: Freitag 11:15–13:15 Raum: VMP4 Audimax 1

Hauptvortrag T 109.1 Fr 11:15 VMP4 Audimax 1

Mehr als reiner Zufall: Neue Entwicklungen in Monte Carlo-Ereignisgeneratoren für den LHC — •Frank Siegert — Institut für Kern- und Teilchenphysik, TU Dresden

Die Entdeckung neuer unbekannter Phänomene in den Kollisionen am LHC wird nur möglich, wenn man die aus der bekannten Theorie zu erwartenden Messergebnisse so präzise wie möglich vorhersagen kann. Dafür benötigt man nicht nur eine möglichst hohe formale Genauigkeit der analytischen Berechnung mit Hilfe von Störungstheorie, sondern auch eine realistische Simulation der nicht-perturbativen Aspekte der Teilchenproduktion. Während Monte Carlo-Ereignisgeneratoren als Simulationsprogramme traditionell in letzterem Bereich ihre Stärken hatten, gewannen sie in den letzten Jahren durch neue Methoden auch eine formale Genauigkeit, die sie zum Mittel der Wahl für Präzisionsberechnungen werden lässt. In diesem Vortrag wird diskutiert, welche Erfolge mit diesen neuen Methoden erzielt werden können, und an welchen Stellen Potential fuer weitere Verbesserungen besteht.

Hauptvortrag T 109.2 Fr 11:55 VMP4 Audimax 1

The hunt for cosmic accelerators: neutrinos — •Elisa Resconi — TUM, Munich, Germany

The recent discovery of high energy cosmic neutrinos from the IceCube Neutrino Observatory opens new opportunities for particle and astrophysics. We report here the IceCube observation of a diffuse neutrino background and the on-going searches for counterparts.

Hauptvortrag T 109.3 Fr 12:35 VMP4 Audimax 1

Supernova Simulations in Three Dimensions: Models Confronting Observations — •Hans-Thomas Janka — Max Planck Institute for Astrophysics, Garching, Germany

Recently the first self-consistent, three-dimensional computer simulations of supernova explosions of massive stars have become possible and reveal new, stunning phenomena like a dipolar emission asymmetry of electron neutrinos and antineutrinos. They lend support to the viability of the neutrino-driven explosion mechanism in principle, although stars above ten solar masses are hard to explode and might suggest still missing physics. The violent hydrodynamical instabilities that facilitate the onset of the explosion lead to kicks and spins of the newly formed neutron stars and to supernova asymmetries, whose observations can help to decipher the physics of the central engine.