Fachverband Physik der Hadronen und Kerne (HK)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsäle F 1, 2, 3, 5, 33, 072, 073, 102 und 234; Poster F Foyer)

Plenarvorträge

PV I	Mo	11:00–11:45	H 1	**The CNO cycles** — •Michael Wiescher
PV II	Mo	11:45–12:30	H 1	**Das Higgs-Boson – Charakterisierung seiner Natur** — •Markus Schumacher
PV III	Di	18:30–19:30	S Aula	**Lise-Meitner-Lecture: Erforschung von Urknallmaterie an der Weltmaschine LHC** — •Johanna Stachel
PV IV	Mi	8:30– 9:15	H 1	**Advancing Molecular Imaging with Total-Body Positron Emission Tomography** — •Simon R. Cherry
PV V	Mi	9:15–10:00	H 1	**Heavy Quarks: From Hadron to Particle Physics** — •Thomas Mannel
PV VI	Mi	11:40–12:10	H 1	**Kinetic theory of waves and quanta** — •Herbert Spohn
PV VII	Mi	12:10–12:40	H 1	**Topological Insulators: a New State of Matter** — •Laurens W. Molenkamp
PV VIII	Mi	12:40–13:10	H 1	**Gravitationswellenastronomie: Wir können das dunkle Universum hören!** — •Karsten Danzmann
PV IX	Mi	20:00–21:00	H 1	**Max-von-Laue-Lecture: From the "Vergangenheit der Physik" to the "Future of Physics": Monolingualism and the Transformation of a Science** — •Michael D. Gordin
PV X	Do	11:00–11:45	H 1	**Searching for the identity of the dark matter in our local neighbourhood** — •Carlos S. Frenk
PV XI	Do	11:45–12:30	H 1	**Hot QCD matter produced in heavy-ion collisions at the LHC** — •Silvia Masciocchi
PV XII	Do	20:00–21:00	H 1	**Früher war alles besser – aber nicht die Batterien** — •Martin Winter

Hauptvorträge

HK 10.1	Di	8:30– 9:10	F 1	**Status of the FAIR Project** — •Paolo Giubellino
HK 10.2	Di	9:10– 9:50	F 1	**Ab initio calculations of the neutron skin and the electric dipole response of nuclei** — •Sonia Bacca
HK 10.3	Di	9:50–10:30	F 1	**QCD in external magnetic fields** — •Gergely Endrödi
HK 37.1	Do	8:30– 9:10	F 1	**Direct Neutrino Mass Measurements** — •Susanne Mertens
HK 37.2	Do	9:10– 9:50	F 1	**Precision Nuclear Mass Measurements for Neutrino Physics Studies** — •Sergey Eliseev
HK 37.3	Do	9:50–10:30	F 1	**Few-neutron resonances and their impact on neutron-rich nuclei** — •Joel Lynn
HK 55.1	Fr	8:30– 9:10	F 1	**Heavy-ion collisions at the LHC - theory overview** — •Urs Achim Wiedemann
HK 55.2	Fr	9:10– 9:50	F 1	**The BESII and PANDA experiments** — •Cristina Morales
HK 55.3	Fr	9:50–10:30	F 1	**Baryons as bound states of quarks** — •Gernot Eichmann
HK 56.1	Fr	11:00–11:40	F 1	**The origin of low-lying collective E1 and E2 strength in atomic nuclei** — •Mark Spieker
HK 56.2	Fr	11:40–12:20	F 1	**Radionuclides for medical applications** — •Ulli Köster

Dissertationspreis-Symposiums SYDI

Am Montag, 27.3.2017, 14:00h, findet im H1 das Dissertationspreis-Symposium 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 SYDM

Das vollständige Programm dieses Symposiums ist unter SYDM aufgeführt.

SYDM 1.1	Mi	14:00–14:35	H 1	**Effective field theories for dark matter direct detection** — •Martin Hoferichter
SYDM 1.2	Mi	14:35–15:10	H 1	**Direct dark matter detection** — •Manfred Lindner
SYDM 1.3	Mi	15:10–15:45	H 1	**A search for the invisible: Dark Matter and LHC** — •Monica Dunford
SYDM 1.4	Mi	15:45–16:20	H 1	**Indirect detection of dark matter - status and perspectives** — •Jan Conrad

Fachsitzungen

HK 1.1–1.7	Mo	16:45–19:00	F 5	**Hadron Structure and Spectroscopy I**
HK 2.1–2.8	Mo	16:45–19:00	F 1	**Heavy Ion Collisions and QCD Phases I**
HK 3.1–3.8	Mo	16:45–19:00	F 3	**Heavy Ion Collisions and QCD Phases II**
HK 4.1–4.6	Mo	16:45–18:30	F 2	**Structure and Dynamics of Nuclei I**
HK 5.1–5.8	Mo	16:45–19:00	F 33	**Nuclear Astrophysics I**
HK 6.1–6.9	Mo	16:45–19:00	F 072	**Instrumentation I**
HK 7.1–7.7	Mo	16:45–18:45	F 073	**Instrumentation II**
HK 8.1–8.8	Mo	16:45–19:00	F 102	**HK+T Joint Session I: Gas Detectors/TPC**
HK 9.1–9.8	Mo	16:45–19:00	F 234	**HK+T Joint Session II: Silicon Strip Detectors**
HK 10.1–10.3	Di	8:30–10:30	F 1	**Hauptvorträge I**
HK 11.1–11.6	Di	11:00–12:30	F 5	**Hadron Structure and Spectroscopy II**
HK 12.1–12.5	Di	11:00–12:30	F 1	**Heavy Ion Collisions and QCD Phases III**
HK 13.1–13.5	Di	11:00–12:30	F 2	**Structure and Dynamics of Nuclei II**
HK 14.1–14.5	Di	11:00–12:30	F 33	**Astroparticle Physics I**
HK 15.1–15.5	Di	11:00–12:30	F 3	**Instrumentation III**
HK 16.1–16.4	Di	11:00–12:30	F 072	**Instrumentation IV**
HK 17.1–17.6	Di	11:00–12:30	F 102	**HK+T Joint Session III: Gas Detectors/GEM**
HK 18.1–18.5	Di	11:00–12:20	F 073	**HK+T Joint Session IV: Pixel Detectors**
HK 19.1–19.7	Di	14:00–16:15	F 5	**Hadron Structure and Spectroscopy III**
HK 20.1–20.8	Di	14:00–16:15	F 1	**Heavy Ion Collisions and QCD Phases IV**
HK 21.1–21.8	Di	14:00–16:15	F 3	**Heavy Ion Collisions and QCD Phases V**
HK 22.1–22.8	Di	14:00–16:15	F 2	**Structure and Dynamics of Nuclei III**
HK 23.1–23.8	Di	14:00–16:15	F 33	**Nuclear Astrophysics II**
HK 24.1–24.6	Di	14:00–16:15	F 073	**Fundamental Symmetries I**
HK 25.1–25.5	Di	14:00–15:30	F 072	**Instrumentation VI**
HK 26.1–26.8	Di	14:00–16:15	F 102	**Instrumentation V**
HK 27.1–27.95	Di	16:45–18:45	F Foyer	**Poster**
HK 28.1–28.8	Mi	16:45–19:00	F 5	**Hadron Structure and Spectroscopy IV**
HK 29.1–29.8	Mi	16:45–19:00	F 1	**Heavy Ion Collisions and QCD Phases VI**
HK 30.1–30.8	Mi	16:45–19:00	F 3	**Heavy Ion Collisions and QCD Phases VII**
HK 31.1–31.9	Mi	16:45–19:00	F 2	**Structure and Dynamics of Nuclei IV**
HK 32.1–32.8	Mi	16:45–19:00	F 33	**Structure and Dynamics of Nuclei V**
HK 33.1–33.8	Mi	16:45–19:00	F 072	**Instrumentation VII**
HK 34.1–34.8	Mi	16:45–19:00	F 073	**Instrumentation VIII and Accelerators**
HK 35.1–35.9	Mi	16:45–19:00	F 102	**HK+T Joint Session V: Silicon Strip Detectors**
HK 36.1–36.9	Mi	16:45–19:00	F 234	**HK+T Joint Session VI: Radiation Damage**
HK 37.1–37.3	Do	8:30–10:30	F 1	**Hauptvorträge II**
HK 38.1–38.8	Do	14:00–16:15	F 5	**Hadron Structure and Spectroscopy V**
HK 39.1–39.8	Do	14:00–16:15	F 1	**Heavy Ion Collisions and QCD Phases VIII**
HK 40.1–40.9	Do	14:00–16:15	F 3	**Heavy Ion Collisions and QCD Phases IX**
HK 41.1–41.8	Do	14:00–16:15	F 2	**Structure and Dynamics of Nuclei VI**

HK 42.1–42.7	Do	14:00–16:00	F 33	**Nuclear Astrophysics III**
HK 43.1–43.7	Do	14:00–16:15	F 073	**Astroparticle Physics II**
HK 44.1–44.7	Do	14:00–16:00	F 102	**Instrumentation IX**
HK 45.1–45.7	Do	14:00–15:45	F 072	**Instrumentation X**
HK 46.1–46.7	Do	16:45–19:00	F 5	**Hadron Structure and Spectroscopy VI**
HK 47.1–47.8	Do	16:45–19:00	F 1	**Heavy Ion Collisions and QCD Phases X**
HK 48.1–48.9	Do	16:45–19:00	F 2	**Structure and Dynamics of Nuclei VII**
HK 49.1–49.8	Do	16:45–19:00	F 33	**Structure and Dynamics of Nuclei VIII**
HK 50.1–50.9	Do	16:45–19:00	F 3	**Instrumentation XI**
HK 51.1–51.9	Do	16:45–19:00	F 072	**Instrumentation XII**
HK 52.1–52.8	Do	16:45–19:00	F 102	**HK+T Joint Session VII: Gas Detectors/GEM**
HK 53.1–53.8	Do	16:45–19:00	F 073	**HK+T Joint Session VIII: Pixel Detectors**
HK 54.1–54.8	Do	16:45–19:05	F 234	**HK+T Joint Session IX: Calorimeter**
HK 55.1–55.3	Fr	8:30–10:30	F 1	**Hauptvorträge III**
HK 56.1–56.2	Fr	11:00–12:20	F 1	**Hauptvorträge IV**
HK 57.1–57.7	Fr	14:00–16:15	F 5	**Hadron Structure and Spectroscopy VII**
HK 58.1–58.8	Fr	14:00–16:15	F 1	**Heavy Ion Collisions and QCD Phases XI**
HK 59.1–59.7	Fr	14:00–16:15	F 3	**Heavy Ion Collisions and QCD Phases XII**
HK 60.1–60.8	Fr	14:00–16:15	F 2	**Structure and Dynamics of Nuclei IX**
HK 61.1–61.9	Fr	14:00–16:15	F 33	**Structure and Dynamics of Nuclei X**
HK 62.1–62.8	Fr	14:00–16:00	F 102	**Instrumentation XIII**
HK 63.1–63.8	Fr	14:00–16:00	F 072	**Instrumentation XIV**

Mitgliederversammlung Fachverband Physik der Hadronen und Kerne

Donnerstag 19:15–20:00 F 1

HK 1: Hadron Structure and Spectroscopy I

Zeit: Montag 16:45–19:00 Raum: F 5

Gruppenbericht HK 1.1 Mo 16:45 F 5
Hadron Spectroscopy with COMPASS — •Stefan Wallner — Physik-Department E18, Technische Universität München

COMPASS is a multi-purpose fixed-target experiment at the CERN Super Proton Synchrotron aimed at studying the structure and spectrum of hadrons. The two-stage spectrometer has a good acceptance for charged as well as neutral particles over a wide kinematic range and is thus able to measure a wide range of reactions. Light mesons are studied with negative (mostly π^-) and positive (p, π^+) hadron beams with a momentum of 190 GeV/c. COMPASS has measured the so far world's largest dataset of the diffractively produced $\pi^-\pi^+\pi^-$ final state. We will report on new results for this final state, which allows to investigate a_J and π_J like light mesons including mesons with spin-exotic $J^{PC} = 1^{-+}$ quantum numbers, which are forbidden for quark-antiquark states. We employ the method of partial-wave analysis (PWA) to extract these states from the data. In this method, the decay into $\pi^-\pi^+\pi^-$ is modeled as subsequent two-body decays and a fixed mass shape for the appearing $\pi^-\pi^+$ resonances is assumed. However, the large size of our dataset also allows us to extract these shapes directly from data. Finally, the resonance parameters of a_J and π_J like mesons are measured by disentangling resonant and non-resonant parts of selected partial waves in resonance-model fits.

This work was supported by the BMBF, the DFG Cluster of Excellence "Origin and Structure of the Universe" (Exc 153), and the Maier-Leibnitz-Laboratorium der Universität und der Technischen Universität München.

Gruppenbericht HK 1.2 Mo 17:15 F 5
ComPWA: Amplitudenanalysen ohne Einschränkungen — •Mathias Michel[1], Klaus Götzen[2], Wolfgang Gradl[3], Frank Nerling[2], Klaus Peters[2], Stefan Pflüger[1], Andreas Pitka[4], Peter Weidenkaff[3] und Miriam Fritsch[4] — [1]Helmholtz-Institut Mainz — [2]GSI Darmstadt — [3]JGU Mainz — [4]RU Bochum

Eine der spannendsten Herausforderungen der Physik der Hadronen ist die Suche nach neuen konventionellen und exotischen hadronischen Zuständen wie zum Beispiel Hybriden und Glueballen. Um diese experimentell nachzuweisen und auch klassische Zustände entsprechend zu klassifizieren, benötigt man in den meisten Fällen eine Amplitudenanalyse. Von besonderem Interesse ist zusätzlich der Vergleich und die simultane Analyse von Daten mehrerer Experimente. Um dies zu ermöglichen wurde das neue, unabhängige und effiziente Amplitudenanalyseframework ComPWA entwickelt. Es ist modularisiert, was eine einfache Erweiterung durch Modelle und Formalismen ermöglicht. Es bietet verschiedene Abschätzungen der Anpassungsqualität und Schnittstellen zu den Optimierungsbiblitotheken Minuit2 und Geneva. Durch die Modularität werden auch komplizierte Methoden wie die modellunabhängige Extraktion von Wellen ermöglicht. ComPWA wird bereits für die Analyse von BESIII Daten eingesetzt. Weitere Analysen von BESIII-Daten sind vorgesehen und die Schnittstellen für andere auch zukünftige Experimenten wie PANDA sind definiert. In diesem Vortrag werden die Möglichkeiten von ComPWA sowie erste Analysen vorgestellt.

HK 1.3 Mo 17:45 F 5
Open Effective Field Theories from Highly Inelastic Reactions — Eric Braaten[1], •Hans-Werner Hammer[2], and G. Peter Lepage[3] — [1]Department of Physics, The Ohio State University, Columbus, OH 43210, USA — [2]Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany — [3]LEPP, Cornell University, Ithaca, NY 14583, USA

Effective field theories have often been applied to systems with inelastic reactions that produce particles with large momenta outside the domain of validity of the effective theory. The effects of the highly inelastic reactions have been taken into account in previous work by adding local anti-Hermitian terms to the effective Hamiltonian density. Here we show that an additional modification is required in equations governing the density matrix when multi-particle states are considered. We define an effective density matrix by tracing out states containing high-momentum particles, and show that it satisfies a Lindblad equation, with Lindblad operators determined by the anti-Hermitian terms in the effective Hamiltonian density.

*Supported by BMBF (contract 05P15RDFN1) and by DFG (SFB 1245).

HK 1.4 Mo 18:00 F 5
Extraction of resonance poles with $J^{PC} = 2^{-+}$ from COMPASS data — •Mikhail Mikhasenko[1], Andrew Jackura[2], Bernhard Ketzer[1], and Adam Szczepaniak[2,3] — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, 53115 Bonn, Germany — [2]Indiana University, Bloomington IN, U.S.A. — [3]Thomas Jefferson National Accelerator Facility, Newport News VA, U.S.A.

The COMPASS experiment at CERN has collected 5×10^6 events of diffractive scattering of 190 GeV pions to the three-pion final state. Since around one hundred resonances observed in light-quark sector are coupled to pionic systems, the spin-density matrices from a partial wave analysis are extremely valuable to extract ordinary and, possibly, exotic mesons.

The aim of the present analysis is to extract three-pion scattering amplitudes from the mass-dependence of the COMPASS spin-density matrices using analyticity and unitarity constraints.

The three-body unitarity problem is very difficult and has not been completely solved. In the approximation of the isobar model, it is reduced to quasi-two-body ($\pi\pi$-subchannel resonance + pion) unitarity requirements. We invoke a unitarization procedure to incorporate non-resonant long-range production processes via pion exchange, i.e. "Deck"-like processes.

This theoretical framework is applied to the COMPASS data. We discuss resonant pole positions and scattering phase shifts for the mesonic $J^{PC} = 2^{-+}$ sector. The project is supported by BMBF.

HK 1.5 Mo 18:15 F 5
Model Selection in Partial-Wave Decomposition — •Florian Kaspar, Karl Bicker, Oliver Drotleff, Boris Grube, and Stephan Paul — Physik-Department E18, Technische Universität München

The measurement of the excitation spectrum of light-quark hadrons often requires to apply partial-wave analysis methods. The building blocks of the physical models used in such analyses are the partial-waves, which describe the quantum numbers and the decay paths of the resonances. In diffractive reactions, in principle infinitely many of these waves can contribute. However, for finite data samples, only a finite number of waves carry relevant information. Finding these waves is in general a difficult task. We present a method that imposes constraints in the form of prior probability density functions on the individual waves in order to build sparse models from systematically constructed sets of possible partial waves. As an example we show results of the application of this method to simulated data for diffractively produced $\pi^-\pi^-\pi^+$ events.

This work was supported by the BMBF, the DFG Cluster of Excellence "Origin and Structure of the Universe" (Exc 153), the computing facilities of the Computational Center for Particle and Astrophysics (C2PAP), and the Maier-Leibnitz-Laboratorium der Universität und der Technischen Universität München.

HK 1.6 Mo 18:30 F 5
Coupled-Channel Partial Wave Analysis of $J/\psi \to \phi\pi^+\pi^-$ and $J/\psi \to \phi K^+K^-$ — •Markus Kuhlmann for the BESIII-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum

Gluonic bound states like glueballs or hybrids and multiquark states are predicted by QCD. Hadronic decays of charmonia are gluon rich processes, where the production of those exotics is expected. In this talk, preliminary results of the analysis of the decays $J/\psi \to \phi\pi^+\pi^-$ and $J/\psi \to \phi K^+K^-$ are presented, using the worlds largest data sample of about $1.3 \cdot 10^9$ J/ψ events, collected with the Beijing Spectrometer III (BESIII) in positron-electron annihilations at the Beijing Electron-Positron Collider (BEPCII). The data selection, background analysis, and preliminary results of a coupled-channel partial wave analysis will be discussed.

HK 1.7 Mo 18:45 F 5
Partial wave analysis of three pion final states of J/Ψ and Ψ' at BESIII — •Stuart Fegan for the BESIII-Collaboration — Johannes Gutenberg University, Mainz

The BESIII experiment at the Institute of High Energy Physics, Chinese Academy of Sciences, 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.

Three pion final states (π+π-π0) of J/Ψ and Ψ' decays have been previously studied at several facilities. Despite the same final state, the Ψ' decay shows an unexpectedly low branching fraction and markedly different di-pion mass spectra and Dalitz distributions. One route to explaining these differences, which form the basis of the so-called '$\rho\pi$ puzzle', is to perform partial wave analysis (PWA) of both the J/Ψ and Ψ' decays, testing possible explanations through the intermediate meson states they predict.

The work presented will highlight the progress towards realising PWA of these channels on the BESIII data, and the tools and techniques being developed in Mainz for this purpose.

HK 2: Heavy Ion Collisions and QCD Phases I

Zeit: Montag 16:45–19:00 Raum: F 1

Gruppenbericht HK 2.1 Mo 16:45 F 1

Transverse momentum distributions of charged particles in pp and Pb–Pb collisions with ALICE at the LHC — •Julius Gronefeld for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt

ALICE is an experiment dedicated to the study of heavy-ion collisions at the LHC, with the aim of understanding the physics of the hot and dense deconfined medium produced such in collisions. Since the start of its second phase of running the LHC is delivering collision of protons and lead ions at the top energy of $\sqrt{s} = 13\,\text{TeV}$ for pp and $\sqrt{s_{\text{NN}}} = 5.02\,\text{TeV}$ for Pb–Pb collisions.

The study of inclusive charged particle spectra sheds light on parton energy loss in the medium leading to a suppression of hadron production at high transverse momentum (p_{T}). A common way to investigate this effect is the determination of the nuclear modification factor (R_{AA}) given by the ratio between a given p_{T} spectrum and a reference spectrum in pp collisions scaled by the number of binary collisions.

In this talk achievements in the analysis of transverse momentum distributions with ALICE are presented. A significant reduction of systematic uncertainties was achieved and furthermore newly developed techniques were applied to the analysis of data at $\sqrt{s_{\text{NN}}} = 2.76\,\text{TeV}$ taken in 2010. Spectra and R_{AA} will be shown in dependence of centrality. In addition the results will be compared to current models.

HK 2.2 Mo 17:15 F 1

Comparison of hydrodnamical and transport theoretical calculations for p+A and A+A collisions — •Kai Gallmeister, Harri Niemi, Carsten Greiner, and Dirk Rischke — Institut für Theoretische Physik, Goethe Universität Frankfurt am Main

The good agreement of calculations on the basis of dissipative hydrodynamics with experimental data for p+Pb collisions hints to a strong collective behavior and a fast equilibration. But already for heavy ion collisions large dissipative corrections are necessary within the calculations. By comparing hydrodynamical calculations with microscopical calculations with the transport theoretical Boltzmann solver BAMPS we explore the range of applicability of hydrodynamics to small systems.

HK 2.3 Mo 17:30 F 1

Performance of charged pions, kaons, protons and their antiparticles identification in the CBM experiment — •Viktor Klochkov[1,2] and Ilya Selyuzhenkov[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung — [2]Goethe University Frankfurt

The goal of the CBM experiment at FAIR is to investigate the properties of the dense baryonic matter. Among the key observables which are used to characterize the particle production in heavy-ion collisions are the charged particle spectra, anisotropic flow, and angular correlations. The particle mass ordering and flavor dependence provide an important information on the evolution of the created matter. A procedure for particle identification in centrality classes is developed for CBM. It is based on a Bayesian approach which allows for high-purity selection of charged pions, kaons, and protons using the correlation between the signal in the CBM time-of-flight (TOF) detector and the reconstructed particle momentum. The CBM performance for charged hadron identification is studied for Au-Au collisions simulated at different SIS-100 energies. The developed procedure can be further used to unfold the contribution to physics observables from individual identified hadrons in case of low purity.

Supported by Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe) and GSI Helmholtzzentrum für Schwerionenforschung.

HK 2.4 Mo 17:45 F 1

What do pions tell us about dynamics of heavy-ion collisions at SIS18 energies ? — •Malgorzata Gumberidze for the HADES-Collaboration — TU Darmsatdt, Germany

Pion production is the dominating inelastic process in nucleus-nucleus collisions. The production of pions in the SIS18 energy range (1-2 GeV per nucleon) proceeds primarily through the excitation and decay of baryonic resonances. In a baryon rich environment, therefore, pions serve as important messengers of the reaction dynamics.

In this contribution we present results of a study of charged pion production at SIS18 energies using the HADES spectrometer at GSI. The main focus will be on 40% most central Au(1.23 GeV per nucleon)+Au collisions. Our results contribute with an unprecedented statistics to systematic studies of pion production in heavy-ion collisions.

We have preformed a measurement of the transverse momentum distributions of $\pi^{\pm}$ mesons covering a fairly large rapidity interval. The yields, transverse mass, angular distributions and azimuthal emission patterns are compared with transport model calculations as well as wtih existing data from other experiments.

This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI, GSI.

HK 2.5 Mo 18:00 F 1

Transverse momentum distributions of charged-particles in pp collisions with ALICE at the LHC — •Edgar Perez Lezama for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt am Main — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

The charged-particle transverse momentum spectrum is an important observable for testing pQCD (perturbative QCD) calculations and serves as a reference for Pb-Pb collisions to study QGP bulk properties. The measurement of inclusive production of charged-particles in high-energy proton-proton collisions and its evolution with the event multiplicity is also a key observable to test models of particle production. In 2015, pp collisions at $\sqrt{s} = 13\,\text{TeV}$ and $\sqrt{s} = 5.02\,\text{TeV}$ were recorded using the ALICE detector at the LHC. With the increase in collision energy, the role of hard processes (parton scatterings with large momentum transfer) increases and offers the possibility to understand the interplay between soft and hard processes of particle production. The measurement of the charged-particle spectrum at 5.02 TeV is used in the construction of the nuclear modification factor (R_{AA}). In this talk, the transverse momentum distributions measured with ALICE at a collision energy of $\sqrt{s} = 13\,\text{TeV}$, $\sqrt{s} = 5.02\,\text{TeV}$ in pp collisions and the reanalysis of the data at $\sqrt{s} = 2.76\,\text{TeV}$ will be presented as well as comparisons to models and previous ALICE measurements.

HK 2.6 Mo 18:15 F 1

Performance studies for electron measurement with the CBM-TRD — •Etienne Bechtel — IKF,Frankfurt,Germany

A crucial performance aspect of the CBM-TRD is to achieve a sufficient pion suppression while maintaining a high electron efficency. This requires an adequate identification method and the likelihood method offers a comparable performance to the artifical neural network while at the same time allowing for a maximum of control and robustness. To employ this method one has to get very pure input information about the energy deposition of the particles inside the TRD. For electrons, this is done via careful topology cuts on photon conversions. We will present a simulation study of electron efficiencies, pion suppression and reconstruction efficiencies. Special attention is placed onto the study of intermediate mass di-leptons (1.5 GeV/c^2 < m_{inv} < 3.0 GeV/c^2), which deliver an important physics case for the CBM-TRD, since they potentially provide access to the study of thermal medium radiation. A prerequisite for these studies is a good electron identification at high momenta which is provided by the CBM-TRD.

HK 2.7 Mo 18:30 F 1

Studies of Isolated Photon Production in pp Collisions with ALICE — •Rene Schach — Institut für Kernphysik, Goethe Universität Frankfurt

Isolated photons at high transverse momenta are produced in hard-scattering processes in high-energy pp and heavy-ion collisions. Photon production in heavy-ion collisions is thought to scale by the underlying number of binary collisions times photo-production in pp collisions. Therefore the comparison of results from pp collisions to results from p-Pb and heavy-ion collisions functions as a test for these scaling properties and helps to interpret the isolated-photon spectra in p-Pb and heavy-ion collisions at the LHC.

Since isolated photons originate directly in parton-parton interactions, their measurement may also give insights to possible modifications of nuclear PDFs.

After a description of the analysis technique, the status of the isolated-photon measurement in pp collisions with the ALICE EMCAL will be presented. The cross sections of isolated photons for different collision energies and necessary corrections will be discussed.

Supported by BMBF and the Helmholtz Association.

HK 2.8 Mo 18:45 F 1

Feasibility Studies on a Nuclei Trigger using the ALICE-TRD — •Benjamin Brudnyj — Institut für Kernphysik, Goethe-Universität Frankfurt, Frankfurt am Main

At the Large Hadron Collider (LHC) at CERN significant production rates of light (anti-)(hyper-)nuclei have been measured in Pb–Pb collisions. The production of such nuclei has recently become a topic of high interest. For instance the measured lifetime of the lightest hypernucleus, the hypertriton (a bound state of a proton, a neutron and a Λ hyperon), is significantly below the expectation of state-of-the-art theory calculations which expect the lifetime to be very close to the Λ lifetime. Therefore, it is important to also measure these rare nuclei in p–p collisions.

Due to their short lifetime, only its decay products can be measured, e.g. the charged two body decay channel ${}^3_\Lambda\mathrm{H} \rightarrow {}^3\mathrm{He} + \pi^-$. In order to be able to measure these rare (anti-)fragments also in p–p and p–Pb collisions, it is essential to increase the statistics by employing a trigger on nuclei. Using the data on Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV it turned out that particles with $Z > 1$ in the TRD show a behavior that can be used to implement such a nuclei trigger.

In this talk the physics case of a nuclei trigger will be elaborated as well as the exctracted efficiencies and purities for the different light nuclei, i.e. (anti-)d, (anti-)t, (anti-)^{3}He and (anti-)^{4}He.

HK 3: Heavy Ion Collisions and QCD Phases II

Zeit: Montag 16:45–19:00 Raum: F 3

Gruppenbericht HK 3.1 Mo 16:45 F 3

Electromagnetic probes of hot and dense matter produced in Au+Au collisions at $E_{\mathrm{beam}} = 1.23A$ GeV. — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

Properties of hot and dense QCD medium formed in heavy-ion collisions can be extracted directly from its emissivity in electromagnetic sector. Excess of the low-mass lepton pairs has been measured in such collisions in energy regimes from SIS18 up to top RHIC. Substantial medium effects on light vector mesons is attributed to their coupling to baryons and anti-baryons.

HADES has contributed to this study in moderate temperature but high density region of the QCD phase diagram by measuring lepton pairs production in N+N, N+A, A+A, π+N and π+A at the SIS18 accelerator in GSI. The strong non-linear system size dependence of the excess yield over the experimentally established "cocktail" has been previously extracted from the C+C and Ar+KCl runs.

In this presentation an overview of the results on electromagnetic probes from high statistics Au+Au at $E_{\mathrm{beam}} = 1.23A$ GeV data will be provided. Virtual photon spectra will be confronted with results of other experiments as well as with available model predictions. The understanding of the emerging physical implications can be refined by looking at direct photon production and virtual photon flow. EM transitions of baryonic resonances measured directly in pion-induced reactions are pivotal input to model calculations.

This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI, GSI, HGS-HIRe and H-QM.

HK 3.2 Mo 17:15 F 3

Low-Mass Dielectron Measurements in pp, p–Pb and Pb–Pb Collisions with ALICE — •Theo Bröker for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The measurement of electron-positron pairs (dielectrons) in the low invariant mass region allows to study the vacuum and in-medium properties of light vector mesons. Additionally, dielectrons from semileptonic decays of correlated heavy quark mesons carry information on the heavy-flavour production in the different collision systems. To quantify modifications of the dielectron production in Pb–Pb collisions, measurements in pp collisions serve as a reference, while the analysis of p–Pb collisions allows to disentangle cold from hot nuclear matter effects. During RUN1 at the LHC, studies of dielectron production in pp, p–Pb and Pb–Pb collisions have been performed.

In this talk, we present the dielectron invariant mass and transverse momentum distributions in pp collisions at $\sqrt{s} = 7$ TeV, p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV and Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. Supported by BMBF.

HK 3.3 Mo 17:30 F 3

Constraining HF production mechanisms with dielectrons — •Anisa Dashi for the ALICE-Collaboration — Technische Universität München, Exzellenzcluster Universe, Boltzmannstr. 2, D-85748 Garching

The continuum of electron-positron pairs, produced in heavy ion collisions, provides an excellent probe of quark-gluon plasma (QGP) formation. Since dielectron pairs are produced by different processes at all stages of the collision, their invariant mass spectrum contains various contributions, e.g. the intermediate mass region (1.2 to 2.8 GeV/c) is dominated by correlated semileptonic decays of open heavy flavour. From modifications of this region one can gain information about the effects of QGP on heavy quarks. This requires first, however, a good understanding of the relevance of the various heavy quarks production mechanisms. Heavy quarks are produced in leading order back to back through flavour creation in the initial hard scattering processes of the collision, but also higher order processes like flavour excitation and gluon splitting contribute to their production. This talk presents Monte Carlo simulation studies which aim to the separation of the different heavy flavour production mechanisms exploiting their different angular correlation in order to better understand their contribution to the dielectron mass spectrum. The analysis is performed for proton-proton collisions at 7 TeV, since a study of dielectrons in these collisions provides a crucial reference for the heavy ion data.

This work is supported by BMBF-FSP 202 and the Excellence Cluster Universe.

HK 3.4 Mo 17:45 F 3

Spectral Functions from the FRG beyond the Local Potential Approximation — •Alexander Stegemann[1], Ralf-Arno Tripolt[2], Lorenz von Smekal[3], Dirk-Hermann Rischke[1], and Jürgen Eser[1] — [1]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität Frankfurt am Main, Germany — [2]European Center for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy — [3]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, Germany

The Functional Renormalization Group (FRG) represents a powerful non-perturbative method in order to describe strongly interacting theories like Quantum Chromodynamics (QCD) at finite temperature and chemical potential. Furthermore, it allows for an analytic continuation from imaginary to real time on the level of the flow equations. By this way, it is possible to calculate real-time quantities like spectral functions.

We apply this method to the two-flavour Quark-Meson Model (QMM) in order to study the chiral phase transition as well as mesonic spectral functions. In the Local Potential Approximation (LPA), which is the lowest order truncation of the derivative expansion, discrepancies between the pion pole and curvature masses are observed. We present calculations in LPA′, which incorporates scale-dependent wave function renormalization factors, and discuss their influence on the phase diagram as well as on the mesonic spectral functions.

HK 3.5 Mo 18:00 F 3

Non-equilibrium dilepton production in hadronic transport approaches — •Jan Staudenmaier[1,2], Janus Weil[2], and Hannah Petersen[1,2,3] — [1]Goethe Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung

In this talk the non-equilibrium dilepton production from a hadronic transport approach (SMASH) is presented. The dilepton emission from the hadronic stage is of interest for current HADES results measured at GSI in the beam energy range from 1.25 - 3.5 GeV. Also at high collision energies (RHIC/LHC) the later dilute stages of the reaction are dominated by hadronic dynamics.

First, the employed hadronic transport approach called SMASH (=Simulating Many Accelerated Strongly-interacting Hadrons) is introduced. The main contribution to the dilepton spectra in the low energy regime of GSI/FAIR/RHIC-BES originates from resonance decays. Treatment and results of the dilepton production with SMASH are shown, together with a comparison to HADES data.

Furthermore, the possibility of employing the non-equilibrium dilepton production from a hadronic transport approach combined with a hydrodynamic approach (hybrid model) to describe spectra for high collision energies (RHIC/LHC) is explored.

HK 3.6 Mo 18:15 F 3

Elliptic flow of virtual photons — •Dominique Dittert for the HADES-Collaboration — TU Darmstadt

The HADES at SIS18 (GSI, Darmstadt) investigates strongly interacting matter at high net-baryon densities and moderate temperatures, which resembles properties of QCD matter as they might exist in the interior of compact stellar objects. Virtual photons, that decay into dileptons, are penetrating probes which directly access the entire space-time-evolution of the fireball and escape from the collision zone without further interactions. Thus they provide unique information about the various stages of the collision. In non-central collisions the initial spatial eccentricity of the nuclear overlap region transforms into momentum anisotropies through the action of azimuthally anisotropic pressure gradients. The most dominant contribution to this anisotropic flow is the second fourier harmonic v_2, the elliptic flow. The combined dependence of elliptic flow of dileptons on their transverse momentum and their invariant mass provides a rich landscape of structures, which allows to set the observational window on specific stages of the fireball evolution. First measurements of elliptic flow of dileptons at RHIC were just recently published by the STAR collaboration. To complement their results in the low mass region, the HADES experiment steps in. In this contribution the preliminary results on azimuthal anisotropy of e^+e^- excess radiation measured in Au+Au collisions at $\sqrt{s_{NN}} = 2.4GeV$ will be presented. The extracted v_1 and v_2 components of dileptons with $M_{ee} < 150MeV/c^2$ will be compared to the results obtained for the charged pions.

HK 3.7 Mo 18:30 F 3

Measurement of low-mass dielectrons in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Ivan Vorobyev for the ALICE-Collaboration — Technische Universität München, Excellence Cluster Universe

Low-mass dielectrons are a unique experimental tool to investigate the hot and dense medium created in ultra-relativistic heavy-ion collisions. Since they are created during all stages of the collision and do not interact strongly, they carry information about the medium properties unperturbed by strong final-state effects allowing us to probe the whole space-time evolution of the system.

Measurements of dielectron production in pp collisions serves as important vacuum reference to quantify modifications observed in heavy-ion collisions. It also provides complementary information on heavy-flavour production via correlated semi-leptonic decays. Recent studies of pp collisions with high charged-particle multiplicities showed surprising results similar to the observations previously seen in heavy-ion collisions. Measurements of low-mass dielectrons could provide additional information regarding the underlying physics processes.

In this talk we present the current status of the dielectron analysis with ALICE central barrel in pp collisions at a centre-of-mass energy of 13 TeV. A particular focus of the discussion will be put on the dielectron production in pp collisions collected with a trigger on high charged-particle multiplicities.

This work is supported by BMBF and the DFG cluster of excellence "Origin and Structure of the Universe".

HK 3.8 Mo 18:45 F 3

Results from a low-field pilot run dedicated for dielectron measurements in pp collisions at 13 TeV with ALICE — •Jerome Jung for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

Low-mass dielectrons are an important probe for the hot and dense medium which is created in ultrarelativistic heavy-ion collisions. Since leptons do not interact strongly, they carry information from all collision stages with negligible final-state interaction.

The ALICE detector is well-suited to perform this measurement due to its excellent tracking and particle identification capabilities at very low momenta. However, Dalitz decays and photon conversions lead to a high combinatorial background. A detector configuration with reduced magnetic field increases their reconstruction probability allowing to exclude them from the analysis. Additionally, it also provides the opportunity to increase the accessible phase space of the dielectron measurement.

Such a configuration is planned for the Pb-Pb data taking in LHC Run 3. A successful pilot run using pp collisions was done and is used to adapt and develop analysis techniques. We will present first results of the dielectron measurement in pp collisions at $\sqrt{s}$ = 13 TeV with the low-field configuration and compare it to reference data with the nominal field to show its benefits.

HK 4: Structure and Dynamics of Nuclei I

Zeit: Montag 16:45–18:30 Raum: F 2

Gruppenbericht HK 4.1 Mo 16:45 F 2

Measurements of total reaction cross sections in neutron-rich Sn isotopes at R^{3}B - A method to constrain the EOS — •Fabia Schindler[1,2], Thomas Aumann[1,2], Konstanze Boretzky[2], Andrea Horvat[1,2], Philipp Schrock[3], and Jacob Johansen[4] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum — [3]CNS, University of Tokyo — [4]Aarhus University

Nuclei with a large neutron excess are expected to form a neutron-rich surface layer which is often referred to as the neutron skin. The investigation of this phenomenon is of great interest in nuclear-structure physics and offers a possibility to constrain the equation-of-state (EOS) of neutron-rich matter. Due to the short-range nature of the nuclear interaction, nuclear-induced reactions are a good tool to probe nuclear sizes. Measured reaction cross sections can be used to constrain the density distributions of protons and neutrons in the nucleus and therefore the neutron-skin thickness.

Total reaction, charge changing, and neutron-removal cross sections of neutron-rich tin isotopes in the mass range from A=124 to A=134 have been measured on carbon targets at the R3B setup at GSI in inverse kinematics and, for the first time, with very large acceptance and in a kinematically complete manner. The measurements are compared to calculations based on different energy-density functionals and the impact on the neutron-skin thickness and key parameters of the EOS will be discussed.

This work is supported by HIC for FAIR, NAVI, the GSI-TU Darm-

stadt cooperation, and the BMBF project 05P15RDFN1.

HK 4.2 Mo 17:15 F 2

Systematics of the Electric Dipole Response in Stable Tin Isotopes* — •Sergej Bassauer[1], Peter von Neumann-Cosel[1], and Atsushi Tamii[2] for the E422-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany — [2]Research Center for Nuclear Physics, Osaka 567-0047, Japan

The electric dipole is an important property of heavy nuclei. Precise information on the electric dipole response provides information on the electric dipole polarisability which in turn allows to extract important constraints on neutron-skin thickness in heavy nuclei and parameters of the symmetry energy. The tin isotope chain is particularly suited for a systematic study of the dependence of the electric dipole response on neutron excess as it provides a wide mass range of accessible isotopes with little change of the underlying structure. Recently an inelastic proton scattering experiment under forward angles including 0° on ^{112,116,124}Sn was performed at the Research Centre for Nuclear Physics (RCNP), Japan with a focus on the low energy strength and polarisability. In this talk first results and further analysis plans will be discussed.

*Gefördert durch die DFG im Rahmen des SFB 1245.

HK 4.3 Mo 17:30 F 2

Dipole polarizability of neutron rich tin isotopes — •Andrea Horvat[1,2], Thomas Aumann[1,2], Konstanze Boretzky[2], Dominic Rossi[1,2], Fabia Schindler[1,2], Philipp Schrock[3], and Dmytro Symochko[1] for the R3B-Collaboration — [1]TU Darmstadt, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany — [3]CNS, University of Tokyo, Japan

Collective excitation modes in neutron rich nuclei contain valuable information about the isospin dependence of the nuclear equation of state (EOS). A key observable in this regard is the dipole polarizability, a quantity shown be strongly related to the EOS slope parameter L.

To this purpose an experimental campaign aimed at measuring the dipole response of the neutron rich side of the tin isotopic chain ($^{124-132}$Sn) has been conducted at GSI Helmholtzzentrum für Schwerionenforschung. The method used was relativistic Coulomb scattering in inverse kinematics. The present status of the analysis will be presented.

This work is supported by the BMBF project 05P15RDFN1 and the GSI-TU Darmstadt cooperation.

HK 4.4 Mo 17:45 F 2

Observation of single-particle nature of the low-lying E1 strength in ^{120}Sn — •Michael Weinert, Michelle Färber, Miriam Müscher, Simon G. Pickstone, Mark Spieker, Julius Wilhelmy, Sarah Prill, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne.

A ^{119}Sn(d,pγ) experiment was performed using the combined setup SONIC@HORUS at the 10 MV FN Tandem accelerator in Cologne. The excitation of states in the region of the Pygmy Dipole Resonance (PDR) via this neutron-transfer reaction was investigated in detail. The setup consisted of 14 HPGe and 6 ΔE-E silicon telescope detectors, allowing an offline selection of excitation and deexcitation channels due to the coincident detection of γ-rays and charged particles. Data show a clear excitation of states in the PDR region and several states in this region were identified as J=1 states by comparison to data from a Nuclear Resonance Fluorescence (NRF) experiment. Individual branching ratios could be determined, shedding more light on the internal structure of the PDR. By normalizing the relative excitation in the (d,pγ) reaction to the B(E1) values extracted from NRF, a splitting into two groups of states seems evident, which might hint at a different single-particle character of these groups. This contribution will present the (d,pγ) experiment and all observables determined. Furthermore, results will be put into context by comparison to data from other experiments, i.e., NRF and (p,p') experiments.

Supported by DFG (ZI 510/7-1). J.W. and S.P. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 4.5 Mo 18:00 F 2

Soft-dipol excitation in neutron-rich Sn-isotopes — •Joachim Tscheuschner and Thomas Aumann for the DALI-LaBr-RIBF-Collaboration — TU Darmstadt

To investigate the pygmy-dipole resonance (PDR) in the unstable Sn-128 and Sn-132 isotopes, an alpha-scattering experiment was performed at RIKEN, Japan. The photons of the excited states are measured with a high efficiency detector-array consisting of NaI crystals (DALI2) and in forward-directions large volume LaBr crystals (HECTOR). With alpha-scattering mainly the isoscalar modes are excited, through comparison with Coulomb-excitation it is possible to disentangle the isovector and the isoscalar part of the PDR. The aim of the experiments is to study the the development of the PDR as a function of the neutron-excess. In this contribution the experiments and results of the ingoing analysis are presented. This project is supported by by DFG (SFB1245).

HK 4.6 Mo 18:15 F 2

Measurement of the E1 Strength in ^{112}Sn with NEPTUN — •Diego Semmler[1], Thomas Aumann[1,2], Martin Baumann[1], Michael Beckstein[1], Yevhen Kozymka[1], Philipp Kuchenbrod[1], Norbert Pietralla[1], Heiko Scheit[1], Saket Suman[1], Dmytro Symochko[1], and Sebastian Vaupel[1] — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany

The low energy photon tagger NEPTUN at the S-DALINAC delivers a quasi-monoenergetic photon beam between about 1 MeV and 20 MeV with a resolution of approximately 25 keV. In this talk results from (γ,γ')-reactions in the commissioning with ^{32}S and the first measurement with ^{112}Sn targets will be presented. An excitation energy range from 7.6 MeV to 9.6 MeV has been covered.

This measurement helps to understand the discrepancy observed in the data on E1 strength distribution obtained in recent NRF [1] and (p, p') scattering [2] experiments. It shows that experiments with (quasi-)monochromatic γ-beams are required in this energy regime.

Supported by DFG (CRC 1245)

[1] B. Özel-Tashenov et al. "Low-energy dipole strength in ^{112,120}Sn". In: Physical Review C 90 (2014)

[2] A. M. Krumbholz et al. "Low-energy electric dipole response in ^{120}Sn". In: Physics Letters B 744 (2015), pp. 7 – 12

HK 5: Nuclear Astrophysics I

Zeit: Montag 16:45–19:00 Raum: F 33

Gruppenbericht HK 5.1 Mo 16:45 F 33

Nuclear Astrophysics Experiments in Cologne — •Philipp Scholz, Julia Becker, Felix Heim, Jan Mayer, Mark Spieker, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Nuclear reaction cross sections are one of the main ingredients for the understanding of nucleosynthesis processes in stellar environments. For isotopes heavier than those in the iron-peak region, reaction rates are often calculated using the Hauser-Feshbach statistical model. The accuracy of the predicted cross sections strongly depend on the uncertainties of the nuclear-physics input-parameters. These are nuclear-level densities, γ-strength functions, and particle+nucleus optical-model potentials.

The precise measurement of total and partial reaction cross sections at sub-Coulomb energies and their comparison to statistical model calculations are used to constrain or exclude different nuclear-physics models.

This talk is going to introduce experimental methods and present recent experiments performed at the Cologne 10 MV FN-Tandem accelerator and the high-efficiency HORUS γ-ray spectrometer.

Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 5.2 Mo 17:15 F 33

Recent Progress on hydrogen and helium burning at the LUNA underground accelerator — •Daniel Bemmerer[1] and Klaus Stöckel[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf

(HZDR), Dresden, Germany — [2]TU Dresden, Germany

In-beam radiative-capture experiments at low astrophysical energies require experiments in ultra-low background conditions. The Laboratory for Underground Nuclear Astrophysics (LUNA) 0.4 MV accelerator at INFN Gran Sasso, Italy, is so far the only underground ion accelerator in the world. Recent progress at LUNA regarding the ^{22}Ne(p,γ)^{23}Na [1,2], ^{22}Ne(α,γ)^{26}Mg, and ^{17}O(p,α)^{14}N [3] reactions will be reviewed. The project for the new, 3.5 MV LUNA-MV accelerator is on track and will be summarized.

[1] F. Cavanna *et al.*, Phys. Rev. Lett. 115, 252501 (2015)
[2] R. Depalo *et al.*, Phys. Rev. C 94, 055804 (2016)
[3] C.G. Bruno *et al.*, Phys. Rev. Lett. 117, 142502 (2016)

HK 5.3 Mo 17:30 F 33

Studien zur Nukleosynthesereaktion $^{12}C(\alpha,\gamma)^{16}O$ in inverser Kinematik am MAGIX-Experiment bei MESA — •Stefan Lunkenheimer für die MAGIX-Kollaboration — Institut für Kernphysik der Universiät Mainz

MAGIX ist ein vielseitig einsetzbares Fixed-Target Experiment, welches am neuen Beschleuniger MESA (Mainz Energy-Recovering Superconducting Accelerator) in Mainz eingesetzt werden soll. Dieser wird in wenigen Jahren in Betrieb genommen und ermöglicht es, mit Hilfe der Energierückgewinnung einen sehr hohen Teilchenstrom ($\sim 1\,$mA) im Bereich von ein paar wenigen MEV bis zu 105 MeV zu erreichen. In Kombination mit dem internen Gas-Target von MAGIX kann so eine Luminosität von $\mathcal{O}(10^{35}\,\text{cm}^{-2}\text{s}^{-1})$ erreicht werden. Dies erlaubt es Experimente mit kleinen Impulsüberträgen durchzuführen und eröffnet somit ein reiches physikalisches Programm.

In diesem Vortrag wollen wir auf die geplanten Messungen der Nukleosynthese $^{12}C(\alpha,\gamma)^{16}O$ in inverser Kinematik zur Bestimmung des zugehörigen S-Faktors eingehen. Im Experiment werden Elektronen bei kleinen Impulsüberträgen an Sauerstoff gestreut. Anschließend können über die Detektion des gestreuten Elektrons und des emittierten α-Teilchens der Wirkungsquerschnitt in Abhängigkeit der Schwerpunktsenergie gemessen werden, um den S-Faktor bestimmen zu können. Erste Simulationen geben einen Eindruck über den möglichen Parameterbereich dieser Messung bei MAGIX. In diesem Beitrag werden neben den physikalischen Prozessen die Methoden der Simulation dargestellt und die Ergebnisse diskutiert.

HK 5.4 Mo 17:45 F 33

Explosive Nucleosynthesis in 2D Core-Collapse Supernovae and the Origin of the p-Nuclei ^{92,94}Mo and ^{96,98}Ru — •Marius Eichler — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Deutschland

Core-collapse supernovae (CCSNe) are the first polluters of heavy elements in the galactic history. As such, it is important to study the nuclear compositions of their ejecta, and understand their dependence on the progenitor structure (e.g., mass, compactness, metallicity). Here, we present a detailed nucleosynthesis study based on two long-term 2D CCSN simulations of a 11.2 $M_\odot$ and a 17.0 $M_\odot$ star. We find that in both models nuclei well beyond the iron group nuclei can be produced, and discuss in detail the nucleosynthesis of the p-nuclei ^{92,94}Mo and ^{96,98}Ru. While we observe the production of ^{92}Mo and ^{94}Mo in slightly neutron-rich conditions in both simulations, ^{96,98}Ru can only be produced efficiently via the νp-process. This disentanglement of production mechanisms has interesting consequences when comparing to the abundance ratios between these isotopes in the solar system and in presolar grains.

HK 5.5 Mo 18:00 F 33

Bypassing ^{56}Ni: a new ^{55}Ni(p,γ) rate and its implications on the rp-process — •Christoph Langer[1,2], Wei Jia Ong[2], Fernando Montes[2], and Hendrik Schatz[2] for the e11024-Collaboration — [1]Goethe University Frankfurt a. M. — [2]NSCL, Michigan State University

The observed light curve emitted during an X-Ray burst is predominantly shaped by details of the rapid proton capture process (rp process). A major waiting point is ^{56}Ni. Processing beyond this important isotope is very sensitive to the temperature and density conditions during the burst. In this work we present a possibility to efficiently bypass ^{56}Ni by processing along the $N = 27$ isotones up to the dripline. Here, the ^{55}Ni(p,γ)^{56}Cu reaction rate is important. The rate is dominantly determined by proton capture into states just above the proton separation threshold of ^{56}Cu. For the first time, we reconstructed the low-lying level scheme of ^{56}Cu using the powerful next-generation γ-ray array GRETINA in conjunction with the S800 spectrograph at the NSCL at MSU. This talk will present the results and discuss the impact on the rp process using detailed network calculations for realistic burst conditions.

This work benefited from support by the National Science Foundation under Grant No. PHY-1430152 (JINA Center for the Evolution of the Elements).

HK 5.6 Mo 18:15 F 33

Constraining the rp-process by measuring ^{23}Al(d,n)^{24}Si with GRETINA and LENDA at NSCL — •Clemens Wolf[1], Christoph Langer[1], Fernando Montes[2], and Jorge Pereira[2] for the e15226-Collaboration — [1]Goethe University Frankfurt — [2]NSCL

The ^{23}Al(p,γ)^{24}Si stellar reaction rate has a significant effect on the light-curve emitted in X-Ray bursts. The reaction rate is mainly determined by the properties of the direct capture as well as low-lying 2^+ states and a possible 4^+ state. Up to now the properties of these states have not been determined precisely enough. Our new approach was to study the surrogate reaction ^{23}Al(d,n) at 47 AMeV at NSCL. We used the GRETINA array to detect the γ-rays following the de-excitation of the reaction products in conjunction with the LENDA array to detect the recoiling neutrons and the S800. These information will be used to determine the urgently needed properties of the ^{24}Si.

This work benefited from support by the National Science Foundation under Grant No. PHY-1430152 (JINA Center for the Evolution of the Elements). The research leading to these results has received funding from the European Research Council under the European Unions's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 615126.

HK 5.7 Mo 18:30 F 33

Astrophysics with storage rings: ^{124}Xe beam at ESR — •Zuzana Slavkovská[1,2], Jan Glorius[1,2], and Christoph Langer[1,2] for the E108B-Collaboration — [1]Goethe University Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The astrophysically motivated reaction ^{124}Xe(p,γ) was examined at the Experimentier-Speicherring (ESR) at the GSI in Darmstadt in June 2016.

For the first time it was possible to measure proton capture cross sections down to the Gamow window of the p-process using a storage ring. A ^{124}Xe beam reacted with a hydrogen gas jet target at five different energies between 5.5 AMeV and 8 AMeV. A newly designed double-sided silicon strip detector (DSSSD) placed directly into the ultrahigh vacuum of the ESR was used to detect the reaction products.

In this talk the experimental set-up and method as well as the first results of the beamtime will be presented.

This project is supported by BMBF-CRYRING, HGS-HIRe, HIC for FAIR and GSI-F&E.

HK 5.8 Mo 18:45 F 33

First results of total and partial cross-section measurements of the ^{107}Ag(p,γ)^{108}Cd reaction. — •Felix Heim, Julia Becker, Jan Mayer, Philipp Scholz, Mark Spieker, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The γ process is assumed to play an important role in the nucleosynthesis of the majority of the p nuclei. Since the network of the γ process includes so many different reactions and - mainly unstable - nuclei, cross-section values are predominantly calculated in the scope of the Hauser-Feshbach statistical model. The values heavily depend on the nuclear physics input-parameters. The results of total and partial cross-section measurements are used to improve the accuracy of the theoretical calculations. In order to extend the experimental database the ^{107}Ag(p,γ)^{108}Cd reaction was studied via the in-beam method at the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne. Proton beams with energies between 3.5 and 5.0 MeV were provided by the 10 MV FN-Tandem accelerator. In this talk, first results on total and partial cross sections will be presented.

Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 6: Instrumentation I

Zeit: Montag 16:45–19:00 Raum: F 072

HK 6.1 Mo 16:45 F 072

Pulse Shape Analysis with AGATA using coincident γ-ray detection after e^+/e^- annihilation — •Lars Lewandowski and Peter Reiter for the AGATA-Collaboration — Institut für Kernphysik Köln

The γ spectrometer AGATA is a tracking array consisting of position sensitive, highly segmented HPGe detectors. The gamma ray tracking GRT is based on the pulse shape analysis PSA of the digital signals of the 36 segments and the central electrode. The PSA provides the interaction position within the segments by comparing the measured signals with simulations. To investigate and improve the position resolution a reliable method to determine the performance of the PSA is necessary. Therefore, a measurement with ^{22}Na, that decays by emission of a positron, was performed. The two 511 keV γ rays, that are emitted in an angle of 180 degree after e^+/e^- annihilation, were detected in coincidence. In combination with the known annihilation position this provides a measure for the position resolution of the two detected γ rays. This method was used to improve the performance of the PSA, including a new way to calculate the figure of merit that is used to compare measured and simulated signals. Supported by the German BMBF (05P12PKFNE TP4)

HK 6.2 Mo 17:00 F 072

Numerical correction methods of neutron damage in position-sensitive HPGe detectors — •R. Hetzenegger, B. Birkenbach, B. Bruyneel, P. Reiter, J. Eberth, H. Hess, R. Hirsch, L. Lewandowski, and A. Vogt — IKP, Universität zu Köln

The Advanced GAmma Tracking Array (AGATA) is a major γ-ray spectrometer mainly for nuclear structure studies. AGATA is based on the novel technique of γ-ray tracking in electrically segmented high-purity Ge crystals. The array is currently employed at the Grand Accélérateur National d'Ions Lourds (GANIL, France) in stable-beam experiments with high count rates. Fast neutrons are emitted after almost any nuclear reaction with projectile energies above the Coulomb barrier. These neutrons generate crystal defects by dislocating Ge atoms. Dislocations act as hole traps within the HPGe material, causing a reduced charge collection efficiency, observed as a left tailing in the energy-peak shapes. The crystals can recover from neutron damage by annealing. However, for practical reasons, this treatment cannot be applied after every experiment. Recently, two software-based methods were developed employing pulse-shape analysis (PSA) to minimize the trapping effects between consecutive scheduled annealings of the HPGe crystals. Both approaches employ the position sensitivity of the HPGe detectors and determine the neutron trapping contribution for charge collection after individual γ-ray interactions. Energy resolution and line shape of neutron-damaged detectors are improved dramatically. Results and perspectives on neutron-damage corrections are presented. Supported by German BMBF 05P12PKFNE TP4 and 05P15PKFN9.

HK 6.3 Mo 17:15 F 072

Characterisation and pulse shape discrimination of a SAGe Well detector for future germanium based double beta decay experiments — •Thomas Wester for the GERDA-Collaboration — Institut für Kern- und Teilchenphysik, TU Dresden

The search for the neutrinoless double beta ($0\nu\beta\beta$) decay is a very active field in modern neutrino physics. An observation would come hand in hand with lepton number violation and provides valuable information about the neutrino mass mechanism.

The GERDA experiment searches for the $0\nu\beta\beta$ decay in ^{76}Ge by operating an array of isotopically enriched germanium detectors in a liquid argon cryostat. The background level achieved in Phase II of about 10^{-3} cts/(keV·kg·yr) is the lowest in the field of $0\nu\beta\beta$ experiments. By employing BEGe detectors with a small anode geometry, a big improvement in background reduction was achieved with respect to Phase I. They provide an excellent pulse shape discrimination of surface and high energetic gamma ray background.

Small Anode Germanium (SAGe) Well detectors as manufactured by Canberra combine the small anode technology of BEGe detectors with a much larger volume. This makes them an excellent choice for future germanium based $0\nu\beta\beta$ experiments with source masses exceeding 100 kg.

This talk presents the characterisation and pulse shape discrimination potential of a SAGe detector currently operated in the Felsenkeller underground laboratory in Dresden.

HK 6.4 Mo 17:30 F 072

Status of the Development of a HPGe-BGO Pair Spectrometer for ELI-NP — •Ilja Homm, Alexander Ignatov, Stoyanka Ilieva, and Thorsten Kröll — Technische Universität Darmstadt, Darmstadt, Germany

At the moment, the new european research facility called ELI-NP (The **E**xtreme **L**ight **I**nfrastructure - **N**uclear **P**hysics) is being built in Bucharest-Magurele, Romania. It is one of three parts of the ELI project and offers applications for the investigation of questions concerning nuclear physics. ELI-NP offers unprecedented opportunities for photonuclear reactions with high intensity, brilliant and fully polarized photon beams at energies up to 19.5 MeV.

The 8 HPGe (**H**igh-**P**urity **Ge**rmanium) CLOVER detectors of ELIADE (**ELI**-NP **A**rray of **DE**tectors) with four crystals each and high resolution are important components for the gamma spectroscopic study of photonuclear reactions. These detectors are surrounded by standard anti-Compton shields (AC shield). We investigate the possibility to operate for two of the ELIADE CLOVERS an advanced version of an AC shield as escape γ-rays pair spectrometers to extend the high-resolution spectroscopy to photon energies of several MeV where the pair production process dominates. The main tasks in this work are to develop and test such an AC shield: a pair spectrometer with BGO and CsI(Tl) crystals with APD (avalanche photodiode) or SPM (silicon photomultiplier) readout. The results of prototype testing are reported.

This work is supported by the German BMBF (05P15RDENA).

HK 6.5 Mo 17:45 F 072

First performance results of the BGO prototype for the MINIBALL spectrometer — •Dawid Rosiak, Peter Reiter, Jürgen Eberth, Herbert Hess, Iolanda Matea, and Christine LeGalliard — Institut für Kernphysik, Universität zu Köln

The successful HIE-ISOLDE upgrade at CERN with higher beam energies and intensities increases the experimental potential for reaccelerated radioactive ion beams. Direct- and fusion-evaporation reactions will allow access to states at high excitation energies and higher angular-momentum. The existing MINIBALL γ-ray spectrometer was designed for best solid-angle coverage, resulting in high γ-ray efficiency for low-multiplicity events. In order to cope with higher γ-ray multiplicities the MINIBALL triple cluster detectors will be surrounded with BGO Compton-suppression detectors to reject events from scattering of γ radiation between detectors from high energetic γ-rays and multiple hits. After advanced Monte-Carlo studies a BGO prototype was developed and built in collaboration with the IPN Orsay. Mechanical test of the BGO detector as well as for the PMTs and the electronics started in Orsay. A prototype BGO shield was mounted around a MINIBALL triple cluster in Cologne. First results, especially for the crucial Peak-to-total ratio, were obtained from measurements with γ-ray sources.

HK 6.6 Mo 18:00 F 072

Bayes-Tracking – A new Approach to Gamma-Ray Tracking — •Philipp Napiralla[1], Christian Stahl[1], Herbert Egger[2], Michael Reese[1], and Norbert Pietralla[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]AG Numerik und wissenschaftliches Rechnen, TU Darmstadt

A new mathematical approach to the Gamma-Ray tracking with position-sensitve HPGe detectors using Bayesian inference is presented and the necessary mathematical background is explained. Using data from a simple HPGe detector simulation, the performance of this new Gamma-Ray Tracking algorithm, called Bayes-Tracking, is shown. A comparison between tracked and raw detector data is given. In addition, all necessary improvements of the current version of the Bayes-Tracking are illustrated. Supported by BMBF 05P15RDFN1 - TP9 (Experiment).

HK 6.7 Mo 18:15 F 072

Radiation Damage Caused by Neutron Capture in Boron Doped Silicon Pixel Sensors — •Benjamin Linnik, Tobias Bus,

Michael Deveaux, Dennis Doering, and Ali Yazgili for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

CMOS Monolithic Active Pixel Sensors (MAPS) are considered as an emerging technology in the field of charged particle tracking. They will be used in the vertex detectors of experiments like STAR, CBM and ALICE and are considered for the ILC and the tracker of ATLAS. In those applications, the sensors are exposed to sizeable radiation doses. While the tolerance of MAPS to ionizing radiation and fast hadrons is well known, the damage caused by thermal neutrons was so far not studied in detail. Those neutrons initiate nuclear fission of ^{10}B dopants found in the P-doped silicon forming the active medium of MAPS. This effect can be expected to increase radiation damage beyond the predictions of the NIEL (Non Ionizing Energy Loss) model for pure silicon. We estimate this effect by calculating the additional NIEL created by the fission fragments. Moreover, we show first measured data for CMOS sensors, which were irradiated with cold (1.8 meV) neutrons. The empirical results contradict the prediction of the updated NIEL model both, qualitatively and quantitatively: The sensors irradiated with slow neutrons show an unexpected and strong acceptor removal, which is not observed in sensors irradiated with 1 MeV neutrons.

*This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 6.8 Mo 18:30 F 072

Aging of recent lifetime enhanced Microchannel-Plate Photomultipliers — •Markus Pfaffinger, Merlin Böhm, Rafael Frytz, Albert Lehmann, Daniel Miehling, Samuel Stelter, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut , Universität Erlangen-Nürnberg

At the PANDA experiment at the new FAIR facility two DIRC detectors will be used for particle identification. The focal plane of the detectors will be located inside a magnetic field of >1 Tesla. Microchannel-Plate Photomultipliers (MCP-PMTs) are the favored sensors for the detection of the Cherenkov photons. As the lifetime is a known caveat this has has to be carefully tested and optimized. The quantum efficiency (QE) is an indicator of the MCP-PMT lifetime. The QE may decrease because of aging processes taking place at the photo cathode (PC) till the sensor is "blind". The aging process is mainly caused by feedback ions from the residual gas in the MCP-PMT, which may damage the PC on impact. The QE degradation is correlated to the integrated anode charge (IAC) having been measured in the sensor. With the Erlangen lifetime setup new MCP-PMTs are being illuminated and their IAC is monitored. In time intervals of a few weeks the spectral QE is measured and full surface QE scans are made every few months. This talk will present the current status of the measurement systems and the latest results, especially of the most recent 2 inch MCP-PMTs from Hamamatsu and Photonis. IACs of >>5 C/cm^2 were obtained with no or only minor declines of the QE. This is sufficient for the PANDA DIRCs. - Funded by BMBF and GSI -

HK 6.9 Mo 18:45 F 072

Read-Out Resilience in Radiation Environments — •Andrei-Dumitru Oancea and Udo Kebschull for the CBM-Collaboration — IRI , Geothe-Universität Frankfurt, Germany

In a radiation environment it is only a question of time until single-event effects cause an alteration in the firmware of Read-Out Board FPGAs, which ultimately leads to data loss due to the malfunction of the affected boards. To combat this, we are developing an autonomous concept that ensures that all boards are continuously monitored, quickly repairs errors in the firmware, and re-integrates boards that needed a reset into the read-out chain to minimize the downtime caused by radiation effects. The approach is furthermore free of flash technology, since flash memories will limit the longevity of the involved electronics due to low Total Ionizing Dose.

The developed approach works for Xilinx 7-Series FPGAs and is based on the GBTX chain (CERN), which was designed for radiation-hard data and slow control links in high-energy physics experiments. It utilizes the GBT-SCA, which is a slow control adapter ASIC for programming FPGAs and repair erroneous FPGA configuration frames via selective frame scrubbing on-demand, but only in case the errors cannot be fixed via the internal autonomous SECDED mechanism, which is the advantageous feature of 7-Series FPGAs. The developed concept is scalable for multiple firmwares running on multiple FPGAs.

HK 7: Instrumentation II

Zeit: Montag 16:45–18:45 Raum: F 073

Gruppenbericht HK 7.1 Mo 16:45 F 073

Measurements with neutrons and photons at nELBE — •Roland Beyer[1], Mirco Dietz[1,2], Axel Frotscher[1,2], Joachim Görres[3], Arnd R. Junghans[1], Toni Kögler[1,2], Ralf Nolte[4], Uwe Oberlack[5], Elisa Pirovano[1,6], Arjan Plompen[6], Rene Reifarth[7], Ronald Schwengner[1], Sebastian Urlass[1,2], and Andreas Wagner[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany — [2]Technische Universität, Dresden, Germany — [3]University of Notre Dame, Notre Dame, IN, USA — [4]Physikalisch Technische Bundesanstalt, Braunschweig, Germany — [5]Johannes Gutenberg Universität, Mainz, Germany — [6]EC Joint Research Centre, Geel, Belgium — [7]Goethe Universität, Frankfurt, Germany

The neutron time-of-flight facility nELBE at Helmholtz-Zentrum Dresden-Rossendorf features the first photo-neutron source at a superconducting electron accelerator, which provides a very precise time structure, high repetition rate and favorable background conditions due to the low instantaneous flux and the absence of any moderating materials. The neutron energy spectrum ranges from about 100 keV up to 10 MeV. The resulting very flexible beam properties at nELBE enable a broad range of nuclear physics experiments. Examples for the versatility of nELBE will be presented: Total neutron cross section measurements to look for unknown nuclear levels relevant for the astrophysical s-process, determination of the photon angular distribution after inelastic neutron scattering, determination of the detector response of a Dark Matter detector based on liquid Xe, or determination of the neutron induced fission cross section of ^{242}Pu.

HK 7.2 Mo 17:15 F 073

High spatial resolution in thermal neutron detection: from CASCADE to BASTARD — •Markus Köhli[1,2], Martin Klein[2], Tim Wagner[1], Fabian P. Schmidt[1], Jochen Kaminski[1], Klaus Desch[1], and Ulrich Schmidt[2] — [1]Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn — [2]Physikalisches Institut, Universität Heidelberg, Im Neuenheimer Feld 226, 69120 Heidelberg

By alerts on the future Helium supply critical to perspectives of the European Spallation Source the run on substitutional technologies started. Most of the solutions could be adapted from developments of particle physics and are comprised of one or more layers of Boron-10. The CASCADE detector, developed in Heidelberg for the purposes of Spin Echo spectroscopy, features high spatial and time resolution. The system is comprised of a stack of solid Boron-10 coated Gas Electron Multiplier (GEM) foils, which serve both as a neutron converter and as an amplifier for the primary ionization. This multi-layer setup increases the detection efficiency of a single entity while still allowing to precisely determine the time-of-flight. The Spin Echo spectrometers at the FRM II run such new generation systems. This talk will discuss the characteristics of the system explicitly on the basis of the CASCADE detector at RESEDA. Furthermore we open up the perspective to the novel neutron detection systems, which are now currently under development at the Physikalisches Insitut in Bonn using the actual state-of-the-art readout electronics.

HK 7.3 Mo 17:30 F 073

Entwicklung eines Szintillationstriggers auf Basis von SiPMs für einen Neutronendetektor — •Fabian Schmidt, Markus Köhli, Tim Wagner, Jochen Kaminski und Klaus Desch — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

Als Folge der Helium-3-Krise steigt die Nachfrage nach Neutronendetektoren auf Basis von alternativen Konvertern. Aus diesem Grund existiert ein großes Interesse an neuen Technologien auf Basis von Bor-10. In Bonn wurde mit der Entwicklung neuer Neutronendetektoren begonnen, mit dem Ziel die räumliche Auflösung durch eine zeitaufgelöste Spurrekonstruktion um mindestens eine Größenordnung zu verbessern. Unter Verwendung dünner Borkarbidschichten werden zwei Detektoren entwickelt. Einer dieser Detektoren setzt den Fokus auf eine hohe Granularität bei gleichzeitig hohen Raten, der andere auf eine sehr hohe räumliche Auflösung. Letzterer arbeitet auf Basis der Zeitprojektionskammer (TPC) mit Borkarbidschichten in einem Gasvolumen. Da Neutronen durch Bor-10 in zwei antiparallel emittierte Ionen konvertiert werden, kann eines in einer Spurdriftkammer zur Ortsbestimmung verwendet werden, das andere dient zur Generierung des Zeitstempels. Als Auslesesystem wird ein Timepix mit Micromegas Gasverstärkungsstufe eingesetzt, welches mit Pixeln von $55 \times 55\,\mu m^2$ eine präzise Spurmessung erlaubt. Das zur Rekonstruktion nötige Zeitsignal liefert ein schneller Szintillationstrigger. Dieser wird über einen Lichtleiter mit Silizium-Photomultipliern (SiPM) ausgelesen. In diesem Vortrag wird die Entwicklung eines solchen Szintillationstriggers zur Detektion von einzelnen Ionen dargestellt.

HK 7.4 Mo 17:45 F 073

Neutron measurement with a GridPix — •Tim Wagner, Markus Köhli, Fabian Schmidt, Jochen Kaminski, and Klaus Desch — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

As a result of the Helium-3 crisis the demand for neutron detectors with alternative neutron converters still increases. Thus new technologies using Boron-10 are highly asked for. In Bonn the development a novel neutron detector started which aims to push the limits of spatial resolution by at least one order of magnitude applying time resolved event reconstruction. Using enriched Boron Carbide in thin layers this model sets the focus on very high spatial resolution. The detector is operated like a Time Projection Chamber (TPC) with a Boron layer placed between the drift volume and a scintillator. As the neutron conversion in Boron-10 produces two charged particles emitted back-to-back the light generated by the scintillator is used as a trigger for the track in the detection gas. The TPC will be read out by an array of GridPix - CMOS ASICs with pixels of $55\mu m \times 55\mu m$ and a micromegas gas amplification on top of the chip, which allows to precisely measure the ionization track to the single electron level.

As a first step a prototype using a board with eight GridPix detectors has been built. With this prototype the track of a converted neutron on a GridPix is studied. The setup of the detector and measurements done will be presented in this talk.

HK 7.5 Mo 18:00 F 073

The neutron lifetime experiment PENeLOPE — •Dominic Gaisbauer for the PENeLOPE-Collaboration — TUM Institute for Hadronic Structure and Fundamental Symmetries, Garching, Germany

The neutron lifetime $\tau_n = 880.2 \pm 1.0$ s is an important parameter in the Standard Model of particle physics and in Big Bang cosmology. Several systematic corrections of previously published results reduced the PDG world average by several σ in the last years and call for a new experiment with complementary systematics.

The experiment PENeLOPE, currently under construction at the Physik-Department of Technische Universität München, aims to determine the neutron lifetime with a precision of 0.1 s. It will trap ultra-cold neutrons in a magneto-gravitational trap using a large superconducting magnet and will measure their lifetime by both neutron counting and online proton detection.

This presentation will give an overview over the latest developments of the experiment. The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

HK 7.6 Mo 18:15 F 073

Low Energy Proton Detector Using APDs for the PENeLOPE Experiment — •Joachim Meichelböck for the PENeLOPE-Collaboration — TUM Institute for Hadronic Structure and Fundamental Symmetries, Garching, Germany

PENeLOPE is a neutron lifetime measurement experiment at the Forschungsreaktor Muenchen II aiming to achieve a precision of 0.1 seconds. The detector for PENeLOPE consists of about 1250 Avalanche Photodiodes (APDs) with an total active area of 1225 cm^2. The detector and electronics will be operated at the high electrostatic potential of -30 kV, the magnetic field of 0.6 T. This includes shaper, preamplifier, ADC and FPGA stage. In addition the APDs will be operated at 77 Kelvin. The 1250 APDs are divided into 14 groups of 96 channels each including some spare. Each group is processed by one FPGA card which reads out the 12-bit ADC with 1MSps. Also a complete new firmware was developed for the detector including a self-triggering readout with continuos pedestal calculation and configurable signal detection. The data transmission and configuration is done via the Unified Communication Framework (UCF). It is a time-division multiplexing low layer protocol which provides determind latency for time critical messages, IPBus and JTAG interfaces. The network has a n:1 topology and thereby reducing number of optical links.

HK 7.7 Mo 18:30 F 073

A new Detector Design for Electron Spectroscopy in Neutron Beta Decay — •Christoph Roick[1], Bastian Märkisch[1], Lukas Raffelt[2], Heiko Saul[1,3], and Ulrich Schmidt[2] — [1]Physik-Department ENE, TU München — [2]Physikalisches Institut, Universität Heidelberg — [3]Atominstitut, TU Wien

The upcoming versatile instrument PERC will significantly increase the precision in neutron beta decay studies. This also demands new developments in electron detector design.

In this talk we present a new scintillator based detector setup featuring machine milled light guides, temperature stabilized photomultiplier tubes and a conductive coating. This system can be used for electron spectroscopy or coincident electron-proton-detection. During a recent measurement of the proton asymmetry with Perkeo III, we could prove that a superior performance in light yield at similar spatial homogeniety compared to former detectors with and without coating is achieved.

HK 8: HK+T Joint Session I: Gas Detectors/TPC

Zeit: Montag 16:45–19:00 Raum: F 102

Gruppenbericht HK 8.1 Mo 16:45 F 102

Towards the mass production of readout chambers for the upgrade of the ALICE TPC — •Alexander Deisting for the ALICE-Collaboration — GSI, Darmstadt, Deutschland — Physikalisches Institut, Heidelberg, Deutschland

The LHC will provide, during run 3 (2021 onwards) lead-lead collisions at interaction rates as high as 50 kHz. In order to cope with this luminosity the ALICE Time Projection Chamber (TPC) will be upgraded with new readout chambers and new readout electronics.

The goal of this upgrade is to allow continuous readout of the TPC, while preserving its excellent momentum and dE/dx resolution. Therefore the ion back flow into the drift volume must be less than 1%, otherwise the field distortions due to space-charge build-up would decrease the performance significantly. Extensive R&D was performed to develop new readout chambers, meeting these goals. The resulting chambers employ a stack of four Gas Electron Multipliers (GEMs) with a special high voltage configuration.

With the long shutdown 2 approaching at the end of 2018, the design parameters have been finalized and the mass-production of the GEM-based readout chambers has started. In this talk the status of the ALICE TPC upgrade will be given. In particular the design of the chambers is presented. An overview of the recent R&D activities will be shown as well. These include stability studies of the four GEM setup, tests to ensure the quality of the GEM foils during mass-production and the commissioning of the first front-end cards. In addition we report on the challenges of the mass production.

HK 8.2 Mo 17:15 F 102

Studies of space-charge distortions in the ALICE TPC — •Ernst Hellbär[1], Jens Wiechula[1], Marian Ivanov[2], and Ruben Shahoyan[3] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI — [3]CERN

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. With the advent of high luminosity data in LHC Run 2, unexpectedly large local distortions of the drift paths of ionization electrons are observed at the edges of specific readout chambers. These distortions are caused by ions which originate at the readout chambers, leading to local space-charge accumulation in the drift volume of the TPC.

A dedicated correction procedure that was initially developed for the high-rate TPC operation in Run 3 and beyond has been implemented into the current detector calibration framework to correct the distortions with sufficient precision. The observed distortions will be shown as well as results of the investigation of their origin. Moreover, the correction procedure and its performance will be presented.

Supported by BMBF and the Helmholtz Association.

HK 8.3 Mo 17:30 F 102

Development and construction of InGrid based gaseous detectors — Klaus Desch, Jochen Kaminski, Christoph Krieger, and •Tobias Schiffer — Physikalisches Institut, Universität Bonn, Nußallee 12, 53115 Bonn

Gaseous detectors are used in many particle physics experiments and applications. Especially multipattern gaseous detectors like Micromegas are able to achieve high spatial resolution through their granularity. To make full use of this granularity one has to combine the highly granular gas amplification stage with a readout structure of similar feature size, e.g. a pixelized readout chip like the Timepix and Timepix3 ASICs. The Micromegas stage can be produced directly on top of the chip by means of photolithographic postprocessing technology which allows for an almost perfect alignment between grid holes and pixels. This integrated gas amplification stage is called InGrid.

One application for detectors based on the InGrid technology is the detection of low energy X-ray photons exploiting the capability to detect individual primary electrons. To be able to detect low energy X-ray photons this kind of detector needs to fulfill special requirements which will be discussed.

Meanwhile the first InGrids on top of Timepix3 ASICs, the successor of the Timepix ASIC, are available. For testing purposes a versatile test detector is constructed and will be presented.

HK 8.4 Mo 17:45 F 102

Improving Hough transform algorithm for the track reconstruction of a Time Projection Chamber — •Amir Noori Shirazi and Ivor Fleck — Department Physik, Universität Siegen, Walter-Flex-Str. 3,57068 Siegen, Germany

A Time Projection Chamber (TPC) is foreseen as the main tracking detector for the International Large Detector (ILD) one of the two detectors for the next candidate collider named International Linear Collider (ILC).

GridPix, which is a combination of micro-pattern gaseous detector with a pixelised readout system, is one of the candidate readout systems for the TPC. One of the challenges in the track reconstruction is the large numbers of individual hits along the track (around 100 per cm). Due to the small pixel size of 55 x 55 μm^2, the hits are not consecutive. This leads to the challenge of assigning the individual hits to the correct track. Hits within a given distance from a reconstructed track are called inliers. Consequently, finding inliers within the many hits and noise is difficult for pattern recognition and this difficulty is increased by diffusion effects in the TPC.

In this analysis, a Hough transform is used. Instead of collected the inliers in the image space they are collected directly in the Hough space using a bivariate normal distribution based on the covariance matrix calculated from the diffusion defects. Results for track reconstruction efficiency and double track resolution will be presented.

HK 8.5 Mo 18:00 F 102

A Time Projection Chamber for the CBELSA/TAPS experiment — •Jonathan Ottnad, Markus Ball, Reinhard Beck, Dimitri Schaab, and Bernhard Ketzer — Helmholtz-Institut für Strahlen und Kernphysik, Bonn, DE

The CBELSA/TAPS experiment in Bonn aims to investigate the excitation spectrum of baryons and the properties of baryon resonances. Up to now, only the neutral decay products of the baryonic resonances are observed by the Crystal Barrel (CB), a high resolution electromagnetic calorimeter. A Time Projection Chamber (TPC) is foreseen to grant access to charged reaction channels in addition. Besides tracking, a TPC provides particle identification via the specific energy loss.

A TPC consists of a gas-filled, cylindrical volume with very low material-budget. The combination of electric and magnetic fields allows a three-dimensional track reconstruction. Constraints from the experimental setup limit the size of the fieldcage (length: 727.8 mm, outer diameter: 308 mm). The experiment's fixed target geometry results in a strong forward boost of the reaction products. Therefore the readout-electronics can only be mounted on one side of the TPC, which means one HV-cathode and one segmented readout-anode. For the gaseous amplification stage Gas Electron Multipliers were chosen.

This talk will cover the implementation of a TPC at the CBELSA/TAPS experiment, the current status of the TPC-prototype and its connected soft- and hardware infrastructure, as well as the development of a field calibration system.

Supported by SFB/TR 16.

HK 8.6 Mo 18:15 F 102

Track Reconstruction for the CBELSA/TAPS TPC — •Philipp Bielefeldt, Markus Ball, Jonathan Ottnad, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, DE

The CBELSA/TAPS Experiment at the ELSA accelerator facility in Bonn is a photo-production experiment that studies the spectrum and properties of baryon resonances. The current set-up is well-suited for the identification of neutral particles. For a future upgrade, a gas-filled Time Projection Chamber (TPC) with Gas Electron Multiplier (GEM) based amplification is under construction. It will allow studies of charged final states and provide improved particle identification capabilities and suppression of low-energetic electron background.

Track reconstruction will be done using GENFIT II, a sophisticated, experiment-independent tracking framework. It offers an abstract way to describe detector measurements and material handling as well as fitting routines, i. a. a Kálmán fitter. By design, measurement dimensionality and detector plane orientation need not be constrained, making it especially useful for a TPC, where the passage of particles is not measured on predefined planes.

In this talk, the implementation of the GENFIT II framework for the CBELSA/TAPS experiment will be discussed. An overview of the pattern recognition and fitting algorithms for the experiment will be given, as well as information on the expected performance of the GEM-TPC upgrade for the CBELSA/TAPS set-up.

Supported by SFB/TR 16.

HK 8.7 Mo 18:30 F 102

Transverse Diffusion in the TPC of the T2K Near Detector — Philp Hamacher-Baumann, Lukas Koch, •Thomas Radermacher, Stefan Roth, and Jochen Steinmann — III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Transverse diffusion affects the spatial resolution in a Time Projection Chamber (TPC). In the TPCs of the T2K near detector it can be derived from the charge distribution on the Micromegas plane. The electron cloud width is reconstructed from the charge fraction detected by the individual anode pads. This cloud width is investigated in dependence of the drift distance and the transverse diffusion coefficient is extracted.

HK 8.8 Mo 18:45 F 102

Multicomponent drift gas mixtures for the SHiP Muon Magnetic Spectrometer — •Stefan Bieschke, Caren Hagner, Daniel Bick, Joachim Ebert, and Walter Schmidt-Parzefall — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

SHiP is a proposed beam dump experiment to Search for Hidden Particles. It has a dedicated subdetector for neutrino physics that is equipped with a Muon Magnetic Spectrometer. For the spectrometer, upgraded drift tubes from the OPERA experiment are foreseen. The drift gas mixture used at OPERA had a high maximum drift time and a non-linear *rt*-relation. Due to the high rates at a beam dump experiment, a faster drift gas is needed. By adding small amounts of Nitrogen to the drift gas mixture, the maximum drift time was significantly reduced and the *rt*-relation became more linear. The drift gas mixture $Ar:CO_2:N_2$ 96:3:1 was found to be best suited candidate for a linear and fast drift gas mixture at atmospheric pressure.

HK 9: HK+T Joint Session II: Silicon Strip Detectors

Zeit: Montag 16:45–19:00 Raum: F 234

HK 9.1 Mo 16:45 F 234

Präzisions Siliziumteleskop für den DESY Teststrahl — Ties Behnke, •Uwe Krämer, Marcel Stanitzki und Dimitra Tsionou — DESY, Hamburg, Deutschland

Der DESY Teststrahl ist eine Nutzereinrichtung, in der Elektron-Strahlen mit Energien bis zu 5 GeV zur Verfügung stehen. Ein Solenoidmagnet liefert ein Feld von einem Tesla zur Messung von Detektoreigenschaften in einem Magnetfeld. Um die Nutzung der Einrichtung weiter zu verbessern, soll ein hochauflösender Silizium basierender Spurdetektor in den Magneten eingebaut werden. Bis zu sechs Lagen von Silizium sollen drei Raumpunkte vor und drei Raumpunkte hinter dem zu testenden Gerät liefern. Um das verfügbare Volumen im Magneten möglichst wenig einzuschränken, muss der Detektor auf der einen Seite eine sehr hohe Ortsauflösung liefern, auf der anderen Seite mit sehr wenig Bauraum auskommen.

Im Rahmen des AIDA2020 Projektes soll ein solcher Detektor aufgebaut werden. Er basiert auf großflächigen Silizium Streifensensoren die ursprünglich für einen Siliziumtracker am International Linear Collider, ILC, entwickelt worden sind, und die eine Ortsauflösung von etwa 10 μm erreichen. Der Sensor wird mit einem Chip ausgelesen, der direkt auf den Sensor gebonded ist und dadurch eine sehr kompakte Bauform erlaubt. In dem Vortrag werden Studien und erste Testergebnisse eines solchen Detektors vorgestellt, und seine Nutzung im Rahmen von Studien zur Entwicklung einer hochauflösenden TPC diskutiert.

Gruppenbericht HK 9.2 Mo 17:00 F 234

The Silicon Tracking System of the CBM Experiment at FAIR — •Olga Bertini for the CBM-Collaboration — GSI Darmstadt, Germany

The Compressed Baryonic Matter experiment will explore the phase diagram of strongly interacting matter in nucleus-nucleus collisions in the region of high net baryon densities using a number of rare probes and bulk observables. Its main component – the Silicon Tracking System (STS) – has to enable the reconstruction of up to 1000 charged particle trajectories per N-N collision at interaction rates of up to 10 MHz. The system design employs high-granularity sensors matching the non-uniform track density and fast self-triggering electronics needed for free streaming data acquisition system and online event selection. The required momentum resolution of $\Delta p/p \sim 1.5\%$ dictates the need of a low-mass design with material budget of 0.3-1%X_0 per station. The eight tracking stations of the STS are located in the aperture of a dipole magnet with 1 T field, and will cover an active area of 4.2 m^2, corresponding to polar the polar angles between 2.5° and 25°. The STS will comprise about 1000 detector modules consisting of double-sided silicon microstrip sensors, ultra-thin readout cables and front-end electronics that are mounted onto lightweight carbon fiber support structures. The assembly of the detector module components into full-scale prototypes and the engineering of the mechanical structure of the STS detector will be presented as well as progress with the final components, in particular sensors, readout cables and front-end electronics.

HK 9.3 Mo 17:30 F 234

Proton beam tests of silicon microstrip sensors for the CBM experiment — •Maksym Teklishyn[1,2], Olga Bertini[3], Johann Heuser[3], Anton Lymanets[3,2], Hanna Malygina[3,4,2], and Ievgeniia Momot[3,4,2] for the CBM-Collaboration — [1]FAIR, Darmstadt — [2]KINR, Kyiv, Ukraine — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [4]Goethe Universität Frankfurt

The physics aim of the Compressed Baryonic Matter (CBM) experiment is to explore the phase diagram of strongly interacting matter at highest net baryon densities and moderate temperatures in the range reachable with heavy ions collisions between $2 - 45\,A$GeV, initially $2 - 14\,A$GeV (SIS 100).

Double-sided 300 μm thick silicon microstrip sensors are planned to be used in the Silicon Tracking System (STS). The performance of recent sensor prototypes was studied with the beam of 1.6 GeV/c protons at COSY, Jülich. The Alibava system, based on the Beetle front-end chip, served as read-out electronics.

We performed various tests with the sensor prototypes: the charge collection efficiency was studied for the set of connection schemes for the different penetration angles of incident particles. The analysis of the data, collected with the proton beam, improves our understanding of the charge collection mechanism, relevant for the sensor production readiness.

Supported by HGS-HIRe and the EU-H2020 project CREMLIN.

HK 9.4 Mo 17:45 F 234

Testmessungen zur CO_2-Kühlung der 2S-Module für das Phase-2-Upgrade des CMS-Trackers — Lutz Feld, Waclaw Karpinski, Katja Klein, Marius Preuten, •Max Rauch, Nicolas Röwert 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 2023. Im Phase-2-Tracker werden etwa 8000 Stück der neuartigen 2S-Siliziumstreifenmodule eingesetzt werden. Die 2S-Module sollen mit einer Trägerstruktur aus einem Aluminium-Kohlefaser-Verbundmaterial gebaut werden, über die auch die Anbindung an das 2-phasige CO_2-Kühlsystem erfolgt, das bei einer nominellen Temperatur von $-30\,°$C betrieben werden soll.
Es wurde ein Aufbau entwickelt, in dem 2S-Modul-Prototypen thermisch mit einem zweiphasigen CO_2-Kühlsystem bei $-30\,°$C bei kontrollierter Umgebungstemperatur vermessen werden können. Die Messergebnisse werden mit Ergebnissen aus FE-Simulationen verglichen und die Resultate diskutiert.

HK 9.5 Mo 18:00 F 234

Hit position error estimation for the CBM Silicon Tracking System — •Hanna Malygina[1,2,3], Friese Volker[3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe Universität Frankfurt — [2]KINR, Kyiv, Ukraine — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The Compressed Baryonic Matter experiment (CBM) at FAIR is a heavy-ion experiment that will investigate dense QCD matter by measuring nuclear collisions in the beam energy range $2-45$ GeV/nucleon. Its main features are a high track-density environment at extreme interaction rates of up to 10 MHz. As the central detector component, the Silicon Tracking System (STS) is based on double-sided micro-strip sensors. Accurate detector modeling in simulations is crucial to assess the physics performance of the device and to arrive at a proper design choice.

The response of the silicon double-sided strip detector is included in the STS digitizer which simulates a complete chain of physical processes caused by charged particles traversing the detector, from charge creation in silicon to a digital output signal. Using the current implementation, one can test the influence of each physical processes on hit reconstruction separately. We have developed a new unbiased cluster position finding algorithm and a hit error estimation method for it. The estimated errors were verified using the hit pull and track χ^2 distributions.

Supported by HGS-HIRe.

HK 9.6 Mo 18:15 F 234

Progress with System Integration of the CBM Silicon Tracking Detector — •Johann M. Heuser for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The Silicon Tracking System (STS) is the central detector for charged-particle track measurement and momentum determination in the CBM experiment. It comprises about 900 low-mass detector modules, based on double-sided silicon micro-strip sensors. The read-out electronics is self-triggering and capable of acquiring data without event pile-up at beam-target collision rates up to 10 MHz. The STS modules are arranged on 106 carbon-fiber support ladders, which in turn are mounted onto 18 mechanical half-units to form 8 low-mass tracking stations. Cooling of the electronics is provided at the top and bottom periphery of the units to remove about 40 kW dissipated power total. The sensors will be operated at below -5 °C to limit leakage currents and radiation damage effects. The STS will be enclosed by thermally insulating walls and installed in the gap of a superconducting dipole magnet.
In the presentation, progress with the system integration of the STS detector will be discussed to meet the performance goals with respect to mechanical and operational precision as well as maintenance. The overview will include module and ladder assembly, cooling, mechan-

ical prototyping of a unit, the powering concept, cabling within the STS box and connectivity towards the supply, control and acquisition systems.

HK 9.7 Mo 18:30 F 234

Bau und Test von Prototypen für den ATLAS-Streifendetektor — Silke Altenheiner, Claus Gössling, Reiner Klingenberg, Kevin Kröninger, •Jonas Lönker, Daniela Röttges und Felix Wizemann — TU Dortmund, Experimentelle Physik IV

Um die gesteigerten Anforderungen durch das Upgrade auf den HL-LHC erfüllen zu können, ist geplant, den Inneren Detektor des ATLAS-Experiments zu ersetzen. Der neue Spurdetektor, genannt Inner Tracker (ITk), soll in den äußeren Lagen aus Silizium-Streifenmodulen aufgebaut werden, die aus Sensor und PCB inkl. Auslesechips (ASICs) bestehen. Die einzelnen Komponenten werden durch Kleber mechanisch und per Wirebonds elektrisch miteinander verbunden.
Vorgestellt werden Maßnahmen und Ergebnisse der geplanten Qualitätssicherung während der Produktion hinsichtlich einheitlicher Klebedicken und elektrischen Eigenschaften in Dortmund.

HK 9.8 Mo 18:45 F 234

Testbeam Analyse von Prototyp-Streifenmodulen des ATLAS ITK — •Moritz Wiehe, Marc Hauser, Riccardo Mori, Ulrich Parzefall, Susanne Kühn, Brian Moser und Karl Jakobs — Albert-Ludwigs-Universität Freiburg

Der innere Spurdetektor des ATLAS-Experiments erfährt im Zuge des Ausbaus des LHC zum HL-LHC ein umfassendes Upgrade (ATLAS Phase II Upgrade). Zur Bestimmung der Leistungsfähigkeit der Siliziumstreifenmodule wurden im Juli 2016 bestrahlte und unbestrahlte Prototypen im Testbeam am CERN untersucht. Die getesteten Prototypen bestehen aus Miniatur- und Full-Size-Sensoren, sowie realistischen Hybriden und ASICS, wie sie für die spätere Verwendung im ATLAS-Experiment geplant sind. Ergebnisse der Analyse der rekonstruierten Daten werden hier präsentiert. Unser Ziele waren es die Sensorperformance in Abhängigkeit der Spurposition, mit besonderem Blick auf Effizienz, Auflösung und 'Charge Sharing', zu bestimmen, sowie die Funktionalität der Ausleseelektronik zu prüfen.

HK 10: Hauptvorträge I

Zeit: Dienstag 8:30–10:30 Raum: F 1

Hauptvortrag HK 10.1 Di 8:30 F 1

Status of the FAIR Project — •Paolo Giubellino — FAIR & GSI, Darmstadt

The Facility for Antiproton and Ion Research FAIR is one of the European flagship facilities for basic science in the coming decades. The unique accelerator and experimental facilities will allow for a large variety of unprecedented fore-front research in physics and applied science. The science program of FAIR is structured in four research pillars: APPA, CBM, NUSTAR and PANDA. In the field of nuclear structure, nuclear astrophysics and nuclear reactions, the FAIR accelerator with the versatile NUSTAR instrumentation will give access to the yet unknown region of r-process path nuclei at and beyond N=126 and thereby provide stringent constraints for our understanding of the nucleosynthesis of the heaviest nuclei. In the field of nuclear and hadronic matter physics, CBM will offer unique conditions for a comprehensive study of QCD matter at the highest net-baryon densities achievable in the laboratory. In the field of hadron physics, PANDA opens up excellent research opportunities for high-precision systematic measurements in hadron spectroscopy and hadron structure. In addition FAIR will also allow for novel precision experiments in atomic physics as well as for tests of fundamental symmetries and interactions in nature. Last but not least, FAIR, with its large variety of ion beam species, energies and intensities will offer broad opportunities for a rich applied research program, APPA. The status of the FAIR realization and the plans for an intermediate research program at GSI will be presented.

Hauptvortrag HK 10.2 Di 9:10 F 1

Ab initio calculations of the neutron skin and the electric dipole response of nuclei — •Sonia Bacca — TRIUMF, Vancouver, Canada

The nuclear dipole response and its sum-rules are strongly correlated with the size of atomic nuclei. They also informs us about the neutron equation of state and thus link atomic nuclei to neutron stars [1]. Combining the Lorentz integral transform with the coupled-cluster method allowed us to perform ab initio computations of response functions for medium mass nuclei [2,3]. I will show recent highlights in conjunction with calculations of neutron skins and discuss them in light of recent and future experiments [1,4]. [1] G. Hagen et al., Nature Physics 12, 186-190 (2016). [2] S.Bacca et al., Phys. Rev. Lett. 111 122502 (2013). [3] M.Miorelli et al., Phys. Rev. C 94, 034317 (2016). [4] J. Birkhan et al., arXiv:1611.07072

Hauptvortrag HK 10.3 Di 9:50 F 1

QCD in external magnetic fields — •Gergely Endrődi — Goethe University Frankfurt

The physics of strongly interacting matter in background magnetic fields features rich phenomenology and has a wide range of applications, ranging from heavy-ion collisions through neutron star physics to the evolution of the early Universe. The most effective systematic approach to investigate this field is by means of numerical lattice simulations of the underlying theory, QCD. In this talk I give an overview of the recent developments in lattice QCD with background magnetic fields and discuss the relevance of the results for heavy-ion phenomenology.

HK 11: Hadron Structure and Spectroscopy II

Zeit: Dienstag 11:00–12:30 Raum: F 5

HK 11.1 Di 11:00 F 5

Analysis of the reaction $\gamma p \to K^0\Sigma^+$ in the decay channel $(\pi^0\pi^0)(\pi^+ n)$ at the BGO-OD experiment — •Stefan Alef for the BGO-OD-Collaboration — Physikalisches Institut Universität Bonn

The BGO-OD experiment at the ELSA facility in Bonn investigates nucleon excitations via meson photoproduction. One research objective is associated strangeness production, which includes the reaction channel $\gamma p \to K^0\Sigma^+$.

Results of the analysis of the mixed charged/neutral decay channel $K^0\Sigma^+ \to (\pi^0\pi^0)(\pi^+ n)$ will be presented. Kinematic and template fitting are used to discriminate the reaction against background.
Supported by DFG (SFB/TR-16).

HK 11.2 Di 11:15 F 5

Hyperon Photoproduction with the BGO-OD Experiment* — •Georg Scheluchin for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, D-53115 Bonn

One aim of the BGO-OD experiment is the investigation of non-strange and strange hyperon photoproduction. The setup combines a large aperture forward magnetic spectrometer and a central BGO crystal calorimeter covering the polar angles up to 12° and 25° to 155°, respectively. The acceptance gap in between is covered by a segmented plastic scintillator.

Since the discovery of the $\Lambda(1405)$, it remains poorly described by conventional constituent quark models, and it is a candidate for having an "exotic" meson-baryon or "penta-quark" structure, similar to states recently reported in the hidden charm sector.

The $\Lambda(1405)$ can be produced in the reaction $\gamma p \to K^+\Lambda(1405)$. One decay mode is into $\Sigma^0\pi^0$, which is prohibited for the mass-overlapping $\Sigma(1385)$. A similar reaction to reconstruct is $\gamma p \to K^+\Sigma^0$, which yields one less pion in the final state. BGO-OD is ideally suited to measure

both reactions and preliminary results will be presented.
*Supported by DFG (SFB/TR-16).

HK 11.3 Di 11:30 F 5

$K^+\Lambda$ and $K^+\Sigma^0$ photoproduction at extremely forward angles with the BGO-OD experiment — •Thomas Jude for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment at the ELSA accelerator facility uses an energy tagged bremstrahlung photon beam to investigate the internal structure of the nucleon. The setup consists of a highly segmented BGO calorimeter surrounding the target, with a particle tracking magnetic spectrometer at forward angles.

BGO-OD is ideal for investigating low momentum transfer processes due to the acceptance and high momentum resolution at forward angles. In particular, this enables the investigation of strangeness photoproduction where t-channel exchange mechanisms play a dominant role. As part of an extensive strangeness photoproduction experimental programme, the differential cross section measurements for $K^+\Lambda$ and $K^+\Sigma^0$ photoproduction at centre of mass polar angles between 4° to 25° will be presented.

These first data at extremely forward angles are important for partial wave analyses, and models where accurate knowledge of t-channel mechanisms are required. The data also constrain models for hypernuclei electroproduction, where at very low Q^2, the $K^+\Lambda$ cross section is comparable to photoproduction.

Forward K^+ identification, fitting techniques to separate signal from background, and preliminary results will be shown.

HK 11.4 Di 11:45 F 5

Analysis of the reaction $\gamma p \to K^0\Sigma^+$ by the identification of the charged $K*$ decay channel at the BGO-OD experiment* — •Björn-Eric Reitz for the BGO-OD-Collaboration — Physikalisches Institut Universität Bonn

The BGO-OD experiment at the ELSA facility in Bonn investigates nucleon excitations via meson photoproduction. A program of measurements of associated strangeness final states has begun, one of which is $\gamma p \to K^0\Sigma^+$.

This talk shows preliminary results of the analysis for the charged decay channel $K^0\Sigma^+ \to (\pi^-\pi^+)(\pi^0 p)$ obtained from new data.
*Supported by DFG (SFB/TR-16).

HK 11.5 Di 12:00 F 5

Cascading nucleon resonance decays * — •Mariana Nanova for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

A key step towards understanding non-perturbative QCD is baryon spectroscopy, the investigation of the spectrum and properties of baryon resonances [1]. We studied the two-meson photoproduction with the CB/TAPS detector system at the ELSA accelerator in Bonn in the reactions γp→ $p\pi^0\pi^0$ and γp→ $p\pi^0\eta$. High statistics have been obtained in irradiating a liquid hydrogen target with photon beams in the incident energy range from 0.5 to 3.0 GeV. A kinematic fit has been used in the reconstruction and identification of the exit channels. Dalitz plots show a clear evidence for the $\Delta(1232)$, and further baryon resonances populated in the decay of higher lying nucleon resonances [2,3,4]. Preliminary results on $\Delta(1232)\pi^0$ and $\Delta(1232)\eta$ excitation functions will be presented.

[1] E. Klempt and J.-M. Richard, *Rev. Mod. Phys.* **82** (2010) 1095
[2] E. Gutz et al., *Eur. Phys. J. A* **50** (2014) 74
[3] V. Sokhoyan et al., *Eur. Phys. J. A* **51** (2015) 95
[4] A. Thiel et al., *Phys. Rev. Lett.* **114** (2015) 091803
*Supported by DFG through SFB/TR16.

HK 11.6 Di 12:15 F 5

Cascading decays of nucleon and delta resonances with the CLAS detector at JLAB — •Stefan Diehl, Kai-Thomas Brinkmann, Eric Gutz, and Mariana Nanova for the CLAS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

A rich variety of nucleon and delta resonances with cascading decays into hadrons (i.e. $\Delta^{**} \to \Delta^{++}\pi^- \to \mathrm{p}\pi^+\pi^-$) are predicted by different relativistic quark models and lattice QCD calculations in the mass range above 2 GeV. The CEBAF Large Acceptance Spectrometer (CLAS) at Jefferson National Laoboratory (JLAB), Newport News, Virginia, provides an excellent opportunity to discover such resonances. In this contribution, the search for cascading nucleon and delta resonances in the reaction γp → Δ^{**} and $\gamma p \to$ N** with photon energies between 3.0 GeV and 3.8 GeV based on a resonance scan and on the angular distributions of the pions, will be presented. The analysis is based on an isolation of isobars (e.g. Δ π) in the dataset via Dalitz plots. The obtained subsets are then analysed with respect to cascading decays of high-mass excited states. Due to the high statistics provided by the g11 dataset of CLAS, resonance scans could be performed with a high accuracy. In addition, the status of the search at lower energies, which enables a cross check to earlier analyses, will be presented. As an outlook the focus will be set on the search for hadrons containing strange quarks, which show cascading decays with, for example, Kaons in the final state. *S. D. is supported by JLU Gießen through a JUST'us scholarship grant.

HK 12: Heavy Ion Collisions and QCD Phases III

Zeit: Dienstag 11:00–12:30 Raum: F 1

Gruppenbericht HK 12.1 Di 11:00 F 1

Event reconstruction and selection in high-rate heavy-ion reactions in the CBM experiment at FAIR — •Maksym Zyzak for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung

The CBM experiment at FAIR is being designed for the study of the QCD phase diagram in the region of the high baryon chemical potential at relatively moderate temperatures, where a complex structure is predicted by modern theories. The physics program of CBM includes precision measurements of a wide set of observables that contains very rare particles like charmed hadrons, dileptons, multi-strange (anti-) hyperons, and hypernuclei. The comprehensive and systematic study of these particles including their phase-space distributions requires extremely high interaction rates of up to 10^7 collisions per second. The complicated decay topologies of these observables prevent the use of simple hardware triggers. Therefore, the CBM collaboration is developing a free-streaming data read-out system, where each single detector signal will be provided with a time stamp, and then send to a high-performance computing farm. There, a full online (4-D) event reconstruction will be performed based on the signals from the various detector systems. Fast algorithms then will online select those events which contain candidates of particles under investigation. The status of the CBM online event reconstruction and selection procedures will be discussed.

HK 12.2 Di 11:30 F 1

Geometry independent Kalman filter based track fit — •Artemiy Belousov[1,2], Ivan Kisel[1,2,3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH

Modern experiments in High Energy Physics are tend to increase the amount of data to be processed, thus, the speed of the algorithms become crucial. However, the efficiency and precision of the applied procedures can not be compromised. Therefore, the Kalman filter method is usually used as the core for the reconstruction of collision, as it satisfies all the requirements.

Current implementations of the Kalman filter method to the reconstruction of charged particle trajectories are based on the assumption of the 2D measurements with the third coordinate fixed. Such an approach leads to the strong dependency of the fitting procedure on the geometry of the experiment.

In the current work the 3D Kalman filter based track fit is developed, which operates with 3D measurements of 3 independent coordinates. The algorithm shows correct results with pulls of unity width and flat distribution of the prob-function.

HK 12.3 Di 11:45 F 1

Transverse-momentum distributions of charged particles in

p-Pb collisions with ALICE at the LHC — •Michael Habib for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

The inclusive charged particle spectra in proton-lead collisions is used to quantify initial state effects and provides a reference measurement for the studies of deconfined matter created in nucleus-nucleus collision.

The ALICE experiment at the LHC recorded p-Pb collisions at a center of mass energy of $\sqrt{s_{\rm NN}} = 5.02$ TeV in the years 2013 and 2016.

In this talk the transverse-momentum spectrum in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV measured with the ALICE detector and the corresponding nuclear modification factor $R_{\rm pPb}$, given by the ratio of the $p_{\rm T}$ spectrum in proton-lead to that in proton-proton collisions scaled by the number of binary collisions, will be presented. The primary charged particle transverse-momentum ($p_{\rm T}$) distribution of the 2013 dataset was reanalyzed with improved analysis methods, leading to significant reduced systematic uncertainties. The ALICE pp reference spectrum at a collision energy of $\sqrt{s} = 5$ has been used for $R_{\rm pPb}$ factor calculations.

HK 12.4 Di 12:00 F 1

Determination of secondary particles contamination in charged particle spectra measured with ALICE at LHC — •Federica Sozzi for the ALICE-Collaboration — GSI, Darmstadt, and Universität Heidelberg

Transverse-momentum distributions for primary charged particles and corresponding nuclear modification factor R_{AA} have been measured by the ALICE Collaboration for different collision systems and energies, comprising newer data sets collected in Run 2 and re-analysed data sets from Run 1.

The systematic uncertainties are largely reduced with respect to similar past ALICE measurements, due to improvements in the analysis procedure. One of the systematic contribution that has been studied is the contamination of secondary particles in the sample, originating from the interaction of particles with material and, to a larger extent, from the weak decay of neutral strange particles, K^0 and Λ. The fraction of secondaries after the track selection cuts is of the order of few percent and depends on the transverse-momentum. Since the yield of the strange particles is known to be underestimated in event generators, the determination of this fraction from MC leads to a corresponding large uncertainty. Therefore the fractions of secondaries have been determined through fits of the experimentally-measured distributions of the distance to closest approach of tracks to vertex. In this contribution the fitting method, the results and their impact on the transverse-momentum distribution measurement will be described.

HK 12.5 Di 12:15 F 1

Performance of 4-Dimensional Cellular Automaton Track Finder in CBM — •Valentina Akishina[1,3,4] and Ivan Kisel[1,2,3] for the CBM-Collaboration — [1]Goethe- Universitat Frankfurt am Main — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum fur Schwerionenforschung GmbH — [4]Joint Institute for Nuclear Research

The CBM experiment will focus on the measurement of rare probes at interaction rates up to 10 MHz with data flow of up to 1 TB/s. In this case resolving different collisions, which may overlap in time, is a non-trivial task. Event building requires full online event reconstruction and selection taking into account not only space coordinates, but also time measurements, so-called 4D reconstruction. The algorithms must be fast, precise and suitable for online data processing in order to use the full potential of modern many-core computer architectures.

For the most time-consuming part of the reconstruction procedure the Cellular Automaton track finder is used. The event-based CA track finder was adapted for time-slice-based 4D track reconstruction, which is a requirement in case of CBM. The 4D CA track finder is both vectorized and parallelized. The algorithm shows strong scalability on many-core systems. The speed-up factor of 10.1 was achieved on a CPU with 10 hyper-threaded cores. The algorithm performance is compared with event-based approach event-wise with the help of ideal event-builder. The 4D CA track finder is able to reproduce the efficiency and the speed performance of the event-based CA track finder. The algorithm was included into the CBMROOT framework.

HK 13: Structure and Dynamics of Nuclei II

Zeit: Dienstag 11:00–12:30 Raum: F 2

Gruppenbericht HK 13.1 Di 11:00 F 2

Nuclear Physics Around the Unitarity Limit — •Sebastian König — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

In the unitarity (or unitary) limit, where the two-nucleon S-wave channels have infinite scattering lengths and zero-energy bound states, only one dimensionful parameter is left and set by the triton binding energy. While the proximity of the real world to this idealized scenario has been discussed qualitatively for a long time, it has traditionally not played any special role in constructing nuclear forces.

Here it is argued that at least light nuclei may reside in a sweet spot: bound weakly enough to be insensitive to the details of the interaction, but dense enough to be insensitive to the exact values of the large two-body scattering lengths as well, so that a systematic expansion around the unitarity limit converges. With this, the gross features of states in the nuclear chart are determined by a very simple leading-order interaction, whereas—much like the fine structure of atomic spectra—observables are moved to their physical values by small *perturbative* corrections. Explicit evidence in favor of this conjecture is shown for the binding energies of three and four nucleons.

Reference: SK, H.W. Grießhammer, H.-W. Hammer, U. van Kolck, arXiv:1607.04623 [nucl-th]

This work is supported in part by the ERC Grant No. 307986 STRONGINT.

HK 13.2 Di 11:30 F 2

Partial wave analysis of nucleon-nucleon scattering with a chiral potential at fifth order — •Patrick Reinert, Evgeny Epelbaum, and Hermann Krebs — Institut für Theoretische Physik II, Ruhr-Universität Bochum, D-44780 Bochum, Germany

We use neutron-proton and proton-proton scattering data to determine the low-energy constants of the novel semilocal two-nucleon potentials up to fifth order in chiral effective field theory. To minimize the sensitivity to the chosen energy range, the novel approach to estimate the theoretical uncertainty from the truncation of the chiral expansion is incorporated in the fit procedure. The resulting phase shifts and mixing angles are in a good agreement with the partial wave analyses by the Nijmegen and Granada groups within the estimated theoretical uncertainties. We give χ^2 per datum values and effective range parameters for different ultraviolet cutoffs and chiral orders. Furthermore, we discuss the uncertainty stemming from F-waves which are still free of adjustable parameters at fifth order in the chiral expansion.

HK 13.3 Di 11:45 F 2

Two-pion exchange corrections to the nucleon-nucleon scattering amplitude in the modified Weinberg approach — •Jens Behrendt — Ruhr-Universität Bochum

We consider the two-pion exchange corrections to the potential and calculate the scattering amplitude in the modified, renormalizable Weinberg approach to the nucleon-nucleon scattering problem in chiral effective field theory. This approach uses time-ordered perturbation theory applied to the manifestly Lorentz invariant form of the effective Lagrangian and does not rely on the heavy baryon expansion. In this framework the leading order amplitude is obtained by solving the Kadyshevsky equation and the corrections are calculated perturbatively.

HK 13.4 Di 12:00 F 2

Weinberg eigenvalue analysis based on chiral forces — •Jan Hoppe[1,2], Christian Drischler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We apply the Weinberg eigenvalue analysis as a powerful tool to investigate and quantify the perturbativeness of recent local and semilocal chiral nucleon-nucleon potentials. This check is of particular interest in the framework of (many-body) perturbation theory. We study the impact of cutoff variations on non-perturbative sources, such as the repulsive core in terms of the so-called Weinberg eigenvalues. We show results in different partial waves, in free-space and in-medium, where we distinguish repulsive and attractive eigenvalues to diagnose the impact of the different non-perturbative sources. Due to recent advances in normal-ordering, we are able to include 3N contributions up to N^3LO and present results for more traditional chiral potentials.

*This work is supported by the DFG through Grant SFB 1245 and the ERC Grant No. 307986 STRONGINT.

HK 13.5 Di 12:15 F 2

Charge Symmetry Breaking in the $dd \to {}^4\mathrm{He}\pi^0$ Reaction with WASA-at-COSY — •Maria Zurek — Forschungszentrum Jülich, Jülich, Germany

If protons and neutrons were treated equally by all types of interactions, isospin symmetry would be conserved. Since up and down quarks, which are the constituent quarks of the proton and the neutron, have different charges and masses, isospin symmetry is not an exact one. It is broken both by electromagnetic and strong interactions.

Investigations of the charge symmetry breaking $dd \to {}^4\mathrm{He}\pi^0$ reaction is one of the primary goals for the WASA-at-COSY experiment. The aim is to provide experimental results for comparison with Chiral Perturbation Theory (χ_{PT}) predictions gaining information on the proton-neutron mass difference induced by the strong interaction.

First steps towards a theoretical understanding of the $dd \to {}^4\mathrm{He}\pi^0$ reaction have found that the existing data are not sufficient for a precise determination of the parameters of χ_{PT}, and further data are required at sufficiently high energy where the p-wave contribution becomes important.

Results from a first measurement with the WASA detector setup at a beam momentum of 1.2 GeV/c had been already published, but the limited statistics did not allow a decisive interpretation. Thus, a second measurement using an improved detector setup aiming at higher statistics has been performed in spring 2014. The new results will be presented.

HK 14: Astroparticle Physics I

Zeit: Dienstag 11:00–12:30 Raum: F 33

Gruppenbericht HK 14.1 Di 11:00 F 33

First results of Gerda Phase II — •Anne Wegmann for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

The Gerda experiment is searching for neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Gerda operates bare Germanium detectors in liquid argon, that are enriched in the $\beta\beta$ isotope. Phase II of the experiment combines for the first time the excellent properties of semiconductor Germanium detectors with an active background suppression technique based on the simultaneous detection of liquid argon scintillation light by photomultiplier tubes and silicon photomultipliers coupled to scintillating fibers (LAr veto).

This talk outlines the Phase II upgrade with special emphasis on background rejection techniques and focusses on the first results of Phase II. Exhibiting the world-best background index (if normalized to the narrow energy-signal region of Germanium detectors), a limit on the $0\nu\beta\beta$-decay half-life of $5.3 \cdot 10^{25}$ yr at 90% C.L. could be set based on an exposure of only 34.4 kg·yr. With an ultimate exposure of 100 kg·yr this will allow for a $0\nu\beta\beta$-decay half-life sensitivity of the Gerda Phase II experiment of 10^{26} yr.

HK 14.2 Di 11:30 F 33

Performance of Germanium detectors in gerda Phase II — •Andrea Lazzaro for the GERDA-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, Germany

The gerda experiment searches for neutrinoless double beta decay with Ge semiconductor detectors operated in liquid Ar. The Phase II of the experiment is taking data since December 2015. The goal is to increase the sensitivity for the half–life of ^{76}Ge above 10^{26} yr.

Two types of high purity Ge detectors, enriched in ^{76}Ge, deployed: semi–coaxial and *BEGe*. These detectors have excellent energy resolution and allowed pulse shape discrimination of the main background sources: multiple–site events; external α's and β's.

In this talk I will present the performance of the detectors during the first part of the Phase II data–taking. The stability of the spectroscopy parameters, as energy calibration and resolution, is fundamental to operate a modular system. I will also discuss the active suppression of the different background components. This work was supported by the BMBF.

HK 14.3 Di 11:45 F 33

Pulse shape discrimination performance of BEGe detectors in Gerda Phase II — •Anna Julia Zsigmond for the GERDA-Collaboration — Max Planck Institut für Physik, München

The Gerda experiment searches for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Bare Ge diodes are operated in liquid argon at cryogenic temperatures in an ultra-low background environment. Isotopically enriched Broad Energy Germanium (BEGe) detectors are used in Phase II of the experiment because of their superior energy resolution and pulse shape discrimination properties. $0\nu\beta\beta$ events are single-site events confined in the detector active volume to a scale of about a millimeter, while most of the backgrounds are multi-site gamma-ray events or surface events. These events are identified by a single parameter, the amplitude of the change pulse over the energy of the event and rejected to maximize the sensitivity of the experiment. The long-term stability and performance of the detectors during Phase II data taking using calibration and $2\nu\beta\beta$ data will be presented. The effect of pulse shape discrimination on the background index and $0\nu\beta\beta$ half-life limit will be demonstrated.

HK 14.4 Di 12:00 F 33

Development of novel pulse shape discrimination algorithms for Gerda — •Philipp Holl for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

The Gerda experiment located at the Laboratori Nazionali del Gran Sasso of INFN searches for neutrinoless double beta decay using germanium diodes as source and detector. Its sensitivity strongly depends on the background. Pulse shape discrimination is used for the rejection of background events where multiple energy depositions happen inside the detector or the energy is deposited at the surface of the detector.

In this talk, a novel approach to pulse shape analysis making use of different digital signal processing filters and state-of-the-art machine learning algorithms will be presented. Preliminary results on the training of the classifiers will be shown using ^{228}Th calibration data from Gerda.

HK 14.5 Di 12:15 F 33

Muon-induced Neutrons in GERDA — •Laura Vanhoefer for the GERDA-Collaboration — Max-Planck-Institut für Physik, München

Neutrons can produce background in experiments searching for rare events like neutrinoless double beta ($0\nu\beta\beta$) decay. Gerda is using germanium detectors operated in liquid argon to search for the $0\nu\beta\beta$ decay of ^{76}Ge. Since the signature is a peak at the Q-value of the decay, $Q_{\beta\beta}$ (2039 keV for ^{76}Ge), any energy deposition around the Q-value is potential background. Neutrons can produce long-lived radioisotopes inside the experiment via neutron capture, spallation etc. or excite nuclei. Energy deposition from the decay/de-excitation can mimic a $0\nu\beta\beta$ signal.

If the neutron flux inside the experiment is known, this background can be estimated. Neutron capture on germanium was used as a signature for determining the muon-induced neutron flux inside Gerda. This allows to refine background predictions for future ton scale $0\nu\beta\beta$ germanium experiments.

HK 15: Instrumentation III

Zeit: Dienstag 11:00–12:30 Raum: F 3

Gruppenbericht HK 15.1 Di 11:00 F 3

The CBM First-level Event Selector — •Jan de Cuveland and Volker Lindenstruth for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM experiment currently under construction at GSI/FAIR is designed to study QCD predictions at high baryon densities. The CBM First-Level Event Selector (FLES) is the central event selection system of the experiment. Designed as a high-performance computer cluster, its task is an online analysis of the physics data including full event reconstruction at an incoming data rate exceeding 1 TByte/s.

The CBM detector systems are free-running and self-triggered, delivering time-stamped data streams. As there is no inherent event separation, traditional approaches for global event building and event selection are not directly applicable. Instead of event building, the FLES combines the data from approximately 1000 input links to self-contained, overlapping processing intervals and distributes them to compute nodes. It employs a high-bandwidth InfiniBand network as well as dedicated custom FPGA input boards providing time-addressed access to buffered data. Subsequently, specialized event selection algorithms analyze these processing intervals in 4-D, identify events, and select those relevant for storage depending on the chosen CBM setup and selection scenario.

This presentation summarizes the status of developments for the CBM First-level Event Selector and includes results from recent demonstrator setups.

HK 15.2 Di 11:30 F 3

Readout and stimulus of a microwave multiplexed thermal sensor — •Panos Neroutsos and Udo Kebschull — Goethe University, Frankfurt am Main, Germany

This PhD research topic expands our knowledge regarding technology for broadband high energy resolution particle spectroscopy. This experiment comprises of a multiplexed readout system of large metallic magnetic calorimeter (MMC) detector arrays. This is an energy dispersive particle detector, which operates at temperatures below 100mK. The proposed readout system aims to a simultaneous readout of thousands of detectors by using a single pair two coaxial cables that are routed from the room-temperature electronics to the detector array. Therefore, in order to readout such an array, a frequency comb having all its tones adjusted to the different resonator frequencies must be injected to in the detector. The resultant signal must be acquired, analyzed and post-processed in order to determine the time dependent phase and amplitude variation, among others, of each sinusoids. A chain of FPGA is the core of this readout system along with the ADC/DAC boards and it is responsible for the manipulation of the ADC/DAC boards, the comb generation, the channelizing process and the digitization respectively. We are using the approach of High Level Synthesis (HLS) Tools, optimized for streaming data applications for the implementation of the post-processing algorithms and Hardware Description Languages (HDL) for the readout of the ADC/DAC boards and the data propagation to our target FPGA(s).

HK 15.3 Di 11:45 F 3

Integration of redundancy logic in the hardware event builder of the COMPASS DAQ — •Dominik Steffen[1,4], Yunpeng Bai[1], Martin Bodlak[2], Vladimir Frolov[3], Stefan Huber[1], Vladimir Jary[2], Igor Konorov[1], Dmitri Levit[1], Joseph Novy[2], Ondrej Subrt[2,4], and Miroslav Virius[2] — [1]Technische Universität München (DE) — [2]Czech Technical University (CZ) — [3]Joint Institute for Nuclear Research (RU) — [4]European Organization for Nuclear Research -CERN (CH)

This contribution will introduce the principles of the event building process in Data Acquisition systems (DAQ) of high-energy physics experiments. Since 2014, the COMPASS experiment at CERN exploits the superior properties of FPGAs to execute this task. The talk will discuss the advantages and drawbacks of the COMPASS hardware event builder in contrast to the traditional approach which relies on software running on distributed computer nodes interconnected via a common Ethernet network. Moreover, it will describe in detail the necessary changes in software and hardware in order to implement redundancy logic into the hardware event builder. Redundant hardware nodes which can be activated in case of defective other nodes and thus prevent the system from failing will eliminate one of the major drawbacks compared to traditional event builders.

HK 15.4 Di 12:00 F 3

A prototype of the free-streaming data acquisition system for the Compressed Baryonic Matter experiment at FAIR — •David Emschermann for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) will be based at the new Facility for Antiproton and Ion Research (FAIR), which will deliver heavy-ion beams up to energies of 14 A GeV. In nucleus-nucleus collisions at these beam energies strongly interacting matter with densities up to 10 times normal nuclear matter is expected to be produced. The key objective of CBM is to investigate the QCD phase diagram in the region of high baryon-densities, where a first order phase transition from hadronic to partonic matter as well as a chiral phase transition is expected to occur, representing a substantial discovery potential at FAIR energies. As a fixed-target experiment CBM is consequently designed to cope with very high interaction rates up to 10 MHz. This will allow to perform high precision measurements of extremely rare probes which have not been accessible by previous nucleus-nucleus experiments in this energy regime. To achieve the high rate capability CBM will be equipped with fast and radiation hard detectors employing free-streaming readout electronics. A prototype high-speed Data Aquisition (DAQ) system was built in 2016. It has been successfully deployed at a CBM beamtest at the SPS accelerator at CERN, where it has forwarded data from the detector front-ends of the TOF and MUCH subsystems to a prototype of the First Level Event Selector (FLES). We will report on the status of this CBM DAQ prototype.

HK 15.5 Di 12:15 F 3

mCBM@SIS18 - a CBM full system test-setup at GSI — •Christian Sturm, David Emschermann, Jochen Frühauf, Pierre-Alain Loizeau, Wolfgang Niebur, Florian Uhlig, and Junfeng Yang for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at FAIR will measure relativistic nucleus-nucleus collisions with unprecedented collision rates up to 10 MHz leading to data rates up to 1 TB per second. To achieve the required performance a free-streaming data acquisition system is being developed. A CBM full system test-setup called mCBM@SIS18 ("mini-CBM") will be installed at GSI/SIS18 in the years 2017/2018 in order to develop, commission and optimize (i) the free-streaming data acquisition system including the data transport to a high performance computer farm (GreenIT cube) (ii) the online track and event reconstruction and event selection algorithms and (iii) the offline data analysis as well as the controls software package. Furthermore, the setup offers additional high-rate tests of the final detector prototypes in nucleus-nucleus collisions. Hence, mCBM@SIS18 will allow to test and optimize the performance of the detector systems including the software chain under realistic experiment conditions which will significantly reduce the commissioning time for CBM at SIS100. At this presentation an overview on the project will be given.

HK 16: Instrumentation IV

Zeit: Dienstag 11:00–12:30 Raum: F 072

Gruppenbericht HK 16.1 Di 11:00 F 072
Barrel Time-of-Flight detector for the PANDA experiment — •Ken Suzuki[1], Marius Chirita[1], Lukas Gruber[1], Dominik Steinschaden[1], Sebastian Zimmermann[1], Merlin Böhm[2], Albert Lehmann[2], Carsten Schwarz[3], Herbert Orth[4], Kai Brinkmann[5], Kamal Dutta[6], and Kushal Kalita[6] for the PANDA-Collaboration — [1]SMI — [2]Erlangen — [3]GSI — [4]HIM — [5]Gießen — [6]Assam

We describe the technical layout and the expected performance of the Barrel Time-of-Flight detector (Barrel TOF) for the PANDA target spectrometer. The Barrel TOF detector has been designed to precisely measure the time at which a charged particle transits the detector with a resolution superior to the other sub-detectors. It will signal the topology of physics events, hence setting cornerstones for event classification. The implementation of the Barrel TOF is based on very fast organic scintillator tiles coupled to Silicon Photomultipliers, in total 2000 scintillators and 16k SiPMs will be used, covering 5 m^2. The detector R&D is now in an advanced stage and the technical design report is being reviewed by the collaboration.

Gruppenbericht HK 16.2 Di 11:30 F 072
The CBM Time-of-Flight wall — •Ingo Martin Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg, Heidelberg

The Compressed Baryonic Matter spectrometer (CBM) is a future heavy ion experiment located at the Facility for Anti-proton and Ion Research (FAIR) in Darmstadt, Germany. The main interest of CBM is the investigation of the phase diagram of strongly interacting matter in the region of the highest baryon densities. In order to measure the necessary observables with unprecedented precision an excellent particle identification is required. The key element providing hadron identification at incident energies between 2 and 35 AGeV will be a 120 m^2 large Time-of-Flight (ToF) wall composed of Multi-gap Resistive Plate Chambers (MRPC) with a system time resolution better than 80 ps. The most demanding challenge, however, is the enormous incident particle fluxes between 100 Hz/cm^2 and 25 kHz/cm^2 generated at the highest interaction rates (10 MHz) that CBM is designed for.
The current conceptual design of the ToF-wall which is based on a modular structure composed of modules containing 4 different counter types called MRPC1 - MRPC4 will be presented. In order to elaborate the final MRPC design of these counters heavy ion test beam times were performed at SPS/CERN. In this contribution we will present recent performance test results regarding time resolution, efficiency, cluster size and rate capability for several counter types.
Work was supported partially by BMBF 05P2015 and by EU/FP7-HadronPhysics3/WP19.

HK 16.3 Di 12:00 F 072
ALICE HLT readout and FPGA based data processing in Run 2 — •Heiko Engel and Udo Kebschull for the ALICE-Collaboration — IRI, Goethe-Universität Frankfurt

The ALICE High Level Trigger (HLT) is a computing cluster dedicated to the online reconstruction, analysis and compression of experimental data. The High-Level Trigger receives detector data via serial optical links into custom PCI-Express based FPGA readout cards installed in the cluster machines. The readout cards provide the data to the host machines via Direct Memory Access (DMA). Raw data from the Time Projection Chamber (TPC) is processed already in the FPGA with a hardware cluster finding algorithm. This implementation is significantly faster than a software implementation and saves a great amount of CPU resources in the HLT cluster. It also provides some data reduction while introducing only a marginal additional latency into the readout path. This algorithm was ported to the new HLT readout hardware for Run 2, was improved for higher link rates and adjusted to the upgraded TPC Readout Control Unit (RCU2). A flexible firmware implementation allows both the old and the new TPC data format and link rates to be handled transparently. Extended protocol and data error detection, error handling and the enhanced RCU2 data ordering scheme provide an improved physics performance of the cluster finder. This contribution describes the state of the firmware developments in the HLT, the integration of the readout into the HLT framework as well as the FPGA based TPC cluster finding and its adoption to the changed readout conditions during Run 2.

HK 16.4 Di 12:15 F 072
Tracklet-based PID for the ALICE TRD Upgrade for LHC RUN 3 — •Hannah Klingenmeyer for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

The purpose of the Transition Radiation Detector (TRD) at the Large Hadron Collider (LHC) is to provide electron identification as well as particle tracking in the central barrel of A Large Ion Collider Experiment (ALICE). For the upgrade programme of the TRD for LHC RUN 3, the read-out of online-processed track segments instead of raw clusters in order to reduce the data volume and increase the read-out speed is foreseen. These so-called tracklets contain information about position, incident angle and particle identification (PID), written to a 32-bit word. The challenge of a tracklet-only read-out in terms of PID will be to ensure the highest performance possible with the bit size available in the tracklet word. In this talk, the current state of a tracklet-based PID approach to be used in LHC RUN 3 is discussed. A multi-dimensional likelihood method is applied to the tracklet data, enabling the extraction of the pion rejection for a given electron efficiency as a means of judging the quality of the PID performance.

HK 17: HK+T Joint Session III: Gas Detectors/GEM

Zeit: Dienstag 11:00–12:30 Raum: F 102

HK 17.1 Di 11:00 F 102
The tracking system for NA64 at CERN SPS — •Michael Hösgen, NA64 Collaboration, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Deutschland

NA64 is a new experiment at CERN SPS, which conducts a direct search for invisible decays of sub-GeV dark photons (A'). The A' might be produced by 100 GeV electrons incident on an active target Electromagnetic Calorimeter (ECAL) in the reaction $e^- Z \to e^- Z A'$ via kinetic mixing with photons. The A's supposedly decay invisibly into dark matter particles resulting in a large amount of missing energy.

To verify the momentum of the incident electrons and to clean-up the event sample, tracking of the electrons is crucial for this experiment. The tracking system utilises four Micromegas (MM) and two Gas Electron Multiplier (GEM) detectors. The GEM detectors used in the tracking system have three $10 \times 10\,(cm)^2$ standard GEM foils and a two layer strip readout resulting in 256 channels per plane. As conversion gas an Ar/CO2 (70/30) mixture is used. Tracks will be reconstructed using the tracking framework GENFIT II.

In this talk the performance of the tracking system, especially the GEMs, will be presented. I will also show new limits on the $\gamma - A'$ mixing deduced from a first run in 2016.

HK 17.2 Di 11:15 F 102
Entwicklung und Beamtestergebnisse eines GEM-basierten TPC-Auslesesystems — •Paul Malek für die LCTPC-Deutschland-Kollaboration — Deutsches Elektronen-Synchrotron DESY — Universität Hamburg, Institut für Experimentalphysik

Für den *International Large Detector* (ILD) am geplanten *International Linear Collider* (ILC) ist eine Zeitprojektionskammer (*Time Projection Chamber*, TPC) als zentraler Spurdetektor geplant. Um die nötige Spurauflösung zu erreichen, ist ein Gasverstärkungs- und Auslesesystem mit mikrostrukturierten Gasdetektoren (*Micro Pattern Gaseous Detectors*, MPGD) vorgesehen. Eine der untersuchten Möglichkeiten für die Gasverstärkung und Detektion sind Gas-Electron-Multiplier (GEM).

In dem Beitrag wird ein GEM Modul vorgestellt, dass mit Hilfe von Keramikstrukturen eine sehr grosse Abdeckung der Fläche erreicht, bei gleichzeitiger Minimierung des Materials. Durch Entwicklung von geeigneten Prozeduren und Werkzeugen zur Produktion konnten die Parameter des Module wie Flachheit und Stabilität deutlich verbessert werden. Ergebnisse umfangreicher Messungen im DESY Teststrahl werden vorgestellt. Der Einfluss der besseren Modul Parameter auf Auflösung und insbesondere für die Messung des spezifischen Energieverlustes, dE/dx, werden diskutiert.

HK 17.3 Di 11:30 F 102

Study of electrostatic charge-up phenomena in Gas Electron Multipliers — •Philip Hauer, Steffen Urban, Markus Ball, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, DE

Gas Electron Multipliers (GEM) are widely used as amplification stage in gaseous detectors exposed to high rates, e.g. in the Time Projection Chamber of the ALICE (A Large Ion Collider Experiment) experiment after its upgrade. The GEM consists of a polyimide foil which is coated by two thin copper layers. GEM have a high density of holes, where charges are multiplied if suitable voltages are applied. One critical property is the electrostatic charge-up of GEM. It occurs when the trajectories of drifting ions or electrons end on the polyimide surface. Since polyimide is a very good insulator, the charge remains there. The charge-up influences key properties of the GEM, e.g. the gain.

The characteristics of the charge-up process are studied in simulations. The electrostatic environment is calculated with a finite-element method. Afterwards, the movement of single particles in the electrostatic environment is simulated. The possibility to study the behaviour of single charges gives insight on the charge-up process. Furthermore, the simulated properties are cross-checked with measurements. Results of the measurements and simulations of the charge-up effect will be presented. Additionally, the influence of different parameters, e.g. the rate of incoming radiation, on the time constant of the charge-up process will be discussed.

Supported by BMBF.

HK 17.4 Di 11:45 F 102

Status of the Digitization for the Upgraded ALICE GEM-TPC — •Andreas Mathis[1] and Jens Wiechula[2] for the ALICE-Collaboration — [1]TU München, Physik Department E62, Excellence Cluster 'Universe', Garching — [2]Institut für Kernphysik, Goethe-Universität, Frankfurt am Main

The ALICE Collaboration is planning a major upgrade of its central barrel detectors to be able to cope with the increased LHC luminosity beyond 2019. In order to record at an increased interaction rate of up to 50 kHz in Pb–Pb collisions, the TPC will be operated in an ungated mode with continuous readout. This demands for a replacement of the currently employed gated Multi-Wire Proportional Chambers by GEM-based (Gas Electron Multiplier) readout chambers, while retaining the performance in particular in terms of particle identification capabilities via the measurement of the specific energy loss.

The increase in interaction rate and the requirements of a triggerless, continuous readout demand for significant modifications of the front-end cards, the computing system and the corresponding calibration, reconstruction and simulation framework. In particular, the upgraded readout scheme of the TPC with GEMs requires a complete re-design of the digitization, which includes a detailed simulation of the detector response after electron amplification in a stack of four GEM-foils.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe' and BMBF-Verbundprojekt ALICE at High Rate 05P15WOCA1.

HK 17.5 Di 12:00 F 102

Discharge studies with a double GEM setup — •Alexandra Datz[1,2] and Alexander Deisting[1,2] for the ALICE-Collaboration — [1]GSI, Darmstadt — [2]Physikalisches Institut, Heidelberg

The interaction rate of lead-lead collisions at the LHC will increase to 50 kHz during run 3. Hence an upgrade of the readout chambers of the Time Projection Chamber (TPC) of ALICE is necessary. New readout chambers equipped with stacks of four Gas Electron Multipliers (GEMs) have been developed. These allow for a continuous readout and preserve the momentum and dE/dx resolution of the current TPC. However, the new chambers have a higher risk to be damaged during a discharge than the current wire chambers. It has been confirmed at beam tests that the high voltage (HV) settings of the GEM stacks have a sufficiently low discharge probability. In order to understand the discharge mechanism and to further minimize the discharge probability, studies with small detectors have been carried out and will be presented here.

Our detector consists of two GEMs (10x10cm^2), a drift cathode and a readout plane. Discharges are triggered intentionally by increasing the voltage of one of the GEMs and releasing alpha particles in the gas (Ar-CO2 90-10). The potentials on the GEM sides and the signal at the readout plane are recorded to study the influence of different parameters, such as different resistors in the HV supply lines for the GEMs, on the discharge behavior. Results on secondary discharge probabilities are also shown.

HK 17.6 Di 12:15 F 102

GEM discharge protection with a resistive copper oxide layer — •Oleksiy Fedorchuk for the LCTPC-Deutschland-Collaboration — Deutsches Elektronen-Synchrotron, 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 study the discharge processes and improve the long term high voltage stability 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 22×18cm^2 GEM foils. A novel treatment of the GEM foils by applying a resistive layer of copper oxide will be presented. The impact of this treatment on the high voltage stability and the GEM performance will be discussed. First results from using these GEMs in a prototype TPC will be presented.

HK 18: HK+T Joint Session IV: Pixel Detectors

Zeit: Dienstag 11:00–12:20 Raum: F 073

HK 18.1 Di 11:00 F 073

MuPix8 - a large HV-MAPS prototype — •Heiko Augustin for the Mu3e-Collaboration — Physikalisches Institut, Universität Heidelberg

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

The MuPix7 prototype showed the tremendous possibilities of this technology to build fast, monolithic pixel sensors of 50μm thickness.

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

Further the road map for the characterisation and future R&D towards the final pixel sensor for the Mu3e pixel tracker is depicted.

HK 18.2 Di 11:15 F 073

Large Area Monolithic Pixel Detectors for HL-LHC & Future High Rate Experiments — •Tamasi Rameshchandra Kar, Adrian Herkert, and André Schöning — Physikalisches Institut, Universität Heidelberg, Germany

The high luminosity upgrade of the LHC (HL-LHC) aims to increase the luminosity to five times the designed luminosity to explore and better understand several interesting physics processes. This poses several challenges to the present design of the detector due to increased occupancy, very high pileup (∼ 200) and radiation dense environment.

Recent advancements in HV-CMOS technology gave birth to thin, radiation hard monolithic pixel detectors at a cost per unit area comparable to traditional strip detectors. This opens up the possibilities unthinkable in the past, e.g. it is possible to construct large area pixel detectors for experiments like ATLAS, CMS and other future collider experiments.
Track triggers are on the wish-list for many experiments as a key trigger to harvest interesting physics. A track trigger based on a triplet design comprising of three layers of monolithic pixel sensors is proposed for the ATLAS inner tracker. The feasibility of such a track trigger operated at the first level at 40 MHz is exploited based on a full Geant4 simulation. In addition a design proposal for such a triplet trigger using Mupix8, a first large High Voltage Monolithic Active Pixel Sensor (HV-MAPS) prototype will be presented.

Gruppenbericht HK 18.3 Di 11:30 F 073

The vertex detector of NA61/SHINE* — •Michael Deveaux for the NA61/SHINE-Collaboration — Goethe Universität Frankfurt

The vertex detector of NA61/SHINE at the CERN SPS aims to collect open charm data in Pb+Pb collisions at high SPS energies. In a first phase, the so-called Small Acceptance Vertex Detector (SAVD) was developed and installed. It consists of four layers of 50 μm thin MIMOSA-26AHR CMOS sensors providing a spatial resolution of ~ 3.5 μm. The sensors are integrated on the new ultra-lightweight support and cooling carbon fiber structures developed for the ALICE ITS upgrade. The readout of the detector and the techniques for integrating the sensors were derived from the prototype of the CBM Micro Vertex Detector.

We discuss the concept and design of the detector and show first results on the detector performance as obtained from a beam test with a 150A GeV/c Pb+Pb beam carried out in December 2016. Moreover, we give an outlook toward the construction of a full vertex detector.

* Supported by the Polish NCN (2014/15/B/ST2/02537), St-Petersburg Univ. (11.38.242.2015) and HIC for FAIR.

HK 18.4 Di 11:50 F 073

Performance Studies of Belle II DEPFET Pixel Ladders in Test Beams — •Philipp Wieduwilt, Ulf Stolzenberg, Harrison Schreeck, Benjamin Schwenker, and Ariane Frey — Georg-August-Universität Göttingen

The construction of the new e^+e^--accelerator at the Japanese Flavour Factory (KEKB) has been finalized and the commissioning of its detector experiment (Belle II) is planned to be finished early 2017. The improved e^+e^- collider "SuperKEKB" will deliver an instantaneous luminosity of $8 \cdot 10^{35}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$, which is 40 times higher than the world record set by KEKB. In order to be able to fully exploit the increased number of collision events, and to provide high precision measurements of the decay vertices of the B meson systems in such a harsh environment, the Belle II detector will be equipped with a newly developed silicon vertex detector, which is based on the DEPFET technology. The DEPFET pixels are field effect transistors on a fully depleted silicon bulk and they combine signal detection and amplification per pixel. The new pixel detector is located closest to the interaction point and consists of two layers of active pixel sensors. Belle II will use DEPFET sensors thinned to 75 μm with low power consumption and low intrinsic noise. Beam test campaigns were conducted in order to study the performance of the pixel sensor modules. This talk will present the collected results of the April 2016 beam test and performance studies of the latest front-end read-out ASIC designs.

HK 18.5 Di 12:05 F 073

Evaluation of Innovative Cooling Concepts with High Performance Carbon Material for Vertex Detectors operated in Vacuum — •Daniela Mijatovic for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

Vertex detectors operating in vacuum have to feature, besides a low material budget, also an excellent cooling performance to ensure the efficiency of the sensors. High-performance, carbon-based materials allow to resolve this contradiction, following the concept of heat conduction to guide the heat dissipated by the sensors to heat converters located outside the detector acceptance.

Sensor carrier materials based on graphite (e.g. low-cost Thermal Pyrolythic Graphite (TPG)) and Chemical Vapor Deposited (CVD) diamond were systematically studied. To do so, IR thermography is employed supplemented by PT100 sensors to quantitatively examine the thermal performance of MVD detector modules in vacuum. In addition, we compare the results with dedicated simulations (Autodesk CFD Motion) on the heat load of detector modules.

This contribution presents our work in designing and testing innovative carrier material assemblies to efficiently cool ultra-thin vertex detectors in the context of constructing the Micro-Vertex-Detector (MVD) for CBM at the future FAIR facility.

* This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 19: Hadron Structure and Spectroscopy III

Zeit: Dienstag 14:00–16:15 Raum: F 5

Gruppenbericht HK 19.1 Di 14:00 F 5

Measurement of Electromagnetic Form Factors of Nucleons at the BESIII Experiment — •Dexu Lin[1,2], Samer Ali Nasher Ahmed[1,2], Alaa Dbeyssi[1], Paul Larin[1,2], Frank Maas[1,2,3], Cristina Morales[1], Christoph Rosner[1,2], Yadi Wang[1], and Bo Zheng[1,4] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germay — [3]PRISMA Cluster of Excellence, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germay — [4]University of South China, 421001 Hengyang, China

BEPCII is a symmetric e^+e^--collider located in Beijing running at $\sqrt{s}$ energies between 2.0 and 4.6 GeV. This energy range allows the BESIII experiment to measure hadron form factors both from direct e^+e^--annihilation and from initial-state-radiation processes. Results on $e^+e^- \to p\bar{p}$ based on data at $\sqrt{s}$ energies between 2.22 to 3.67 GeV collected by BESIII in 2011 and 2012 are presented. We also report preliminary results on both tagged and untagged analyses with the initial-state-radiation process $e^+e^- \to p\bar{p}\gamma$ based on data samples at $\sqrt{s}$ energies between 3.773 to 4.60 GeV. Finally, expectations on the measurement of nucleon electromagnetic form factors from the BESIII high luminosity energy scan in 2015 are also presented.

Gruppenbericht HK 19.2 Di 14:30 F 5

The A4 experiment at MAMI — •Luigi Capozza[1,2], David Balaguer Ríos[1], Sebastian Baunack[1,3], Jürgen Diefenbach[1], Boris Gläser[1,2], Yoshio Imai[1,2], Eva-Maria Kabuss[1], Jeong-Han Lee[1], Frank Maas[1,2,3], Maria Carmen Mora Espí[1,2], Ernst Schilling[1], Dietrich von Harrach[1], and Christoph Weinrich[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The A4 experiment at the MAMI accelerator facility at Mainz studies the nucleon structure by measuring beam single spin asymmetries in the electron-proton scattering. Longitudinal spin measurements, i.e. parity violating (PV), for accessing the strangeness contributions to the nucleon form factors, as well transverse spin measurements, sensitive to higher order QED corrections, have been performed on both hydrogen and deuterium targets at both forward and backward angles. A review of the experimental programme with emphasis on the recently published results and the ongoing data analysis activities will be given. The status of the latest attempt of extracting the PV asymmetry from inclusive single-pion electroproduction in the invariant mass range from threshold to the maximum of the $\Delta(1232)$ resonance will be reported.

HK 19.3 Di 15:00 F 5

Beam normal spin asymmetries in the A4 experiment at backward angles — •David Balaguer Ríos for the A4-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

In the A4 experiment at the MAMI accelerator facility the beam normal spin asymmetries in the electron-proton elastic scattering and in the electron-deuteron quasielastic scattering have been measured at $Q^2 = 0.23$ (GeV/c)^2 and $Q^2 = 0.35$ (GeV/c)^2 at backward angles. The analysis of the data is presented and the comparison of the measurements with the theoretical calculation from B. Pasquini et al.

HK 19.4 Di 15:15 F 5

Radiative corrections on $\bar{p}p \to e^+e^-$ with the PANDA experiment at FAIR — •Manuel Zambrana[1,2], Alaa Dbeyssi[1], Frank Maas[1,2,3], Egle Tomasi-Gustafsson[4], Yuri M. Bystritskiy[5], Vladimir A. Zykunov[5], Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[1], Bertold Fröhlich[1,2], Phillip Grasemann[1,2], Sebastian Haasler[1,2], David Izard[1], Dmitry Khaneft[1,2], Jörg Köhler[1,2], María Carmen Mora Espí[1], Oliver Noll[1,2], David Rodríguez Pieñeiro[1], Javier Jorge Rico[1], Sahra Wolff[1,2], and Iris Zimmermann[1,2] — [1]Helmholtz-Institut Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg Universität, Mainz, Germany — [3]Prisma Cluster of Excellence, Mainz, Germany — [4]CEA, IRFU, SPhN, Saclay, France — [5]Joint Institute for Nuclear Research, Dubna, Russia

Simulations studies have shown that the PANDA detector at FAIR will be capable of measuring the timelike electromagnetic form factors of the proton via the reaction $\bar{p}p \to e^+e^-$ with a precision of a few percent at low q^2, thus demanding to take into account radiative corrections. First order radiative corrections to $\bar{p}p \to e^+e^-$ have been calculated in the point-like approximation, including both virtual and real corrections, and interference effects. Suitable event generators to be used in the framework of the PANDA experiment have been developed on the basis of the calculated cross section.

HK 19.5 Di 15:30 F 5

Measurement of the Proton Formfactor by using the MAGIX Jet-Target @A1 — •Stephan Aulenbacher für die MAGIX-Kollaboration — Institut für Kernphysik, Mainz, Deutschland

Within the next decade a new experiment will be built and will start to be operated at the Institut für Kernphysik at the University of Mainz, exploiting the powerful electron beam of the new MESA accelerator. The Target of this experiment - MAGIX - will use a Jet-Target. A Prototype of this Target will be finished till Summer 2017. To test the target we will Perform a Measurement of the Proton Fomfactor via the ISR technique @A1. According to a simulation the Jet Taret should reduce the Background significantly. This Talk will be about the Measurement and the implementation of the Hardware @A1.

HK 19.6 Di 15:45 F 5

Study of chiral dynamics in $\pi^-\pi^0\pi^0$ production in Primakoff reactions at COMPASS — •Markus Krämer — Technische Universität München, Garching, Germany

COMPASS is a multipurpose fixed-target experiment at the CERN SPS, which addresses a wide variety of physic topics, in particular the structure and spectroscopy of hadrons. Diffractive dissociation of pions on nuclear targets allows for a clean access to the light-meson spectrum. * In addition, meson production is studied in pion-photon reactions via the Primakoff effect, where high-energetic pions scatter off the quasi-real photons surrounding the target nuclei. At low pion-photon center-of-mass energies, these reactions are governed by chiral dynamics and can be calculated using chiral perturbation theory. At higher energies, resonances are produced and their radiative coupling is investigated.

Using a 191 GeV/c negatively charged hadron beam (consisting mostly of pions) and a Ni target, 1.2 Million exclusive $\pi^-\pi^0\pi^0$ events have been recorded in the region of small squared four-momentum transfer, i.e. $t' < 0.026\,\mathrm{GeV}^2/c^2$. At very low $t' < 0.002\,\mathrm{GeV}^2/c^2$, the contribution from electromagnetic interactions become visible in the t' spectrum. This is used to determine the differential cross-section $\sigma(\pi^-\gamma \to \pi^-\pi^0\pi^0)$ near the three-pion threshold, where this reaction is dominated by chiral dynamics. In an alternative approach, this cross-section is determined by applying a partial-wave decomposition. Both methods and the obtained results will be presented.

HK 19.7 Di 16:00 F 5

Measurement of the cross section $e^+e^- \to \pi^+\pi^-\pi^0\pi^0$ at the BaBar Experiment — •Konrad Griessinger for the BaBar-Collaboration — Institut für Kernphysik, University of Mainz, Germany

One of the most significant deviations from the Standard Model (SM) in laboratory experiments can be observed when comparing the SM prediction and the direct measurement of $g-2$ of the muon. In order to increase the current significance to the level where evidence of this effect may be claimed or rejected, the experimental input for the theoretical prediction needs to be improved. For this purpose the most pressing issue is the precision measurement of the semi-neutral four pion cross section $\sigma(e^+e^- \to \pi^+\pi^-\pi^0\pi^0)$. This channel has recently been measured on the full BaBar data set, where its cross section as well as the contribution to the muon $g-2$ and the running of the fine structure constant $\Delta\alpha$ are evaluated.

HK 20: Heavy Ion Collisions and QCD Phases IV

Zeit: Dienstag 14:00–16:15 Raum: F 1

Gruppenbericht HK 20.1 Di 14:00 F 1

Femtoscopy in Pb-Pb collisions with ALICE — •Hans Beck for the ALICE-Collaboration — University of Heidelberg

Femtoscopy exploits quantum-statistical and final-state interaction induced correlations to probe the spatio-temporal extent of the particle emitting source. We review the most recent results in Pb-Pb collisions by ALICE; among them measurements involving strangeness-carrying baryons, where the aim is to determine the strong two-body interaction potentials as well as source dynamics through the investigation of the transverse mass dependence of source radii. The latter is also performed with identical kaon pair measurements, where new three-dimensional results highlight the importance of the inclusion of a hadronic phase in the modeling of heavy-ion collisions. New avenues are pursued with non-identical kaon pair measurements which inter alia might identify a tetra-quark particle. We conclude by showing source extent studies with respect to the event plane and will outline prospective analyses, e.g. photon-photon correlation measurements.

HK 20.2 Di 14:30 F 1

Measurement of Identified Hadron Production in Charged Jets from Proton-Lead Collisions with ALICE at the LHC — •Martin Schmidt for the ALICE-Collaboration — Physikalisches Institut, Universität Tübingen

The spectra of identified hadrons in jets offer possibilities to investigate the fragmentation of partons in detail. By comparing the results for proton-proton (pp) and proton-lead (p-Pb) collisions we can test hypotheses about cold nuclear matter effects.

The ALICE experiment at the LHC has excellent particle identification capabilities for tracks with transverse momentum ranging from 150 MeV/c to above 20 GeV/c. It therefore can measure identified hadrons in a way that is unique at the LHC.

In p-Pb collisions the underlying event, coming from soft interactions, cannot be neglected and spoils the jet measurements. We present methods to measure the individual contributions of π/K/p to the underlying event and discuss how to properly subtract it from the particle production inside the jet area. The study of the underlying event in p-Pb collisions also serves as a proof of principle to adapt the methods later on for lead-lead (Pb-Pb) collisions where the underlying event is huge.

We show the corrected jet constituent spectra from p-Pb collisions with systematic uncertainties as a function of $p_{\mathrm{T}}^{\mathrm{track,charged}}$ and $z = p_{\mathrm{T}}^{\mathrm{track,charged}}/p_{\mathrm{T}}^{\mathrm{jet,charged}}$.

Work supported by grant BMBF-05P15VTCA1.

HK 20.3 Di 14:45 F 1

Jet-hadron correlations in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with ALICE — •Jiyoung Kim for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

In the presence of Quark Gluon Plasma (QGP) created in ultra relativistic heavy ion collisions, jets probe the strongly-interacting medium. Jets are collimated sprays of particles produced from fragmenting hard scattered partons. When high energetic partons pass through the QGP, they interact with the medium and lose a part of their energy. This phenomenon, called jet quenching, has been observed as a suppression of high transverse momentum particles and disappearance of opposite side in di-jet production. A quantitative understanding of the mechanisms of parton energy loss and the parton-medium interaction is not yet established. Model calculations suggest the formation of Mach cones as a result of the interaction between partons and the QGP.

We present an analysis of azimuthal correlations of inclusive hadrons with respect to the axis of charged jets in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02TeV with the ALICE detector. Jet-hadron and jet-proton correlations allow to study the interaction between jets and the medium and allow to disentangle jet fragmentation and the medium response. The status of the analysis will be presented.

HK 20.4 Di 15:00 F 1

Recent measurements of jet substructure in Pb-Pb collisions at ALICE — •Leticia Cunqueiro for the ALICE-Collaboration — University of Muenster

We report recent measurements of jet substructure in Heavy Ion Collisions at ALICE. Those measurements are the jet mass, the ratio of 2-Subjettiness to 1-Subjettiness calculated with respect the two subjet axes given by kT in exclusive mode as well as the aperture angle between these axes. These observables probe different aspects of the jet evolution in the presence of a Quark Gluon Plasma: while the mass probes possible broadening/collimation of the jet shower, the Subjettiness measurements are used to investigate the role of coherence. Coherence effects relate to the ability of the medium to resolve a jet*s substructure, which has an impact on the energy loss magnitude and mechanism of the traversing jet. New techniques are used to subtract background, to suppress combinatorial jets and to unfold simultaneously the shape and the jet pT to provide fully corrected measurements in central Pb-Pb collisions at sqrtsNN =2.76 TeV

HK 20.5 Di 15:15 F 1

Beauty-jet reconstruction using the track counting method in pp collisions with ALICE at the LHC — •Linus Feldkamp for the ALICE-Collaboration — Institut für Kernphysik, Westfälische-Wilhelms-Universität Münster

Charm and beauty quarks, produced in the early stage of heavy-ion collisions, are ideal probes to study the characteristics of the hot and dense deconfined medium (Quark-Gluon Plasma) formed in these collisions. The radiative energy loss of high energy partons interacting with the medium is expected to be larger for gluons than for quarks, and to depend on the quark mass, with beauty quarks losing less energy than charm quarks, light quarks and gluons. Therefore, a comparison of the modification in the momentum distribution or possibly in the jet shape of beauty-jets with that of light flavour or c-jets in Pb-Pb collisions relative to pp collisions allows to investigate the mass dependence of the energy loss. It also allows to study the redistribution of the lost energy and possible modifications to b-quark fragmentation in the medium. The track counting method exploits the large rϕ-impact parameters, $d_0 = |\vec{d_0}|$, of B-meson decay products to identify beauty-jets. The signed rϕ-impact parameter, $d_0 = sign(\vec{d_0} \cdot \vec{p}_{\rm jet})d_0$, is calculated for each track in the jet cone, where $\vec{d_0}$ is pointing away from the primary vertex. The distribution of the n-th largest signed impact parameter in a jet is sensitive to the flavour of the hadronizing parton and allows to select jets coming form beauty on a statistical basis. In this contribution, we give an overview of the beauty jet measurement using the track counting method with ALICE in pp collisions at $\sqrt{s} = 7$ TeV.

HK 20.6 Di 15:30 F 1

Shear viscosity and entropy of a hadron gas — •Jean-Bernard Rose[1,2], Dmytro Oliinychenko[1,2], Juan Torres-Rincon[1], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced studies, Frankfurt am Main, Deutschland — [2]Goethe Universität, Frankfurt am Main, Deutschland — [3]GSI Helmholzzentrum für Schwerionenforschung, Darmstadt, Deutschland

Microscopic non-equilibrium dynamics are used to calculate the transport coefficients of dense hadronic matter. Specifically, the shear viscosity to entropy density ratio is investigated, its temperature dependence between 75 MeV and 175 MeV is explored, and the effects of non-zero baryon and strange chemical potentials are probed. This is important to constrain the value of shear viscosity over entropy density used in hydrodynamic calculations of heavy ion reactions at RHIC and the LHC. Calculations are initialized using particle densities computed from a thermal model in a hadronic box simulating infinite matter. After an equilibration delay, the shear viscosity is computed using the Green-Kubo formalism. We use the Gibbs formulato get the entropy density and spectral fitting to obtain the equilibrated temperatures and chemical potentials of the system. The results for the entropy and shear viscosity of a massive and massless pion gas are compared to analytic estimates. The shear viscosity to entropy density ratio is found to be significantly lower than found in previous similar calculations, but in qualitative agreement with other calculations using other methods. This will be the starting point for the calculation of more transport coefficients as functions of temperature and chemical potential.

HK 20.7 Di 15:45 F 1

A generalized quasiparticle model for hot QCD matter — •Thorsten Steinert and Wolfgang Cassing — Institut für Theoretische Physik, JLU Giessen, 35392 Giessen, Germany

The QCD equation of state as predicted by lattice QCD calculations (lQCD) is well reproduced in terms of effective quasiparticle models. These models so far fail to describe the susceptibilties and underestimate the pressure at finite densities. We present a generalised quasiparticle model where the partonic propagators explicitly depend on the three-momentum with respect to the medium. Within this extended model we reproduce simultaneously the equation of state and the susceptibilties as provided by lQCD. We calculate the shear and bulk viscosity as well as the electric conductivity and compared them to default quasiparticle models. We find a good agreement between our model and available lattice data for all transport coefficients. We use thermodynamic consistency to extend the model to finite chemical potential.

HK 20.8 Di 16:00 F 1

Baryon-baryon femtoscopy in pp collisions at 7 TeV with ALICE at the LHC — •Oliver Arnold for the ALICE-Collaboration — Physik Department, Technische Universität München, Garching, Germany — Excellence Cluster "Universe", Garching, Germany

Two-particle correlation functions at low relative momenta are sensitive to the size of the emission zone of the particles. By knowing the interaction of the emitted particle pair very precisely it is possible to make a detailed study of the source size of the system, which has an extension on the fermi scale. This is usually done with particle pairs, where the interaction is precisely known. However, if the size of the emission zone is constrained one can use the femtoscopy technique to investigate the interaction between pairs of particles where not much is known about the interaction.

We use the femtoscopy technique to measure the correlation functions of proton-proton, proton-Lambda and Lambda-Lambda pairs, which were produced in pp collisions at 7 TeV at the Large Hadron Collider and measured with the ALICE experiment. This is the first femtoscopy measurement with baryon pairs at such a large energy and small system. We show that a simultaneous fit of the proton-proton and proton-Lambda correlation functions is sensitive to scattering parameters of the proton-Lambda pair. This opens the possibility to investigate the interaction of proton-Lambda pairs complementary to scattering experiments. This work is supported by HIC for FAIR, HGS-HIRe and BMBF FSB 202.

HK 21: Heavy Ion Collisions and QCD Phases V

Zeit: Dienstag 14:00–16:15 Raum: F 3

Gruppenbericht HK 21.1 Di 14:00 F 3

Neutral meson measurements with ALICE — •Annika Passfeld for the ALICE-Collaboration — WWU Münster

With the ALICE experiment, neutral mesons (π^0, η) can be measured via their two photon decay channel. Therefore, several analysis methods including the electromagnetic calorimeters PHOS and EMCal and the reconstruction of converted photons with the tracking detectors ITS and TPC can be used.

In this group report the different detection techniques will be presented. The results for pp, p-Pb and Pb-Pb collisions will be compared and discussed in the context of initial state modifications, final state interactions, and collective effects.

This work has been supported by BMBF (FSP201-ALICE).

HK 21.2 Di 14:30 F 3

Neutral Meson Production in pp and p-Pb Collisions Measured with ALICE Calorimeters — •Fabian Pliquett for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The properties of the quark-gluon plasma, a hot and dense state of matter created in high-energy nucleus-nucleus collisions, are investigated by ALICE, the dedicated heavy-ion experiment at the LHC, by means of particle production measurements. At high transverse momentum they provide information on the energy-loss mechanism of partons in the plasma. The measurement of neutral meson production complements other measurements of identified particles in the experiment. pp and p-Pb collisions function as control experiments to facilitate a better understanding of particle production in heavy-ion collisions. In ALICE, the reconstruction of neutral mesons is conducted by measuring the energy and position of the decay photons from the two-photon decay channel.

In this talk, the status of the neutral-meson measurements in pp and p-Pb collisions with two of the ALICE calorimeters, PHOS and EMCal, will be presented.

Supported by BMBF and the Helmholtz Association.

HK 21.3 Di 14:45 F 3

Reconstruction of neutral pions at CBM-RICH detector via conversion* — •Ievgenii Kres, Karl-Heinz Kampert, and Christian Pauly for the CBM-Collaboration — Wuppertal University

The Compressed Baryonic Matter (CBM) experiment at the future FAIR complex will investigate the phase diagram of strongly interacting matter at high baryon density and moderate temperatures in A+A collisions from 2-11 AGeV (SIS100). A central component of the proposed detector setup is a Ring Imaging Cherenkov Detector (RICH) using CO_2 as radiator gas, a focussing optics with a large spherical mirror, and, as a result of recent CBM RICH geometry optimizations, a cylindrically shaped photon detection surface. As leptons are not affected by hadronic final state interactions, the dilepton spectrum, in particular dileptonic decays of light vector mesons like ρ or ω, offers the possibility to look into the dense fireball. At the low mass region, this spectrum is dominated by physical background from π^0 and η mesons, mainly decaying into photons suffering subsequent conversion processes. The presented analysis aims at reconstructing π^0 and η mesons via double conversion $\left(\pi^0 \rightarrow \gamma\left(e^+e^-\right) + \gamma\left(e^+e^-\right)\right)$ inside the target or first detector layers in order to scale these background channels accurately in the integral e^+e^- invariant mass spectrum. Proper counting of the pions requires an exact description of the combinatorical background below the pion invariant mass peak, which is achieved using the event mixing technique. First results of this conversion analysis are presented.

*gefördert durch BMBF 05P15PXFCA und GSI

HK 21.4 Di 15:00 F 3

Measurement of neutral mesons in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with PCM in ALICE — •Meike Danisch for the ALICE-Collaboration — Physikalisches Institut Heidelberg

Neutral mesons can provide important information on the energy loss of partons traversing the hot and dense matter, which is created in high energy heavy-ion collisions. Furthermore, they constitute the largest background contribution for direct photons, which are among the most important tools to study the properties of the Quark Gluon Plasma. In the ALICE experiment, neutral mesons can be measured via their decay to two photons. Apart from the two calorimeters EMCal and PHOS, photons can be reconstructed also via the Photon Conversion Method (PCM). The latter exploits the fact that a photon can convert to an electron-positron pair. These charged particles can be detected via their tracks in the Time Projection Chamber (TPC) and the Inner Tracking System (ITS). The PCM allows the measurement of both photons and neutral mesons, carrying low transverse momenta ($p_T \gtrsim 1$ GeV), with very good energy resolution. Apart from presenting the performance of the photon conversion method, first results on the π^0 and η meson production in Pb-Pb collisions with a center-of-mass collision energy per nucleon of $\sqrt{s_{NN}} = 5.02$ TeV will be shown.

HK 21.5 Di 15:15 F 3

Photon and neutral meson measurements with the conversion method in ALICE: Reducing the material budget uncertainty — •Stephan Stiefelmaier for the ALICE-Collaboration — Physikalisches Institut Heidelberg

One method to measure neutral mesons and direct photons in ALICE is to reconstruct electron-positron pairs from the conversion of photons in the detector material. This approach currently suffers from a 4% systematic uncertainty related to the knowledge of the material budget. A reduction of this uncertainty is key for establishing a signal of thermal direct photons at low p_T ($1 < p_T < 3$ GeV/c) and for discriminating between models describing direct-photon production in heavy-ion collisions. We have explored whether the material budget uncertainty can be reduced by calibrating the rest of the detector material using the TPC gas as a well understood reference.

HK 21.6 Di 15:30 F 3

ϕ meson production in p(3.5 GeV) + Nb reactions. — •Christian Wendisch for the HADES-Collaboration — GSI Helmholtzzentrum Darmstadt

For understanding the behavior of strange particles inside nuclear matter besides the study of complex heavy ion collisions, in particular studies of nucleon-core collisions are well suited. In this contribution we focus on the production of the ϕ meson, carrying hidden strangeness, reconstructed via it's hadronic decay into two charged kaons. The investigated data sample comprises $4 \cdot 10^9$ p(3.5 GeV) + Nb Reactions measured by HADES. We discuss the observed ϕ/ω ratio with respect to the suppression by the OZI rule and to the statistical particle production. In addition the preliminary experimental results are compared to transport model calculations.

HK 21.7 Di 15:45 F 3

Preliminary results on the direct photon excess ratio for the HADES experiment — •Christina Deveaux for the HADES-Collaboration — Justus Liebig Universität, Giessen

Measurements of direct photons from PHENIX and ALICE experiments at high energies show an unexpectedly high yield combined with a large elliptic flow. Both observations cannot be reconciled with current models describing the evolution of the fireball. In order to provide additional empirical data to this discussion, we analyze data on Au+Au collisions at 1.23 AGeV taken by the HADES experiment at GSI Helmholtzzentrum, Darmstadt. We present first results on the direct photon excess ratio as a function of transverse momentum and an estimate of the corresponding systematic uncertainties. Supported by BMBF and HIC for FAIR.

HK 21.8 Di 16:00 F 3

Coherent hypernucleus production in antiproton-nucleus collisions and κ meson — •Alexei Larionov[1], Horst Lenske[2], and Marcus Bleicher[3,4] — [1]National Research Center "Kurchatov Institute", 123182 Moscow, Russia — [2]Institut für Theoretische Physik, Universität Giessen, D-35392 Giessen, Germany — [3]Frankfurt Institute for Advanced Studies (FIAS), D-60438 Frankfurt am Main, Germany — [4]Institut für Theoretische Physik, J.W. Goethe-Universität, D-60438 Frankfurt am Main, Germany

Coherent reactions, when the hypernucleus is produced in a given quantum state, are especially sensitive to the reaction mechanism and to the properties of the Λ-nucleus interaction. In this talk we discuss the exclusive reaction $A(\bar{p},\bar{\Lambda})_{\Lambda}A$ at $p_{\rm lab} = 1.5 \div 20$ GeV/c. The amplitude of the underlying $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ process with bound proton and Λ includes t-channel exchanges by the pseudoscalar K, vector K^*, and the yet to be confirmed scalar κ (i.e. $K_0^*(800)$) $S = \pm 1$ mesons. The relativistic wave functions of the bound proton and Λ are calculated from the static Dirac equation with scalar and vector potentials fitted to describe the binding energy and r.m.s. nucleon radii of the initial nucleus and the phenomenological energy levels of the final hypernucleus. The initial and final state interactions of the antibaryons in the nucleus are described in the eikonal approximation. We show that inclusion of the κ meson strongly influences the beam momentum dependence of the hypernucleus production cross sections in various quantum states. This can be regarded as the first clear signal of the correlated πK 0^+ exchange in $\bar{p}A$ collisions.

HK 22: Structure and Dynamics of Nuclei III

Zeit: Dienstag 14:00–16:15 Raum: F 2

Gruppenbericht HK 22.1 Di 14:00 F 2

Decay Spectroscopy of ^{100}Sn and Neighboring Nuclei — •D. Lubos, R. Gernhäuser, and T. Faestermann for the EURICA RIBF09-Collaboration — Technische Universität München

The region around the heaviest known doubly magic N = Z nucleus ^{100}Sn is a unique playground to study nuclear structure as well as fundamental interactions and it is important towards the understanding of the rp-process in astrophysics. The Gamow-Teller transition of ^{100}Sn is predicted to decay dominantly into the lowest 1^+-state of ^{100}In such that this decay allows for an accurate determination of its transition strength. At the radioactive isotope beam factory (RIBF) of the RIKEN Nishina Center, an experiment has been performed in order to investigate the properties of nuclei in the region of ^{100}Sn. The highly segmented Si-detector array WAS3ABi and the high resolution gamma-spectrometer EURICA, employing HPGe- and LaBr-detectors, have been utilized for the decay spectroscopy. A brief overview of the detector setup and the Geant4-simulation will be given within this presentation. The N = Z - 2 nuclei ^{96}In, ^{94}Cd, ^{92}Ag and ^{90}Pd have been newly identified, half-lives were determined with unprecedented precision throughout the region and the experimentally determined $\mathcal{B}_{\mathrm{GT}}$-value of ^{100}Sn can challenge theoretical models for the first time. Furthermore, the ordering of the lowest energy levels, which is affected by the Wigner-energy, of the neighboring odd-odd N = Z nucleus ^{98}In and its decay channels will be discussed in detail. This project is supported by the DFG Cluster of Excellence: Origin and Structure of the Universe and the Hanns-Seidel-Stiftung.

HK 22.2 Di 14:30 F 2

Isomer spectroscopy with the EURICA gamma-ray setup — •Pär-Anders Söderström[1,2,3], Pieter Doornenbal[3], Giuseppe Lorusso[3,4], Shunji Nishimura[3], Jin Wu[3,5], and Zhengyu Xu[6,7] — [1]GSI, Darmstadt, Germany — [2]TU Darmstadt, Darmstadt, Germany — [3]RIKEN, Wako, Japan — [4]NPL, Teddington, UK — [5]Peking University, Beijing, China — [6]University of Tokyo, Tokyo, Japan — [7]KU Leuven, Leuven, Belgium

Isomer-decay spectroscopy is a sensitive probe of nuclear structure, and is often the only techniques capable of providing data for exotic nuclei that are produced with very low rates. The EURICA project (EUROBALL RIKEN Cluster Array) has been operating between 2012 and 2016 with the goal of performing spectroscopy of very exotic nuclei. Several experimental campaigns have been successfully completed. This contribution will highlight some results obtained within the EURICA project, with special emphasis on isomeric states.

HK 22.3 Di 14:45 F 2

First evidence for shape coexistence in neutron-rich krypton isotopes* — •Kevin Moschner, Andrey Blazhev, and Rosa-Belle Gerst for the SEASTAR-Collaboration — Institut für Kernphysik, Universität zu Köln

Low lying excited states of the nuclei ^{94}Kr and ^{96}Kr were studied after nucleon removal reactions at intermediate beam energies at the RIKEN Radioactive Isotope Beam Factory. Previously unknown γ transitions could be observed for both nuclei. The established level schemes confirm the already observed smooth onset of collectivity which is contrary to the findings in the zirconium and strontium isotopic chains [1]. Additionally, the spectroscopic data show evidence for low-lying 0_2^+ and 2_2^+ states in ^{96}Kr. This indication of shape coexistence in the neutron rich krypton isotopes is in agreement with IBM-2 calculations based on the self-consistent beyond-mean-field approach using the Gogny D1S interaction [2].

[1] M. Albers *et al.*, Phys. Rev. Lett. 108, 62701 (2012)

[2] K. Nomura, N. Shimizu, and T. Otsuka, Phys. Rev. C 81, 44307 (2010)

*Supported by the DFG under Grant No. BL 1513/1-1

HK 22.4 Di 15:00 F 2

Shape coexistence in ^{70}Kr — •Tugba Arici[1], Kathrin Wimmer[2], Wolfram Korten[3], Juergen Gerl[1], and Pieter Doornenbal[4] — [1]GSI Helmholtzzentrum fur Schwerionenforschung, Darmstadt, Germany — [2]Department of Physics, University of Tokyo, Japan — [3]CEA Saclay, IRFU, SphN, France — [4]RIKEN Nishina Center, Saitama, Japan

Nuclei in the vicinity of the N = Z line around A = 70 exhibit very rapid shape changes due to the isospin symmetry breaking related to charge effects. This leads to differences in excitation energy between analogue states in isobaric multiplets. In this study we probed Coulomb energy differences in the T_z = -1 nucleus ^{70}Kr with respect to its mirror ^{70}Se. In ^{70}Kr, no spectroscopic information is available so far. We have performed a Coulomb excitation experiment of ^{70}Kr and ^{72}Kr isotopes to measure the B(E2) value. The experiment was performed at the Radioactive Isotope Beam Factory (RIBF). A ^{78}Kr primary beam at 345 MeV/nucleon was impinging on a Be target. The BigRIPS fragment separator was used in order to deliver the ^{70}Kr and ^{72}Kr isotopes at around 150 MeV/nucleon to the secondary target for Coulomb excitation and inelastic scattering measurements. The emitted gamma-rays of the reaction were detected by the DALI2 array and recoils were identified by the ZeroDegree Spectrometer. Results will allow to make a direct comparison with the mirror nucleus ^{70}Se and will give important new information about shape coexistence across the N = Z line.

HK 22.5 Di 15:15 F 2

In-flight and decay spectroscopy of ^{95}Kr* — •Rosa-Belle Gerst, Kevin Moschner, and Andrey Blazhev — Institut für Kernphysik, Universität zu Köln

Excited states in ^{95}Kr have been measured at the RIBF at the RIKEN Nishina Center for Accelerator-Based Science via a prompt-delayed correlation analysis of conjoined SEASTAR and EURICA data. Even-even Sr and Zr nuclei in the A = 100 region show a sudden onset of deformation at N = 60 while the lighter isotopes up to N = 58 are rather spherical. For the even Kr isotopes it could be shown that this onset of collectivity is fairly smooth [1]. The nuclei with N = 59 neutrons lie just at the border of these phenomena and are therefore of particular interest. In a study of fission fragments at the ILL an isomeric $(7/2^+)$ state in ^{95}Kr could be identified [2]. The analysis of prompt gamma-radiation observed in DALI2 in coincidence with isomeric transitions identified in the EURICA array provides new information on the nuclear structure above the known isomeric state in ^{95}Kr.

[1] M. Albers *et al.*, Phys. Rev. Lett. 108, 62701 (2012)

[2] J. Genevey *et al.*, Phys. Rev. C 73, 37308 (2006)

*Supported by the DFG under Grant No. BL 1513/1-1

HK 22.6 Di 15:30 F 2

Signatures of triaxiality in low-spin spectra of ^{86}Ge — •Marc Lettmann[1], Norbert Pietralla[1], Volker Werner[1], Pieter Doornenbal[2], Alexandre Obertelli[3], Tomás R. Rodríguez[4], and Kamila Sieja[5] for the SEASTAR-Collaboration — [1]TU Darmstadt — [2]RIKEN — [3]CEA Saclay — [4]Universidad Autónoma de Madrid — [5]Chargé de recherches CNRS Institut Pluridisciplinaire Hubert Curien

Low-spin states of neutron-rich ^{84,86,88}Ge isotopes were measured via in-beam γ-ray spectroscopy after nucleon removal on hydrogen at intermediate energies. The exotic radioactive beams are provided by the RIKEN-RIBF. Based on the spectroscopic information first level schemes of ^{86,88}Ge are derived. The behavior of the 2_1^+, 4_1^+, 2_2^+ level energies and the $R_{4/2}$ ratio were obtained up to $N = 56$. The data are compared to state of the art shell model and beyond-mean-flied calculations. Triaxial deformation in ^{86}Ge is discussed on the grounds of experimental observations and theoretical predictions. Supported by the BMBF under grant No. 05P15RDFN1 and NuSTAR DA under grant No. 05P12RDFN8

HK 22.7 Di 15:45 F 2

Isomer γ-ray decay spectroscopy of ^{92,94}Se — •Cesar Lizarazo[1,4], Volker Werner[1], Norbert Pietralla[1], P.-A. Söderström[2], Pieter Doornenbal[2], Alexandre Obertelli[3], Cristina Nita[5], and EURICA Collaboration[2] for the SEASTAR-Collaboration — [1]TU Darmstadt, Darmstadt, Germany — [2]RIKEN Nishina Center, Wako-Shi, Japan — [3]CEA, Saclay, Saclay, France — [4]GSI, Darmstadt, Germany — [5]IFIN-HH, Bucharest, Romania

Isomer γ-ray decay of neutron rich $^{92-94}$Se was experimentally studied using the EURICA detector array. The exotic nuclei were produced via the in-flight fission technique at the RIBF-RIKEN facility. They were identified via Z and A/Q determination using the ZeroDegree spectrometer and implanted in the AIDA silicon stopper placed at the

center of the EURICA HPGe detector array. New transitions on all the nuclei studied were detected, allowing to extend the corresponding level schemes. The isomeric state of ^{94}Se has been observed for the first time. The origin of the observed isomeric states is discussed and the experimental results are compared to up-to-date calculations.
Supported by NuSTAR DA unter grant No. 05P12RDFN8.

HK 22.8 Di 16:00 F 2

Sub-Shell Closure and Shape Coexistence in the transitional ^{98}Zr — •W. Witt[1], V. Werner[1], M. Albers[2], M. P. Carpenter[2], R. V. F. Janssens[2], T. Lauritsen[2], G. Savard[2], D. Seweryniak[2], S. Zhu[2], D. Cline[3], A. B. Hayes[3], C.-Y. Wu[4], O. Möller[1], N. Pietralla[1], G. Rainovski[5], R. Stegmann[1], B. Bucher[4], H. David[2], J. Smith[2], A. D. Ayangeakaa[2], and C. Hoffman[2] — [1]IKP, TU Darmstadt, Deutschland — [2]ANL, Argonne, USA — [3]Univ. of Rochester, USA — [4]LLNL, Livermore, USA — [5]Univ. of Sofia, Bulgaria

Sub-shell closures are of special interest for nuclear structure studies. With Z = 40 Zr nuclei show a closed $\pi 2p_{1/2}$ sub-shell and allow for interesting insight into nucleon interactions in the Zr isotopic chain [1]. ^{98}Zr is subject to coexistence of nuclear shapes between the mostly spherically shaped ^{96}Zr and the strongly deformed ^{100}Zr. The degree of mixing between different configurations is unclear as experimental constraints for model predictions are barely available. To study low-lying transitions in ^{98}Zr a Coulomb excitation experiment was conducted at the ATLAS-facility at ANL making use of the GRETINA and CHICO2 arrays for γ- and particle-detection. This talk reports on the firstly determined B(E2; $2_1^+ \to 0_1^+$) value of ^{98}Zr and its interpretation.
Supported by the BMBF under the grant 05P15RDFN9 within the collaboration 05P15 NuSTAR R&D.
[1] C. Kremer et al., Phys. Rev. Lett. 117, 172503 (2016)

HK 23: Nuclear Astrophysics II

Zeit: Dienstag 14:00–16:15 Raum: F 33

Gruppenbericht HK 23.1 Di 14:00 F 33

Chiral nuclear equation of state for neutron-star and supernova simulations — •Corbinian Wellenhofer[1], Jeremy W. Holt[2], Nobert Kaiser[1], and Wolfram Weise[1] — [1]Technische Universität München — [2]Texas A-M University

Chiral effective field theory (χEFT) provides the basis for the description of the nuclear interaction in terms of a systematic low-energy expansion. In this talk, we review recent research efforts headed towards the construction of a χEFT-based nuclear equation of state (EoS) to be used in astrophysical simulations of core-collapse supernovæ and binary neutron-star mergers. The finite-temperature EoS of isospin-asymmetric nuclear matter has been computed using chiral low-momentum two- and three-nucleon interactions in many-body perturbation theory (MBPT), and the results have been benchmarked against available empirical constraints and thermodynamic consistency. At low temperatures, MBPT gives rise to a nonanalytic form of the dependence of the EoS on the isospin asymmetry. The implications of this regarding explicit parametrizations of the isospin-asymmetry dependence are investigated, and we discuss initial results concerning the construction of global EoS tables for astrophysical applications.

HK 23.2 Di 14:30 F 33

Constraining the nuclear equation of state through the moment of inertia of neutron stars — •Svenja Kim Greif[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

The recent discovery of 2 $M_\odot$ neutron stars yields systematic constraints on the nuclear equation of state. Neutron star masses can be measured very precisely, their radii are, however, inherently difficult to measure due to the influence from large systematic uncertainties. A prospective moment of inertia measurement using pulsar timing observations will provide a promising alternative. We present a theoretical framework for calculating neutron star masses, radii, and moments of inertia microscopically. We use state–of–the–art equations of state up to nuclear densities based on chiral effective field theory interactions. For high densities, we expand the equations of state and take the requirements of causality and of reproducing 2 $M_\odot$ neutron stars into account. Our approach allows us to generate a large set of equations of state that predicts different possible combinations of masses, radii, and moments of inertia. Based on our results, we investigate how a moment of inertia measurement constrains the radius and thus the equation of state.

*This work is supported by the ERC Grant No. 307986 STRONGINT and the Deutsche Forschungsgemeinschaft through Grant SFB 1245.

HK 23.3 Di 14:45 F 33

Expansion of the equation of state of neutron-rich nuclear matter from χEFT beyond quadratic order — •Susanne Strohmeier and Norbert Kaiser — Technische Universität München

Based on chiral effective field theory, the equation of state of neutron-rich nuclear matter is investigated systematically. The contributing diagrams up to three-loop order include one- and two-pion exchange together with three-body terms arising from virtual $\Delta(1232)$-isobar excitations. The expansion of the energy per particle in the proton fraction δ for the nuclear many-body system with neutron density $\rho_n = k_f^3(1-\delta)/3\pi^2$ and proton density $\rho_p = k_f^3\delta/3\pi^2$ is performed analytically up to quadratic order: $\bar{E}(k_f,\delta) = \bar{E}_n(k_f) + \delta B_1(k_f) + \delta^{5/3}B_{5/3}(k_f) + \delta^2 B_2(k_f) + \ldots$. Yet higher orders in the δ-expansion are necessary for a reasonable description of the equation of state for proton fractions above 20%. The evaluation of a S-wave contact interaction to second order establishes a non-analytical $\delta^{7/3}\ln\delta$-term. The higher order coefficients of the expansion are determined by a least-squares fit. With terms up to order $\delta^{8/3}$ a good description is obtained from pure neutron matter ($\delta = 0$) up to symmetric nuclear matter ($\delta = 0.5$).
Work supported in part by DFG and NSFC (CRC110).

HK 23.4 Di 15:00 F 33

Long-time hydrodynamical simulations of core-collapse supernovae — •Carlos Mattes[1], Almudena Arcones[1,2], Sean Couch[3], and Albino Perego[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Department of Physics and Astronomy, Michigan State University, USA

Core-collapse supernovae are one of the major contributors to the chemical enrichment in the universe. These explosions eject elements that were synthesized during the life of stars (e.g., oxygen and carbon) and they produce new and heavier elements (e.g., 1/3 of the iron in our galaxy).

We will present long-time hydrodynamic simulations of core-collapse supernovea with the multi-scale and multi-physics code FLASH [1] that follow the supernova explosion from the collapse phase to several seconds after bounce.

[1] Couch S.M. 2013, ApJ, 775, 35
[2] Perego A. 2016, ApJS, 223, 22

HK 23.5 Di 15:15 F 33

Investigation of thermal effects on the equation of state and radii of neutron stars — •Sabrina Schäfer[1,2], Carlos Mattes[1], Almudena Arcones[1,3], and Achim Schwenk[1,2,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Max-Planck-Institut für Kernphysik, Heidelberg

Recently, a set of cold representative equations of state have been derived from calculations based on chiral effective field theory, combined with constraints from neutron star observations. This made it possible to derive an uncertainty band for the equation of state and the radius of cold neutron stars. In this work, we study finite temperature effects on realistic equations of state of hot and dense matter and the resulting proto–neutron star behavior following a core–collapse supernova. Using a method for including thermal effects in the equation of state, we investigate the impact of finite–temperature microphysics on the radii of neutron stars and the contraction behavior of the proto–neutron star during the explosion.

*This work is supported by the DFG through Grant SFB 1245.

HK 23.6 Di 15:30 F 33

Simulation of neutrino-driven winds from core-collapse supernovae — •Maximilian Witt[1] and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Neutrino-driven winds occur after core-collapse supernovae, when the hot proto-neutron star cools by radiating neutrinos. Within the continuous mass outflow that is ejected at supersonic velocities, heavy elements up to silver may form [1].

We have developed a steady-state model that was used to compare to our 1D and 2D hydrodynamic simulations. We have investigated the conditions which lead to a neutrino-driven wind and will discuss how this affects the nucleosynthesis in core-collapse supernovae.

[1] A. Arcones, F.-K. Thielemann, J.Phys. G 40 (2013) 013201

Supported by the Helmholtz-University Young Investigator grant No. VH-NG-825, the SFB 1245 and the ERC grant No. 677912 EUROPIUM.

HK 23.7 Di 15:45 F 33

Nuclear reaction network for hydrodynamical simulations — •Moritz Reichert[1], Dirk Martin[1], Julia Bliss[1], and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum GmbH

Core-collapse supernovae mark the end of the life of stars with at least eight solar masses. These explosive events are very complex to model and involve multidimensional hydrodynamics, neutrino interactions and transport and general relativity to describe the evolution of matter under extreme conditions. An exciting outcome from supernova explosions is the formation of new elements which can be produced only in such a cataclysmic event. Taking all physical aspects into account makes the description of supernovae ultimately challenging and also computationally expensive. Reducing the computational cost is an essential part of supernova simulations. So far, there are no hydrodynamical simulations that use a nuclear reaction network which contains all involved and synthesized elements. We provide an accurate and precise nuclear reaction network that includes only a fraction of nuclei in a well chosen area of the nuclear chart considering all important reactions. This network is able to keep track of nuclear composition and energy generation.

* Supported by Helmholtz Young Investgator Group VH-NG-825 and SFB 1245.

HK 23.8 Di 16:00 F 33

Short gamma ray bursts triggered by neutrino-antineutrino annihilation* — •Hannah Yasin[1], Albino Perego[1], and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Gamma ray bursts (GRB) are one of the most energetic events in the universe. Neutron star mergers are the most favourable candidate for the subclass of GRBs that last less than two seconds. It has been suggested that the annihilation of neutrino-antineutrino pairs emitted by the hot and dense merger remnant could be enough to launch a relativistic jet, producing such a burst [1]. We calculate the energy deposition by neutrino-antineutrino annihilation based on the results of a Newtonian simulation of the aftermath of a binary neutron star merger [2]. In addition, we investigate the role of the central object.

[1] D. Eichler, M. Livio, T. Piran, and D. N. Schramm, Nature 340 (1989) 126.
[2] A. Perego, S. Rosswog, R. M. Cabezon, O. Korobkin, R. Käppeli, A. Arcones, and M. Liebendörfer, MNRAS 443 (2014) 3134.

* Supported by Helmholtz-University Young Investigator grant No. VH-NG-825 and the Deutsche Forschungsgemeinschaft through grant SFB 1245.

HK 24: Fundamental Symmetries I

Zeit: Dienstag 14:00–16:15 Raum: F 073

Gruppenbericht HK 24.1 Di 14:00 F 073

Precision Measurement of the Beta Asymmetry in Neutron Beta Decay with Perkeo III — •Heiko Saul[1,2], Hartmut Abele[2], Dirk Dubbers[3], Bastian Märkisch[1], Alexandr Pethukov[4], Christoph Roick[1], Ulrich Schmidt[3], Torsten Soldner[4], Xiangzun Wang[2], and Dominik Werder[3] — [1]Physik Department, TU München — [2]Atominstitut, TU Wien — [3]Physikalisches Institut, Universität Heidelberg — [4]Institut Laue-Langevin, Grenoble

Neutron beta decay is described accurately within the standard model of particle physics using the first CKM-matrix element, V_{ud}, and the ratio of vector and axial vector couplings, λ, as parameters. Angular correlations, spectra and the neutron lifetime are accessible experimentally, providing an excellent toolkit for investigating the structure of weak interaction.

Measuring the Beta Asymmetry, A, is the most precise way of determining λ, which is an important standard model parameter and necessary for the determination of V_{ud} from Neutron Decay. Moreover it allows to derive limits on non-standard model couplings by combining with measurements of other correlation coefficients.

In this talk we present the most precise measurement of the Beta Asymmetry performed with the decay spectrometer Perkeo III carried out at the PF1B cold neutron beam facility at the Institut Laue-Langevin. We discuss the result and its implications.

Gruppenbericht HK 24.2 Di 14:30 F 073

Parity violation in the 2s-1s muonic X-ray transition — •Frederik Wauters — Johannes Gutenberg University of Mainz, Germany

Negative muons at rest get captured by nearby atoms in highly exited atomic states. These muonic atoms subsequently de-exite via radiative and Auger transitions until the muon ends up in the 1s orbital. Due to the substantial overlap between the muon wave function and the nucleus, muonic X-rays are extremely sensitive to short range interactions. For example, weak neutral currents will mix the opposite parity 2p and 2s atomic states, leading to parity violation in the 2s-1s transition. Recent anomalies in precision muon data suggest new physics which may amplify this effect. A ongoing effort at the Paul Scherrer Institute (Switzerland) aims at measuring atomic parity violating in muonic X-rays for the first time for nuclei around Z=30. As a first step, we will make use of coincidences in the muonic X-ray cascade to suppress the background for the 2s-1s transition, utilizing high granularity, large solid angle germanium detectors. Once a clear 2s-1s signal above background is achieved, our goal for 2017, a full atomic parity violation experiment can be developed.

Gruppenbericht HK 24.3 Di 15:00 F 073

Recent Progress of the JEDI Collaboration — •Martin Gaisser on behalf of the JEDI collaboration — III. Physikalisches Institut B, RWTH Aachen University

The CP violation known from the Standard Model is not sufficient to describe the observed matter over anti-matter dominance in our universe. Electric Dipole Moments (EDMs) of elementary particles, including hadrons, are one of the most powerful tools to search for additional CP violation. Up to now experiments concentrated on neutral systems, namely neutron, atoms and molecules. Storage rings offer the possibility to measure EDMs of charged particles. The Jülich Electric Dipole Moment Investigation (JEDI) collaboration intends to measure the electric dipole moment of charged hadrons. The talk describes the experimental challenges and recent progress made at the COoler SYnchrotron (COSY) in Jülich.

HK 24.4 Di 15:30 F 073

Status of the PERC Instrument — •Bastian Märkisch for the PERC-Collaboration — Physik-Department, Technische Universität

München

Neutron beta decay is an excellent system to study the charged weak interaction experimentally. The decay is precisely described by theory and unencumbered by nuclear structure effects. Observables are numerous correlation coefficients which e.g. relate the spin of the neutron and the momenta of the particles, spectra and the neutron lifetime. Most importantly, precision measurements in neutron beta decay are used to investigate the structure of the weak interaction and to derive the element Vud of the Cabibbio-Kobayashi-Maskawa matrix.

The Proton Electron Radiation Channel instrument, which is currently under construction at the FRM, Garching, is designed to improve measurements of several correlation coefficients by an order of magnitude. In this talk, we will briefly present the concept of the instrument as well as its current status.

HK 24.5 Di 15:45 F 073

Studien zum Energiespektrum von Betazerfällen mit PIPS Detektoren — Kai Zuber, Alexander Robert Domula und •Jan Thurn — IKTP TU Dresden

Die Übergangsmatrixelemente für verbotene Betazerfälle sind maßgeblich von dem benutzten Modell zur Beschreibung des Übergangs abhängig. Die aktuellen Kernmodelle sind jedoch vom gewählten (A,Z)-Bereich abhängig. Weitere experimentelle Ansätze und Messungen können somit zur Verbesserung der vorliegenden Modelle beitragen. Des weiteren kann die Verbesserung der Kenntnis der Energiespektren zu präziseren Aussagen in der Neutrino und Astroteilchenphysik führen.

Zu diesem Zweck wurde ein Setup basierend auf PIPS-Detektoren für die Messung von Betazerfallsspektren mit Quellen niedriger Aktivität entwickelt. Mit diesem wurden erste Messungen der Zerfallsspektren von Si-31 und Bi-210, welches eine wesentliche Rolle als Nuklid in den Untergrundmodellen von Experimenten mit solaren Neutrinos einnimmt, durchgeführt. Erste Ergebnisse zu den durchgeführten Messungen und dem Aufbau der Kammer werden präsentiert.

HK 24.6 Di 16:00 F 073

Studies of cosmogenic neutron activation of natural Tellurium — •Steffen Turkat, Alexander Domula, Valentina Lozza, and Kai Zuber — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

Due to its relative natural abundance of 34.08 % and its high Q-Value of 2.53 MeV, the radionuclide ^{130}Te is a perfect candidate for studying the neutrinoless double beta decay ($0\nu2\beta$). This isotope is currently selected by two experiments: CUORE and SNO^{+}. Important backgrounds for the $0\nu2\beta$ searches are the long-lived, high Q-value isotopes which can be produced by the activation of the target material by high-energetic cosmic neutrons during the period it spends on surface (like during transport). An example is ^{124}Sb. Due to its high Q-value this radionuclide would create a background signal in the expected region of the neutrinoless double beta decay of ^{130}Te.

An experiment at iThemba LABS in South Africa was performed irradiating Tellurium probes by a neutron beam. The emitted gamma spectra of the activated probes were measured using high purity Germanium Detectors.

This talk will describe the analysis of the collected gamma spectra with the extraction of both short- and long-lived radionuclides. The Germanium detectors are fully characterized comparing data to Monte-Carlo Simulations. Additionally, correction factors for summation and for the geometry are obtained. Average cross section values have been extracted and compared to theoretical predictions.

HK 25: Instrumentation VI

Zeit: Dienstag 14:00–15:30 Raum: F 072

Gruppenbericht HK 25.1 Di 14:00 F 072

Status of the R3B experimental setup — •Dominic Rossi for the R3B-Collaboration — Technische Universität Darmstadt, Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The versatile R^{3}B experimental setup has been designed for kinematically complete measurements of various types of nuclear reactions involving exotic secondary beams at relativistic energies. Currently located at GSI, the setup is in use at the existing facility while being completed with new or upgraded detector systems. Once the future FAIR facility is operational, the entire setup will be moved to a new location downstream of the Super-FRS, where it will take advantage of enhanced beam rates and energies.

The experimental setup and scope will be presented briefly, followed by the current status of the various detector subsystems, including for instance the superconducting dipole magnet GLAD, the neutron detector NeuLAND and the photon detector CALIFA.

This work is supported in part by the BMBF under contract number 05P15RDFN1 and by the GSI-TU Darmstadt cooperation agreement.

HK 25.2 Di 14:30 F 072

Upgrade und Inbetriebnahme des Lund-York-Cologne CAlorimeters — •B. Fu[1], K. Wolf[1], P. Reiter[1], C. Goergen[1], S. Thiel[1], M.A. Bentley[2], S. Fox[2], D. Rudolph[3], P. Golubev[3], C. Lorenz[3], P. Coleman-Smith[4] und I. Lazarus[4] — [1]IKP, Universität zu Köln — [2]University of York — [3]Lund University — [4]Daresbury Laboratory

Nach dem erfolgreichen ersten Einsatz des Lund-York-Cologne CAlorimeters (LYCCA) während der NUSTAR-PreSPEC-Kampagne bei der GSI wurde ein Upgrade der Elektronik und des DAQ-Systems am Daresbury Laboratory durchgeführt. Hochintegrierte AIDA Front-End-Elektronik Module mit Application-Specific Integrated Circuits (ASICs) werden eingesetzt, um die Signale von mehr als tausend DSSSD-Kanälen zu verstärken, und zu verarbeiten. Das Multi-Instance-Data-Acquisition-System (MIDAS) ermöglicht Hardware-Einstellungen, Experiment-Kontrolle, Daten-Merging und Daten-Speicherung. Nach der Testphase in Daresbury wurde der LYCCA Detektor mit der neuen Elektronik am Tandembeschleuniger des IKP in Köln aufgebaut. Nach Messungen mit einer Tripel-Alpha-Quelle wurden In-beam-Experimente zur elastischen Streuung von schweren Ionen durchgeführt um die Spezifikationen des Detektors nach dem Upgrade zu überprüfen. Die erzielten Ergebnisse erlauben wichtige Rückschlüsse auf Energieauflösung und Effizienz des Kalorimeters bei niedrigen Energien für zukünftige NUSTAR-Experimente. Supported by the German BMBF (05P12PKFNE TP5) and GSI F&E KREITE 1416

HK 25.3 Di 14:45 F 072

Detector Response of the CALIFA Endcap — Roman Gernhäuser, •Benjamin Heiss, Philipp Klenze, Patrick Remmels, Felix Stark, and Max Winkel for the R3B-Collaboration — Technische Universität München

The 4π-calorimeter CALIFA is one of the major detectors of the R^{3}B-experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt. This calorimeter with 2464 CsI(Tl) crystals and 96 Phoswich detectors provides a high efficiency, good energy resolution of about 5 % at 662 keV γ energies and a large dynamic range, allowing a simultaneous measurement of γ rays at E $>$ 100 keV and scattered protons up to E $<$ 700 MeV. Especially in the forward section of CALIFA, the Endcap, the highest particle rates and energies paired with highly doppler shifted γ rays are expected. This talk will show a full simulation of the detector response in a (p,2p) reaction in direct kinematics at 500 MeV. A special focus is on the coincident measurement of light charged particles and γ rays. We will present results particle reconstruction efficiencies, background suppression, and energy resolution of the total reconstructed energy. Supported by BMBF Project 05P15WOFNA.

HK 25.4 Di 15:00 F 072

Characterisation of the CALIFA petal response to γ-rays up to 9 MeV — Han-Bum Rhee, •Alexander Ignatov, and Thorsten Kröll for the R3B-Collaboration — Institut für Kernphysik,TU Darmstadt, Germany

CALIFA is a calorimeter and spectrometer that aims to detect γ-rays and light charged particles. It is a part of the R3B experiment at GSI and the future FAIR facility. CALIFA is divided into a cylindrical barrel[1] and a forward end-cap[2]. The CALIFA barrel consist of CsI(Tl) scintillating crystals, which are individually read out with Avalanche

Photodiodes(APDs). The functional units for the CALIFA demonstrator are called petals containing 64 crystals each. The petals are built using the same construction procedures, materials and elements as for CALIFA. In this contribution, we investigated the response of one CALIFA petal to high-energy γ-rays from an AmBe source and from the neutron capture process with the Ni target. The results are compared to the R3BRoot simulation, which is based on the FairRoot. This work is supported by German BMBF(05P12RDFN8,05P15DFN1), HIC for FAIR and GSI-TU Darmstadt cooperation contract.

[1] R3B Collaboration,Technical Design Report for the CALIFA Barrel, November 2011
[2] R3B Collaboration,Technical Design Report for the CALIFA Endcap, August 2015

HK 25.5 Di 15:15 F 072

NeuLAND: Simulating the venture into uncharted territory — •Jan Mayer[1], Konstanze Boretzky[2], Michael Heil[2], Dmytro Kresan[2], Simon G. Pickstone[1], Mark Spieker[1], and Andreas Zilges[1] for the R3B-Collaboration — [1]Institute for Nuclear Physics, University of Cologne — [2]GSI Gesellschaft für Schwerionenforschung GmbH, Darmstadt

Located at the existing RIB facility GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, the Facility for Antiproton and Ion Research (FAIR) is currently under construction. One major setup is the R^3B (Reactions with Relativistic Radioactive Beams) experiment, exploring the properties of exotic nuclei.

NeuLAND (new Large-Area Neutron Detector) is a next generation neutron detector, featuring both high detection efficiency and high resolution for fast neutrons. The full detector will be composed of 3000 scintillator bars, providing an active volume of almost 19 m^3.

Data analysis and simulations are both performed with R3BRoot, the FAIRRoot based data analysis software for R3B. Embracing object oriented concepts of `C++11`, I/O, physics business logic, and configuration can be separated into individual tasks and classes.

Simulations have been performed to predict the detector performance in different scenarios. Different neutron event reconstruction algorithms and comparisons with experiments performed at GSI and RIKEN (Japan) will be presented.

Supported by the BMBF (05P2015PKFNA). J.M. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 26: Instrumentation V

Zeit: Dienstag 14:00–16:15 Raum: F 102

Gruppenbericht HK 26.1 Di 14:00 F 102

MAPT—A New Detector System for Astrophysics and Radiation Monitoring — •Martin J. Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, Garching, Germany

We develop the Multi-purpose Active-target Particle Telescope (MAPT), a new detector system suitable for astrophysical studies and radiation monitoring aboard spacecraft. We use state-of-the-art silicon photomultipliers and plastic scintillators to create a very compact and efficient layout that allows to track charged particles omnidirectionally and determine particle energies between 25 MeV per nucleon and 1000 MeV per nucleon. MAPT is thus perfectly suited to characterize non-directional flux environments.

In this contribution, we give an overview of the detector concept, the data acquisition system, and the infrastructure needed to support the detector. We briefly describe the analysis framework and outline potential use cases.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe" (www.universe-cluster.de).

HK 26.2 Di 14:30 F 102

Barrel Time-of-Flight Detector for the PANDA Experiment - Hardware Performance Validation — •Sebastian Zimmermann[1], Marius Chirita[1], Lukas Gruber[1], Dominik Steinschaden[1], Ken Suzuki[1], Merlin Böhm[2], Albert Lehmann[2], Carsten Schwarz[3], Herbert Orth[4], Kai Brinkmann[5], Kamal Dutta[6], and Kushal Kalita[6] for the PANDA-Collaboration — [1]SMI — [2]Erlangen — [3]GSI — [4]HIM — [5]Gießen — [6]Assam

We describe the technical layout and the expected performance of the Barrel Time-of-Flight detector (Barrel TOF) for the P*ANDA target spectrometer. The Barrel TOF detector has been designed to precisely measure the time at which a charged particle transits the detector with a resolution superior to the other sub-detectors. It will signal the topology of physics events, hence setting cornerstones for event classification. The implementation of the Barrel TOF is based on very fast organic scintillator tiles coupled to Silicon Photomultipliers, in total 2000 scintillators and 16k SiPMs will be used, covering 5 m2. The detector R&D is now in advanced stage and the technical design report is being reviewed by the collaboration. This talk will focus on the performance validation of the prototypes and hardware components.

HK 26.3 Di 14:45 F 102

Data Acquisition of the Crystal Zero Degree Detector at BES III — Achim Denig[1], Peter Drexler[1], Brice Garillon[1], •Leonard Koch[2], Wolfgang Kühn[2], Sören Lange[2], Werner Lauth[1], Yutie Liang[2], Torben Rathmann[1], and Christoph Redmer[1] — [1]Johannes Gutenberg Universität Mainz — [2]Justus-Liebig-Universität Gießen

The BES III experiment at the BEPCII electron positron collider in Beijing is collecting data in the charm-τ mass region. Being strongly peaked towards small polar angles, photons from initial state radiation (ISR) are detected with limited efficiency.

In order to increase the detection efficiency of these photons, we propose a small detector comprised of two arrays of scintillating crystals separated by a small gap to be placed in the very forward and backward regions. The scintillation light will be collected by silicon photomultipliers (SiPMs) and the signals will be digitized by feature extracting flash ADCs. This data stream is correlated with the BES III trigger in realtime on FPGA based hardware.

In this contribution the hardware of the data acquisition and the algorithms performing the feature extraction and the event correlation are presented.

This work is supported by grant DFG research group 2359.

HK 26.4 Di 15:00 F 102

High time resolution silicon photomultipliers coupled to plastic scintillators — Daniel Bemmerer[1], Thomas E. Cowan[1,2], Marcel Grieger[1,2], Tobias P. Reinhardt[2], Stefan Reinicke[1,2], Marko Röder[1,2], Daniel Stach[1], •Klaus Stöckel[2,1], Andreas Wagner[1], David Weinberger[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]TU Dresden, Germany

Semiconductor-based light detectors, so-called silicon photomultipliers (SiPMs) may in principle replace classical photomultiplier tubes in several applications. Recently, it has been shown [1] that for large, $270{\times}5{\times}5\,\mathrm{cm}^3$ plastic scintillator bars SiPM readout with efficiency close to unity and high time resolution is possible, when they are irradiated with 30 MeV single electrons from the ELBE superconducting electron linac. These results will be reviewed, and in addition, recent work at TU Dresden and HZDR on neutron/γ pulse shape discrimination capability of large (9-36 mm^2) timing SiPMs coupled to relevant scintillators will be summarized.

[1] T.P. Reinhardt *et al.*, Nucl. Inst. Meth. A 816, 16 (2016)

Supported by BMBF (05P12ODNUG) and GSI F&E (DD-ZUBE).

HK 26.5 Di 15:15 F 102

Precision Measurements of Quenching and Saturation Effects in Organic Scintillators Coupled to Silicon Photomultipliers — •Thomas Pöschl, Martin J. Losekamm, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

Measuring the energy deposition of charged particles in scintillators is a common detection and identification method in particle physics. In the last years, the development of ultra-sensitive silicon photomultipliers (SiPMs) accelerated the development and allowed to diversify the applications for such detectors. The conversion of electronic energy loss by a traversing charged particle into scintillation light and its subsequent detection implicate several loss mechanisms that require precise understanding to determine properties of the primary particle.

These signal-loss mechanisms have been determined using different scintillator-SiPM combinations exposed to protons and pions with momenta of 240 MeV/c to 450 MeV/c. Using Bayesian Inference techniques, we have determined the individual loss-mechanisms and their correlations in detail. The results will improve the current implementations of these mechanisms in simulation tools such as Geant4. This research was supported by the DFG Cluster of excellence 'Origin and Structure of the Universe' (www.universe-cluster.de).

HK 26.6 Di 15:30 F 102

Charakteristika von 700 HAMAMATSU H12700 MAPMTs* — •Jörg Förtsch, Karl-Heinz Kampert und Christian Pauly für die CBM-Kollaboration — Bergische Universität Wuppertal

Eine wesentliche Komponente des CBM Detektors und des HADES Detektor-Upgrades, ist ein Ring-abbildender Cherenkov-Detektor (RICH). Der CBM Detektor und der verbesserte HADES Detektor werden an der FAIR Beschleunigeranlage in Darmstadt in Betrieb genommen werden. Die photosensitive Fläche beider RICH-Detektoren wird mit ortsauflösenden Multianodenphotomultipliern (MAPMT) ausgerüstet. Hierfür wurden 1100 HAMAMATSU H12700 MAPMTs beschafft. Der H12700 ist ein 2×2 in^2 MAPMT mit 64 Anodenpads, guter Effizienz im UV-Bereich (QE @300nm ca. 30%) und gut separiertem Einzelphotonenpeak (PV>1.5:1). Um die 50 monatlich eintreffenden MAPMTs zu überprüfen und für den späteren Detektor zu gruppieren wurde vor Lieferbegin im Dezember 2015 ein Teststand in Betrieb genommen. Dieser Teststand vermisst die MAPMTs z.B. in Bezug auf Verstärkung, effiziente Fläche, Dunkelrate und Nachpulsen. Die Vermessung geschieht mittels positionsaufgelöster Beleuchtung der MAPMTs mit "einzelnen" Photonen. Die Kombination aus einem LED-Pulser, einer selbstgetriggerten Datenauslese (mittels eines nXYter ASIC) und einem automatisierten XY-Tisch erlaubt dann die Erfassung verschiedenster MAPMT Charakteristika. In diesem Vortrag werden Messergebnisse der ersten 700 MAPMTs zusammengefasst und vorgestellt.

*gefördert durch BMBF 05P15PXFCA, und GSI

HK 26.7 Di 15:45 F 102

Investigations of new 2 inch Hamamatsu Microchannel-Plate Photomultipliers — •Samuel Stelter, Merlin Böhm, Daniel Miehling, Albert Lehmann, Markus Pfaffinger, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

An important part of the PANDA experiment at the HESR/FAIR facility will be the two DIRC detectors. Their task is the identification of pions and kaons in the low GeV/c momentum region using the Cherenkov effect. The opening angle of the Cherenkov cone can be reconstructed from photons guided to the upstream end of a quartz radiator by internal reflection. Due to the fact that the DIRC focal planes will be located in a magnetic field of >1 Tesla, standard dynode photomultipliers (PMTs) are not usable for this experiment. Instead multi-anode Microchannel-Plate PMTs have to be used. The performance parameters of these MCP-PMTs have to be carefully measured concerning their suitability for the detector setup. The gain and its uniformity across the active surface, the cross-talk among the anode pixels, the behavior inside magnetic fields and the time resolution are some of the most important characteristics. Especially the finely segmented (0.4 mm pitch) sensors needed for the endcap disc DIRC require low cross-talk to reach the envisaged spatial resolution. This talk will present the measurement setups and the results of new 2x2 inch^2 Hamamatsu MCP-PMT prototypes (8x8 and 6x128 anode pixels) developed for the PANDA DIRCs.

- Funded by BMBF and GSI -

HK 26.8 Di 16:00 F 102

Investigations of a self-made potential-free picoammeter for MCP-PMT lifetime measurements — •Daniel Miehling, Merlin Böhm, Albert Lehmann, Markus Pfaffinger, Samuel Stelter, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

π/K identification in the PANDA experiment at HESR/FAIR will be done with DIRC detectors. These detectors are located in a magnetic field of >1 Tesla. This and other reasons leave the usage of Microchannel-Plate Photomultipliers (MCP-PMTs) as the only option. A serious concern of MCP-PMTs is their lifetime. While the integrated anode charge (IAC) increases the quantum efficiency (QE) of these PMTs decreases due to an aging process caused by feedback ions. A setup in Erlangen measures and monitors the QE, while the MCP-PMTs are illuminated. However, the time the most recent MCP-PMTs take to age at PANDA DIRC photon rates is rather long (up to years). We intend to accelerate this process by increasing the light intensity during the illumination. Unfortunately the limited MCP-PMT rate stability causes the anode signals to saturate at high light intensities. Then it is not possible anymore to directly correlate the IAC and the QE decline, i.e. the damage of the photocathode (PC). This can be avoided by measuring the charge directly at the PC or at the first MCP in combination with the IAC. For this purpose a potential-free picoammeter is needed. Because such devices are either not existent or very expensive, a "self-made" picoammeter was built and tested. The results will be presented in this talk. - Funded by BMBF and GSI -

HK 27: Poster

Zeit: Dienstag 16:45–18:45 Raum: F Foyer

HK 27.1 Di 16:45 F Foyer

Extraction of the luminosity at PANDA — •Stefan Pflüger[1], Florian Feldbauer[1], Roman Klasen[1], Heinrich Leithoff[1], Stephan Maldaner[1], Mathias Michel[1], Christof Motzko[1], Tobias Weber[1], and Miriam Fritsch[1,2] — [1]Helmholtz Institut Mainz — [2]Ruhr-Universität Bochum

The high precision experiment PANDA is specifically designed to shed new light on the structure and properties of hadrons. PANDA is a fixed target antiproton proton experiment and will be part of Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. When measuring the total cross sections or determining the properties of intermediate states very precisely e.g. via the energy scan method, the precise determination of the luminosity is mandatory.

For this purpose, the PANDA luminosity detector will measure the 2D angular distribution of the elastically scattered antiproton trajectories. For the determination of the luminosity the parametrization of the differential cross section in dependence on the scattering angle is fitted to the measured angular distribution. The fit function is highly complex as it is not only able to corrected for the detection efficiency and resolution, but also the antiproton beam shift, spotsize, tilt and divergence. As most of these parameters are extracted from the fit, this method is extremely powerful as it delivers also beam properties. This poster will cover the complete luminosity determination procedure, which is capable of extracting the luminosity with an accuracy in the permille level.

HK 27.2 Di 16:45 F Foyer

Studies in the production of η mesons in the reacation $\mathbf{p + d \to d + \eta + p_{sp}}$ at ANKE* — •Daniel Schröer, Christopher Fritzsch, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster

The production of η mesons in hadronic collisions is an intensively investigated topic. An unexpectedly strong interaction between η mesons and nuclei, which might lead to the formation of mesic nuclei, has been found. For further studis on the characteristics of this interaction the reaction $p + d \to d + \eta + p_{sp}$ has been measured at the ANKE spectrometer at the COSY accelerator of the Forschungszentrum Jülich. With the deuteron as an effective neuteron target whereas the proton is treated as a spectator particle, the use of two different beam momenta ($p_1 = 2.09$ GeV/c and $p_2 = 2.25$ GeV/c) in combination with the Fermi motion inside the target deuteron allow to the determine total and differential cross sections in an excess energy range from threshold up to Q = 90 MeV. With the gained knowledge of the total cross section, specifically at low Q values, it is possble to determine the scattering length $a_{d\eta}$ of an s-wave final state interaction ansatz. The validity of the s-wave assumption is proven with the differential cross sections. Furthermore the data taken at higher excess energies enable to examine the role of nucleonic resonances in the production process of η mesons. Recent results will be presented and discussed.

HK 27.3 Di 16:45 F Foyer

Study of χ_c Decays into Light Hadrons at BESIII — •Iman Keshk for the BESIII-Collaboration — Ruhr-Universität Bochum, Inst. f. Experimentalphysik I, 44780 Bochum

The BESIII experiment which is located at the symmetric electron-positron ring BEPCII in Beijing has recorded large data samples at center of mass energies corresponding to the $\psi(2S)$ charmonium resonance and other energies in the tau-charm mass range. The radiative transitions $\psi(2S) \longrightarrow \gamma\chi_c$ provide a good source of charmonium P-wave states. Their radiative decays are experimentally less understood than those of the vector states and provide new insight into the nature of the χ_c states. Further, exotic states with quantum numbers not accessible in vector charmonium decays can be studied. In this contribution the radiative decays $\chi_c \longrightarrow \gamma\phi\eta$ and $\chi_c \longrightarrow \gamma\omega\eta$ will be discussed based on a data sample corresponding to about $448 \cdot 10^6$ $\psi(2S)$ events.

Supported by DFG (FOR 2359)

HK 27.4 Di 16:45 F Foyer

Resonance extraction from $(3\pi)^-$ final states — •Sebastian Uhl — Technische Universität München

In order to study the spectrum of light hadrons, the COMPASS experiment at CERN has collected a huge data set with a 190 GeV/c π^- beam impinging on a liquid-hydrogen target. Resonances are diffractively produced at squared four-momentum transfers to the target between 0.1 and 1 (GeV/c)^2. The two-stage magnetic spectrometer with two electromagnetic calorimeters allows us to study final states with charged as well as neutral particles. The two dominant channels are the decays into the $\pi^-\pi^-\pi^+$ and $\pi^-\pi^0\pi^0$ final states. We will report on a method to extract resonance properties from both channels simultaneously.

This work was supported by the BMBF, the Maier-Leibnitz-Laboratorium der Universität und der Technischen Universität München, the DFG Cluster of Excellence 'Origin and Structure of the Universe' (Exc 153), and by the computing facilities of the 'Computational Center for Particle and Astrophysics' (C2PAP).

HK 27.5 Di 16:45 F Foyer

Development of a correction function for invariant masses of neutral mesons at the CBELSA/TAPS-experiment. — •Nils Stausberg for the CBELSA/TAPS-Collaboration — Helmholtz- Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

A good understanding of the baryon spectrum needs a precise examinatio of excited states and their decays. In order to extract contributing resonances from the data, cross sections and polarization observables are determined and further investigated by partial wave analysis.

The Crystal Barrel/TAPS experiment is ideally suited to measure the photoproduction of neutral mesons decaying into photons due to its good energy resolution, high detection efficiency for photons, and the nearly complete solid angle coverage.

A good reconstruction of the invariant mass of neutral mesons is of course essential for data analysis. Therefore, not only a precise measurement, but also sophisticated reconstruction techniques are needed. Dead material inside the detector system leads to energy losses in the calorimeter. Those do not only lead to too low photon energies, but also to asymmetric photon energy distributions and finally to angle and energy dependent deviations in the meson masses.

Here, a correction method is discussed using $\pi^0 \to \gamma\gamma$ and $\eta \to \gamma\gamma$ as example.

Supported by the DFG (SFB/TR16).

HK 27.6 Di 16:45 F Foyer

Development of a graphical user interface for the energy calibration of the Crystal Barrel calorimeter — •Ben Salisbury for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

Essential to understand the baryon spectrum is a precise knowledge of the excited states and their decays. Partial wave analysis needs to be performed to extract the contributing resonances from experimental data. In order to find an unambiguous solution, the measurement of polarization observables is necessary. To determine these observables a precise reconstruction of the reactions is indispensable.

With an angular coverage of almost 4π, a high photon detection efficiency and a good energy resolution, the Crystal Barrel/TAPS experiment is very well suited to measure the decay of neutral mesons into photons. To reconstruct the final state particles of a reaction it is necessary to correctly determine the energy deposited by the photons in the detector. Hence each crystal needs to be calibrated, including the gain factor of the electronics chain to retrieve and digitalize the deposited energy. This is done iteratively using the decay $\pi^0 \to \gamma\gamma$ together with the known π^0-mass. A graphical user interface was implemented to reduce the effort involved with the energy calibration of the Crystal Barrel calorimeter.

A short overview over the energy calibration and the most important features of the graphical user interface for the energy calibration will be given.

Supported by the DFG (SFB/TR16).

HK 27.7 Di 16:45 F Foyer

Feasibility studies for the measurement of time-like electromagnetic proton form factors in reactions of the type $\bar{p}p \to \mu^+\mu^-$ at PANDA-FAIR — •Iris Zimmermann[1,2], Manuel Zambrana[1,2], Maria Carmen Mora Espi[2], Frank Maas[1,2,3], Dmitry Khaneft[1,2], and Alaa Dbeyssi[2] for the PANDA-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg Universität Mainz, Germany — [2]Helmholtz-Institut Mainz, Germany — [3]Prisma, Cluster of Excellence, Mainz, Germany

This contribution presents the current status of the feasibility studies for the measurement of time-like proton electromagnetic form factors (FF's) using reactions of the type $\bar{p}p \to \mu^+\mu^-$ at the PANDA experiment at FAIR. Electromagnetic form factors are fundamental quantities which parameterize the electric and magnetic structure of hadrons. In the time-like region, the FF's can be accessed through reactions of the type $p\bar{p} \to l^+l^-$, where l = e, μ, under the assumption of one photon exchange. It will be the first time that muon pairs in the final state will be used for the measurement of the TL em FF's of the proton. In frame of the PANDARoot software, which encompasses full detector simulation and event reconstruction, the statistical precision at which the proton FF's will be determined at PANDA is estimated for the signal reaction $p\bar{p} \to \mu^+\mu^-$ at different antiproton beam momenta. The signal identification and the suppression of the main background process ($p\bar{p} \to \pi^+\pi^-$) are studied. The preliminary results at different beam momenta are presented.

HK 27.8 Di 16:45 F Foyer

Feasibility studies of time-like proton electromagnetic form factors at PANDA at FAIR — Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[1], Alaa Dbeyssi[1], Bertold Fröhlich[1,2], Phillip Grasemann[1,2], Sebastian Haasler[1,2], David Izard[1], •Dmitry Khaneft[1,2], Jörg Köhler[1,2], Frank Maas[1,2,3], Maria Carmen Mora Espí[1], Oliver Noll[1,2], David Rodríguez Piñeíro[1], Javier Jorge Rico[1], Sahra Wolff[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[1,2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The PANDA experiment at the upcoming FAIR accelerator facility will study antiproton annihilation reactions at antiproton beam momenta between 1.5 GeV/c up to 30 GeV/c. Simulation results of the feasibility studies of time-like proton electromagnetic form factors at PANDA are presented. The simulation was performed using the PandaRoot software framework in a wide q^2 range. The signal $\bar{p}p \to e^+e^-$ and the background $\bar{p}p \to \pi^+\pi^-$ channels have been studied using two different methods. Individual signal efficiency and background suppression techniques were applied to extract the proton form factors. The statistical precision of the proton form factors extraction is determined. The results of two methods are consistent with each other. A number of systematic uncertainties have also been evaluated. The competitiveness of the PANDA experiment with existing data and planned experiments is presented.

HK 27.9 Di 16:45 F Foyer

Konzeptstudien für das P2-Experiment an MESA — •Dominik Becker für die P2-Kollaboration — Institut für Kernphysik, JGU Mainz

Das Ziel der P2-Kollaboration ist es, den elektroschwachen Mischungswinkel $\sin^2(\theta_W)$ bei niedrigem Impulsübertrag mit einer relativen Unsicherheit von 0,15 % zu bestimmen. Dies kann durch eine Messung der schwachen Ladung des Protons mit einer Genauigkeit von 1,9 % erreicht werden. Die paritätsverletzende Asymmetrie der elastischen Elektron-Proton-Streuung gewährt dabei den experimentellen Zugang zur schwachen Ladung des Protons. Das Projekt befindet sich gegenwärtig in Vorbereitung, die Messung wird am neuen Elektronenbeschleuniger MESA in Mainz durchgeführt werden. Anhand des Posters werden das experimentelle Konzept, Berechnungen zur erreichbaren Präzision bei der Bestimmung des elektroschwachen Mischungswinkels, sowie Simulationen mit Geant4, welche durchgeführt werden, um mögliche Detektorkonfigurationen zu erforschen, vorgestellt.

HK 27.10 Di 16:45 F Foyer

Superconducting Shielding for a Transversely Polarized Target at PANDA — •Alaa Dbeyssi[1], Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[1], Bertold Fröhlich[1,2], Phillip Grasemann[1,2], Sebastian Haasler[1,2], David Izard[1], Dmitry Khaneft[1,2], Jörg Köhler[1,2], Frank Maas[1,2,3], Maria Carmen Mora Espí[1], Oliver Noll[1,2], David Rodríguez Piñeíro[1], Javier Jorge Rico[1], Sahra Wolff[1,2], Manuel Zambrana[1,2], Iris Zimmermann[1,2], and Maria Consuelo Barrantes Masot[1] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

Time-like electromagnetic form factors of the proton can be experimentally accessible through the annihilation process of antiproton-proton into lepton pair. A transversely polarized proton target at the future PANDA experiment allows us to access the relative phase between the electric and the magnetic form factors of the proton. The first step to achieve the transverse target polarization is to study the feasibility of shielding the target region from the external 2 T longitudinal magnetic field generated by the PANDA solenoid. BSCCO-2212, a new high-temperature superconductor material, has been identified as a possible candidate to be used for shielding this external magnetic field. Tests with BSCCO-2212 at 4 K have taken place at the Helmholtz-Institut Mainz, and the first preliminary results will be reported here.

HK 27.11 Di 16:45 F Foyer

Energy Sum for the Avalanche Photo Diode readout for the Crystal Barrel calorimeter — •Sebastian Ciupka for the CBELSA/TAPS-Collaboration — Helmholtz-Instituts für Strahlen- und Kernphysik, Universität Bonn

The Crystal Barrel (CB) calorimeter at the accelerator facility ELSA in Bonn,which consists of 1320 CsI(Tl) crystals, has recently been upgraded by a new Avalanche Photo Diode (APD) crystal readout. The APD readout provides a sufficiently fast trigger signal to allow a cluster finder to be included in the first level trigger. The upgrade also presents the opportunity for a new trigger condition utilizing the energy sum of the CB-calorimeter.

A newly developed board will sum up the analogue signals of one CB segment. This board contains a 4-bit adjustable resistance per channel to allow for an individual weight for each crystal, as well as an adjustable offset, all controlled via the I^2C-Bus. Additionally an ADC allows the board to monitor the sum and the signal of individual channels and automatically calibrate the weights of all channels.

This poster presents the features of the energy sum board and its properties.

HK 27.12 Di 16:45 F Foyer

Study of the Primakoff reaction $\pi^- + \gamma \to \pi^- + \pi^0$ at COMPASS — •Julian Seyfried — TU München, Deutschland

The COMPASS experiment at CERN has measured pion-photon scattering reactions via the Primakoff effect. In these reactions, high-energetic pions scatter off virtual photons from the Coulomb field of nuclei with high atomic number. To separate Primakoff reactions from background induced by the strong interaction, a high resolution of the squared four-momentum transfer to the nucleus is essential. This places tight requirements on the accuracy of the Monte Carlo simulation and the reconstruction of the reaction. In 2012, COMPASS has recorded a large Primakoff data sample with an optimized detector setup. This sample contains the reaction $\pi^- + \gamma \to \pi^- + \pi^0$. We will present first results from an analysis of this reaction, which offers the possibility to measure the chiral anomaly.

This work was supported by the BMBF, the DFG Cluster of Excellence "Origin and Structure of the Universe" (Exc 153), the Maier-Leibnitz-Laboratorium der Universität und der Technischen Universität München.

HK 27.13 Di 16:45 F Foyer

Search for C-violation in $\eta \to \pi^0 e^+ e^-$ with WASA-at-COSY* — •Kay Demmich, Florian Bergmann, Nils Hüsken, and Alfons Khoukaz for the WASA-at-COSY-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

The electromagnetic decay $\eta \to \pi^0 e^+ e^-$ via a virtual photon violates the C-parity and is therefore forbidden within the standard model. Higher order processes are C-convserving but highly suppressed. Hence, this η-decay is a perfect probe to test the C-parity conservation to search for physics beyond the standard model, e.g., for dark bosons. The WASA-at-COSY setup was utilized to collect a huge $pp \to pp\eta$ data set of $\approx 5 \times 10^8$ η-mesons dedicated for studies on rare and forbidden η-decays. Based on this data set the relative branching ratio can be determined with a significantly higher sensitivity than the current upper limit of 4×10^{-5} as quoted by the PDG. Preliminary results of the analysis will be presented and discussed. In a further contribution by the WASA-at-COSY collaboration recent results of the corresponding analysis based on the reaction $pd \to {}^3He\eta$ will be presented.

*Supported by FFE program of the Forschungszentrum Jülich.

HK 27.14 Di 16:45 F Foyer

First observation of Σ^0 production in proton induced reactions on a nuclear target — •Tobias Kunz and Jürgen Friese for the HADES-Collaboration — Technische Universität München, Physik Department E62

We have studied the production of neutral Σ^0 baryons in the nuclear reaction p + Nb at an incident proton energy $E_{kin} = 3.5$ GeV. The measurement has been performed with the HADES experiment setup at GSI, Darmstadt. $\Sigma^0 \to \Lambda^0\gamma$ decays were identified via the charged decay $\Lambda^0 \to p\pi^-$ coincident to e^+e^- pairs from external gamma conversion. Experimental details, analysis procedures and background determination are presented. An observed total of about 250 candidate events is used to determine the $\frac{\Lambda+\Sigma}{\Sigma}$ production ratio. The obtained numbers and spectra are compared to predictions from transport model calculations and are discussed in the context of thermal particle production in nuclear fireballs.

* supp. by BMBF(05P15WOFCA), GSI F&E(TMLFRG1316) and the Excellence Cluster Universe

HK 27.15 Di 16:45 F Foyer

Flow at SIS using the Scalar product method — •Mathilde Himmelreich for the HADES-Collaboration — Goethe-Universität Frankfurt

Collective flow phenomena are a sensitive probe of hot and dense matter created in relativistic heavy-ion collisions. The analysis of this phenomena depends on an accurate calculation of the reaction plane. In this contribution we compare two different procedures with focus on achievable resolution for the reconstruction of the reaction plane in Au-Au collisions at 1.23 AGeV recorded with HADES: event plane and scalar product method. The latter permits an event-by-event correction of the event plane and the possibility to examine possible dependencies of its resolution. We show a comparative study between the two approaches to evaluate the influence of systematic effects as a function of centrality, efficiency and rapidity. For this purpose we analysed the directed and elliptic flow (v_1 and v_2) of protons and charged pions using simulations and HADES data taken in April 2012.
This work has been supported by BMBF (05P15RFFCA) and GSI.

HK 27.16 Di 16:45 F Foyer

Systematic Studies of the Peak Extraction of η Mesons with the ALICE PHOS — •Andrea Hornung for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

ALICE, the dedicated heavy-ion experiment at the LHC, investigates the properties of the quark-gluon plasma. In the experiment, the measurement of neutral mesons (π^0, η) in the calorimeters complements measurements of charged particles in the central barrel. In order to interpret the measurements of particle production in heavy-ion collisions, particle production in pp collisions is studied. Furthermore, particle production in pp provides information about the initial pQCD processes in the collision.
The PHOS detector, one of the electromagnetic calorimeters of the experiment, measures the position and energy of photons and therefore allows for the reconstruction of the η meson via its two-photon decay channel.
In this poster, the status of the analysis of η mesons produced in PHOS-triggered pp collisions at $\sqrt{s} = 8$ TeV with the ALICE PHOS will be presented. A systematic study of the peak-extraction method

and its systematic uncertainties will be discussed in detail.
Supported by BMBF and the Helmholtz Association.

HK 27.17 Di 16:45 F Foyer

Quality Assurance of π^0 Measurements with the ALICE EMCal — •Joshua Koenig for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

ALICE, as the dedicated heavy-ion experiment at the LHC, is designed to investigate the properties of the quark-gluon plasma (QGP), that is believed to be produced in the Pb-Pb collision system at high center of mass energies. The suppression of neutral pion (π^0) production in Pb-Pb collisions compared to pp collisions reveals information about energy loss mechanisms in the QGP.
The EMCal detector, one of the electromagnetic calorimeters of the experiment, measures the energy and position of photons and therewith allows to reconstruct neutral pions via their two photon decay channel.
In this poster the status of an analysis of π^0 in Pb-Pb collisions at $\sqrt{s_{\rm nn}}$ = 5.02 TeV with the EMCal will be presented. The determination of the data quality, focusing on the detector channels, and the extraction of the raw π^0 yield will be discussed in detail.
Supported by BMBF and the Helmholtz Association.

HK 27.18 Di 16:45 F Foyer

Electric conductivity of a hadron gas — •Jan Hammelmann[1,2], Jean-Bernard Rose[1,2], Juan M. Torres-Rincon[2], and Hannah Petersen[1,2,3] — [1]Johann Wolfgang Goethe Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholzzentrum für Schwerionenforschung

A numerical calculation of the electric conductivity of a hadron gas is presented using the hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons).

Transport coefficients are important properties of matter and a necessary input for dissipative fluid dynamics. They can be calculated analytically for a simplified setup e.g a pion gas. For more realistic systems like a full hadronic gas, it is only feasible to calculate the electric conductivity numerically.

As a first step towards the calculation of the electric conductivity of a full hadronic gas, a pion box with periodic boundary conditions is initialized within SMASH and extract the electric conductivity with the Green-Kubo formalism to compare it to previous results.

HK 27.19 Di 16:45 F Foyer

Monte-Carlo studies of the trigger efficiency of the ALICE-PHOS detector — •Alexej Kraiker for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

The ALICE experiment at the LHC investigates the properties of the Quark-Gluon-Plasma (QGP). Various properties of the QGP can be studied by comparing the production of neutral mesons in Pb-Pb and pp collisions.

In ALICE, π^0 and η mesons are reconstructed via their two photon decay channel. The decay photons are measured with the calorimeters of the experiment EMCal, DCal and PHOS. In the experiment the measurements of neutral mesons facilitate triggered data to increase the significance of the signal. To normalize the triggered data the trigger efficiency of the trigger needs to be determined.

The poster presents a simulation of the high energy trigger of the PHOS-detector to determine the trigger efficiency. The π^0 trigger efficiency is compared with measured data, and predictions for the η mesons trigger efficiency are presented.

HK 27.20 Di 16:45 F Foyer

Low-Momentum Corrections of the ALICE TPC dE/dx-Signal — •Matthias Kleiner for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. At momenta below 300 MeV/c the TPC dE/dx signal shows a deviation from the expected behavior as described by the Bethe-Bloch formula.
Three different correction methods for the calculation of the TPC dE/dx signal for electrons and pions are tested. The quality of the corrections is evaluated by their effects on the mean TPC dE/dx signal, the relative resolution and the separation power. Potential reasons for the deviation from the expected behavior and the corrected dE/dx signals will be presented.

HK 27.21 Di 16:45 F Foyer

Measurement of Neutral Pions in pp collisions at $\sqrt{s}$ = 5.02 TeV with the ALICE DCAL. — •Adrian Mechler for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment investigates the properties of the quark-gluon plasma (QGP) which is believed to be produced in Pb-Pb collisions at high collision energies. Hadron production measurements in pp collisions provide information about particle production through QCD processes. Furthermore, they provide an important baseline for heavy-ion collisions.

This analysis focuses on the measurement of neutral pions (π^0) which are reconstructed via their dominant two photon decay. In the ALICE experiment, the calorimeters are used to measure the position and energy of these photons: During the long shutdown one (LS1) the DCAL calorimeter has been added to the central barrel of the experiment and complements measurements by the EMCal and PHOS detectors.

We will present the status of an ongoing π^0 analysis in pp collisions at $\sqrt{s}$=5.02 TeV with the DCAL calorimeter. Different analysis steps such as the Bad Channel Map and yield extraction will be discussed.
Supported by BMBF and the Helmholtz Association.

HK 27.22 Di 16:45 F Foyer

Lambda - Proton Correlation in Pion-Induced Reactions at 1.7 GeV/c — •Steffen Maurus[1,2] and Laura Fabbietti[1,2] for the HADES-Collaboration — [1]Physik Department, TUM, Garching, Germany — [2]Excellence Cluster "Universe", Garching, Germany

World data for elastic Λ - proton scattering over a wide range of Λ momenta are quite scarce. In order to provide a better theoretical description, new constraints to improve the parametrization of cross-section is needed.
In this context the inclusive Λ momenta spectrum aside with the angular correlation between proton and Λ is studied in pion-nucleon reactions (π^- + A, A = C, W) at p_{π^-} = 1.7 GeV/c with the HADES detector at GSI.
After the Λ has been produced, it interacts with the surrounding nucleons and eventually scattering occurs. The latter can be characterized by a large relative momenta between the Λ and the protons, allowing us to investigate the short distance interactions. We will report on the analysis of the collected statistics and comparison to transport model to test the sensitivity of the data to different assumption on the short range lambda-nucleon interaction.
∗ supported by BMBF 05P15WOFCA

HK 27.23 Di 16:45 F Foyer

Monte Carlo Studies of the Background in Dielectron Measurements with ALICE — •Alexander Michalik — Institut für Kernphysik, Goethe Universität Frankfurt

The major purpose of the ALICE experiment at the LHC is to explore the deconfined strongly interacting matter, the Quark-Gluon Plasma (QGP), that is formed in ultra-relativistic heavy-ion collisions. Since leptons are produced throughout all collision stages and do not experience any strong interactions with the medium, they are an ideal probe to study the properties of the QGP. However, dielectrons are a rare probe and therefore it is crucial to estimate the background of the signal to a high precision. Contributions to this background come from mis-identified hadrons and from electron-positron pairs from conversions in the detector material. In this poster we discuss the correlated and uncorrelated background and show their impact on the subtracted signal facilitating a full Monte Carlo simulation.

HK 27.24 Di 16:45 F Foyer

Performance studies for J/ψ measurements in p+A collisions with CBM — •Daniel Giang for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The CBM experiment at FAIR aims to explore the QCD phase diagram at moderate temperatures and high net-baryon densities. The J/ψ meson is considered to be one of the most important observables for the quark-gluon plasma (QGP), since the potential that binds the $c\bar{c}$-pair can be screened by the presence of free color charges. Besides QGP effects, a part of the suppression happens because of cold nuclear matter effects. We can analyze the contribution of these effects in p+A collisions, where no QGP is expected.
In this work we present a simulation of the J/ψ production in p+Au collision to study the performance of the detector setup in the CBM

experiment. Additionally, we will discuss fast simulation methods which allow to generate huge amounts of events, needed to produce a significant J/ψ signal.

Supported by the German BMBF-grant 05P15RFFC1

HK 27.25 Di 16:45 F Foyer

Lorentz Invariance of a Hadronic Transport Approach — •Justin Mohs[1,3], Dmytro Oliinychenko[1,2], and Hannah Petersen[1,3,4] — [1]Frankfurt Institute for Advanced Studies — [2]Bogolyubov Institute for Theoretical Physics — [3]Institute for Theoretical Physics — [4]GSI Helmholtzzentrum für Schwerionenforschung

In heavy ion collisions a relativistic description is essential in order to achieve correct results, since relativistic effects, such as time dilation or length contraction, grow with increasing velocities.

At low beam energies hadron transport approaches are successfully employed to describe the dynamical evolution of heavy ion reactions. Even though the underlying Boltzmann equation is covariant, it is known, that the geometric collision criterion used in the numerical solution introduces non-local interactions. In this work, a newly developed transport approach, SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) is tested for Lorentz invariance.

The collision rates of these transport calculations in different observational reference frames are compared in order to observe a possible frame dependency in the calculation. A procedure of performing Lorentz boosts to different frames as well as the results for several initial and boundary conditions is presented. From these results, conclusions about the conditions under which the calculations are Lorentz invariant can be drawn.

HK 27.26 Di 16:45 F Foyer

Monte Carlo Studies of Collision Energy Dependence of π^0-Production in pp Collisions — •Leonard Brandenburg — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to investigate the properties of the quark-gluon plasma (QGP), which is believed to be produced in Pb-Pb collisions at high center-of-mass energies. Studies on the production of neutral mesons in Pb-Pb collisions use particle production measurements in pp collisions as an important baseline.
Monte Carlo event generators are essential tools used in detector design and experimental analysis. Since not all aspects of these simulations can be derived from first principles, they require tuning of their parameters in order to accurately describe experimental data. Ideally, these tuned event generators should match experimental data over a wide range of center-of-mass energies.
In this poster, the dependence of π^0 production in pp collisions on center-of-mass energy will be discussed using the 4C, 4Cx and Monash 2013 tunes of the PYTHIA 8 event generator. Furthermore the results will be compared to experimental data at center-of-mass energies from 62.4 GeV to 7 TeV.

HK 27.27 Di 16:45 F Foyer

π^0 and η production in π^- induced reactions with HADES* — •Jan-Hendrik Otto for the HADES-Collaboration — Justus Liebig Universität Gießen

The High Acceptance DiElectron Spectrometer (HADES), located at GSI, Darmstadt, Germany, is build to study properties of baryon rich matter and particle and resonance production in elementary collisions.

In the HADES beam time in 2014 several pion induced reactions have been investigated using a negatively charged pion beam and either a Polyethylene, Carbon or Tungsten target. Those systems have been measured at different energies provided by the SIS18 accelerator.

In this contribution we present the status of the reconstruction of π^0 and η mesons using the photon conversion method in pion induced reactions for various pion beam momentum ranging from $0.69GeV/c$ to $1.7GeV/c$. Further we aim at extracting a transverse momentum spectrum of photons and to use it as a reference spectrum for $Au+Au$ collisions. This analysis will bring insides to our understanding of the contribution of photons from Dalitz decays of baryons to the so called 'direct' photon spectra extracted from $Au+Au$ collisions.

(*supported by BMBF grants 05P15RGFCA)

HK 27.28 Di 16:45 F Foyer

Femtoscopy studies using the EPOS and UrQMD models — •Dimitar Mihaylov, Laura Fabbietti, Olliver Arnold, and Ante Bilandzic — Technische Universität München, James-Franck-Straße, 85748, Garching, Germany

Femtoscopy is a method used to investigate particle correlations by using the experimentally accessible two-particle momentum correlation function. This function can be mathematically obtained by integrating the product of the source function and the two-particle wave function.

Currently there is a lot of focus on investigating hyperon-nucleon interactions using experimental data collected by ALICE at LHC and by HADES at GSI. The EPOS and UrQMD transport models can be used to describe the emission source at high and low collision energies respectively. Those models can be tested by comparing their predicted correlation function to the experimentally obtained one for a known interaction, e.g. pp. If the determination of the source is proven robust one could rely on the model and investigate the interaction potential for particle pairs which do not have well determined scattering parameters, e.g. pΛ. Furthermore having the source fixed at both high and low energies will allow for a direct comparison of the interaction at different energies. However the EPOS model predicts very small source-radii which may break-down the standardly used asymptotic approximation. This motivated the development of a framework working with a numerical evaluation of the wave-function.

This work is supported by BMBF-FSP 202 and the Excellence Cluster Universe.

HK 27.29 Di 16:45 F Foyer

Towards Laser Spectroscopy of Boron-8 — •Bernhard Maass[1], Peter Müller[2], Jason Clark[2], Christian Gorges[1], Simon Kaufmann[1], Kristian König[1], Jörg Krämer[1], Anthony Levand[2], Rodney Orford[2], Rodolfo Sánchez[3], Guy Savard[2], Felix Sommer[1], and Wilfried Nörtershäuser[1] — [1]IKP,TU Darmstadt, DE — [2]ANL, Chicago, IL, USA — [3]GSI Darmstadt, DE

The BOR8 experiment aims at the determination of the nuclear charge radius of boron-8 with high-resolution laser spectroscopy. ^{8}B is perhaps the best candidate of a nucleus exhibiting an extended proton wave-function or one-proton-halo. The charge radius, which is directly correlated with the extent of the proton wave function, can be extracted from the measured isotope shift along the boron isotopic chain. Atomic theory calculations of the five-electron system, which were recently carried out, pave the way for targeting neutral boron atoms, whose spectroscopic properties are well suited for such measurements. In-flight production and preparation of sufficient yields of ^{8}B ions at low energies are provided by the Argonne Tandem Linac Accelerator System (ATLAS) at Argonne National Laboratory (ANL). In a first off-line experiment, the isotope shift of the stable isotopes ^{10,11}B have been measured with resonance ionization mass spectrometry. This delivers a valuable test not only of atomic theory, but also of experimental equipment which will later be used at ANL.

This work is supported by the U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-AC02-06CH1135, and by the Deutsche Forschungsgemeinschaft through Grant SFB 1245.

HK 27.30 Di 16:45 F Foyer

The multi-detector array ELIADE at ELI-NP — •Julius Wilhelmy[1], C. A. Ur[2], A. Zilges[1], N. Pietralla[3], J. Beller[3], B. Boisdefre[2], M. O. Cernaianu[2], B. Löher[4], C. Matei[2], G. Pascovici[3], C. Petcu[2], C. Romig[3], D. Savran[5], G. Suliman[2], E. Udup[2], and V. Werner[3] — [1]Institute for Nuclear Physics, University of Cologne — [2]ELI-NP, "Horia-Hulubei" National Institute for Physics and Nuclear Engineering, Bucharest, Romania — [3]Institute for Nuclear Physics, University of Darmstadt — [4]ExtreMe Matter Institute, GSI, Darmstadt — [5]University of Mainz

The new laser-based Inverse Compton Scattering gamma-beam system at ELI-NP (Extreme Light Infrastructure - Nuclear Physics) in Bucharest will provide extremely high intensities at very narrow bandwidths. The Nuclear Resonance Fluorescence (NRF) technique gives access to several experimental quantities like excitation energies, level widths, γ-decay branching ratios, spin quantum numbers, and parities in a model independent way. The main detection system for NRF experiments is the multi-detector array **ELIADE** (**EL**I-NP **A**rray of **DE**tectors). It is composed of high-purity Ge detectors and large volume $LaBr_3$ scintillator detectors, providing both, high efficiency and very good energy resolution. An overview of the experimental setup and its current status will be presented.

Supported by the Project Extreme Light Infrastructure - Nuclear Physics (ELI-NP) - co-financed by the Romanian Government, the European Union through the European Regional Development Fund and the BMBF (05P2015/ELI-NP).

HK 27.31 Di 16:45 F Foyer

Confined β-soft Rotor Modell als Spin-Meter von superdeformierten Banden für ^{194}Hg — •Andreas Weber, Tobias Beck, Andreas Krugmann, Norbert Pietralla und Michael Reese — Institut für Kernphysik, TU Darmstadt

Geometrische Superdeformation wurde bei vielen schweren Kernen beobachtet. Sie äußert sich in dem Auftreten von Rotationsbanden angeregter Zustände im Termschema. Durch deren komplexe Zerfallsverzweigungen ist bis auf wenige Ausnahmen eine eindeutige Zuweisung von Drehimpulsquantenzahlen zu diesen Zuständen nicht möglich und geschieht oft über einen Vergleich zum einfachen Modell des Starren Rotors. Das Confined β-soft (CBS) Rotor Modell [1] liefert analytische Lösungen des Bohr-Hamiltonians und ist dem Starren Rotor in der Genauigkeit seiner Vorhersagen für relative Anregungsenergien überlegen. Das CBS Rotor Modell wird hier dazu verwendet, um Zuständen der Rotationsbanden des Kerns ^{194}Hg Drehimpulsquantenzahlen zuzuordnen und die (noch unbekannten) Anregungsenergien der jeweiligen Bandenköpfe vorherzusagen.

[1] N. Pietralla and O.M. Gorbachenko, PRC 70,011304 (2004).

HK 27.32 Di 16:45 F Foyer

Lifetimes of 2_1^+,4_1^+ states of ^{148}Ce from EXILL&FATIMA — •Pavlos Koseoglou[1], V. Werner[1,2], N. Pietralla[1], S. Ilieva[1], M. Thürauf[1], C. Bernards[2], A. Blanc[3], A.M. Bruce[4], R.B. Cakirli[5], N. Cooper[2], G. de France[6], M. Jentschel[3], J. Jolie[7], U. Koester[3], T. Kröll[1], P. Mutti[3], Z. Patel[8], V. Paziy[9], Zs. Podolyak[8], P. H. Regan[8,10], J.-M. Régis[7], O.J. Roberts[4], N. Saed-Samii[7], G.S. Simpson[11], T. Soldner[3], C. A. Ur[12], W. Urban[3], D. Wilmsen[7], and E. Wilson[8] — [1]IKP TU-Darmstadt, Germany — [2]Yale University, USA — [3]ILL Grenoble, France — [4]University of Brighton, England — [5]MPIK Heidelberg, Germany — [6]GANIL Caen, France — [7]IKP University of Cologne, Germany — [8]University of Surrey, England — [9]Universidad Complutense, Spain — [10]National Physical Laboratory, UK — [11]LPSC Grenoble, France — [12]INFN Legnaro, Italy

An update on the analysis of the EXILL&FATIMA data on ^{148}Ce will be given. ^{148}Ce lies on the down boundaries of a shape phase transition region of the even-even N=90 isotones with Z=60-66. The $B_{4/2}$ value will point out the behaviour of the phase transition evolution. A first estimation will be presented and it will be connected to a new CPS called X(4).^{235}U and ^{241}Pu fission fragments were measured by a mixed spectrometer consisting of Ge and $LaBr_3$(Ce)-scintillator detectors at the ILL. Lifetimes in the ps region are extracted with the slope and the General Centroid Difference method. This kind of analysis can serve as preparation for the FATIMA experiments at FAIR. Supported by HGS-HIRe, US DOE under Grant No. DE-FG02-91ER-40609 and BMBF grant No. 05P15RDFN1.

HK 27.33 Di 16:45 F Foyer

Experimente zur Einschränkung von Modellen für elektroschwache Prozesse — •Philipp Christian Ries, Joachim Enders, Udo Gayer, Peter von Neumann-Cosel, Norbert Pietralla und Volker Werner — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt

In kommenden Experimenten am Darmstädter supraleitenden Elektronenlinearbeschleuniger S-DALINAC sollen zwei Aspekte der schwachen Wechselwirkung in der Kern- und Astrophysik mit Hilfe von Elektronenstreuung untersucht werden. Zum einen sollen Parameter zur Berechnung der Übergangsmatrixelemente eines möglichen neutrinolosen doppelten Betazerfall ($0\nu\beta\beta$) von ^{76}Ge zu ^{76}Se eingegrenzt werden. Hierfür werden die Monopolübergange vom ersten angeregten 0^+-Zustand zum 0^+-Grundzustand in beiden Isotopen in Hinblick auf "Shape Mixing", welches den $0\nu\beta\beta$-Zerfall in den angeregten 0^+-Zustand in ^{76}Se verstärken würde, vermessen.

Zum anderen sollen Formfaktoren der Grundzustände und ersten angeregten Zustände von ^{129}Xe und ^{131}Xe bestimmt werden. Diese sollen für theoretische Betrachtungen der Wechselwirkungen von schwach wechselwirkenden schweren Teilchen (WIMPs), die als Kandidaten für Dunkle Materie gelten, dienen. Falls die Wechselwirkung zwischen WIMPs und Nukleonen spinabhängig wäre, wird für die Xenonisotope ungerader Massezahl, die als Detektormaterial in der XENON-Kollaboration eingesetzt werden, ein erheblicher Beitrag durch inelastische Streuung erwartet.

*Gefördert durch die DFG im Rahmen des SFB 1245

HK 27.34 Di 16:45 F Foyer

Pygmy-Resonanz im schweren deformierten Kern ^{154}Sm aus polarisierter Protonenstreuung unter 0°.* — •Andreas Krugmann[1], Sergej Bassauer[1], Isabelle Brandherm[1], Dirk Martin[1], Peter von Neumann-Cosel[1], Norbert Pietralla[1], Vladimir Ponomarev[1] und Atsushi Tamii[2] — [1]Insitut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Research, Osaka University

Am RCNP in Osaka wurde ein Protonenstreuexperiment mit polarisierten Protonen am deformierten Kern ^{154}Sm unter extremen Vorwärtswinkeln inklusive 0° durchgeführt. Mit Hilfe von Polarisationstransferobservablen konnte eine Trennung des Spinflipanteils und des Nicht-Spinflipanteils und damit eine Trennung von E1 und M1 Anteilen am gesamten Wirkungsquerschnitt vorgenommen werden. Im Falle der elektrischen Dipolstärke konnte zum ersten Mal die Pygmy-Dipolresonanz in einem schweren deformierten Kern identifiziert werden. Eine Doppelstruktur mit Maxima bei 6 und 8 MeV wurde beobachtet. Als mögliche Interpretation wird eine Deformationsaufspaltung aufgrund der Erhaltung der K-Quantenzahl analog zur Dipolriesenresonanz gegeben. Der Photoabsorptionsquerschnitt zeigt ein deutlich größeres K=1/K=0 Verhältnis im Bereich der Dipolriesenresonanz als frühere (γ,xn) Experimente [1].

[1] P. Carlos et al., Nucl. Phys. A **225**, 171 (1974).

* Gefördert durch die DFG im Rahmen des SFB 1245.

HK 27.35 Di 16:45 F Foyer

Verbesserung der Energie- und Zeitauflösung des QCLAM-Spektrometers — •Antonio D'Alessio, Peter von Neumann-Cosel, Norbert Pietralla, Maxim Singer und Volker Werner — Institut für Kernphysik, TU Darmstadt

Der Superconducting-DArmstadt-LINear-ACcelerator (S-DALINAC) befindet sich momentan in einer Umbauphase und wird zu einem Energy Recovery LINAC umgerüstet. In diesem Zuge wird ebenfalls die Energieauflösung des Beschleunigers verbessert. In der jetzigen Konfiguration wäre das QCLAM-Magnet-Spektrometer das limitierende Element in der Energieauflösung bei zukünftigen Experimenten. Aus diesem Grund wird die Elektronik und das Detektorsystem des Spektrometers weiter entwickelt.

Die Vieldraht-Driftkammern des Detektorsystem werden von einem Argon-Isobutan Gasgemisch auf ein Argon-Kohlenstoffdioxid Gasgemisch umgestellt, hiermit erreicht man eine geringere Diffusion der Elektronenlawine innerhalb des Gases und somit eine bessere Zeitauflösung. Ebenfalls werden nun alle Drähte als Zähldrähte genutzt.

Gefördert wird diese Arbeit durch das Graduierten-Kolleg GRK 2128 "AccelencE„ und den Sonderfoschungsbereich SFB 1245.

HK 27.36 Di 16:45 F Foyer

Experimental study of nuclear vorticity with the ^{12}C(e,e'γ) reaction at the QCLAM electron spectrometer* — •Tobias Klaus, Sergej Bassauer, Andreas Krugmann, Peter von Neumann-Cosel, Norbert Pietralla, Vladimir Ponomarev, Maxim Singer, and Jochen Wambach — Institut für Kernphysik, TU Darmstadt

Experiments of inelastically scattered electrons in coincidence with real photons have the big advantage that the probe is purely electromagnetic and hence allow for nuclear structure studies of highest precision. We developed a setup for electron-γ-ray coincidence spectroscopy at the QCLAM electron spectrometer at the S-DALINAC. The first experiment is a study of γ-decay angular distributions in ^{12}C in order to infer the vorticity of nuclear velocity fields in low-lying exited states. We present the experimental setup and discuss theoretical predictions for the velocity field distributions for the 2_1^+ and 3_1^- state. The $1_{T=1}^+$ state at 15.11 MeV will be used to calibrate the setup for further experimental campaigns.

*Supported by the DFG within the SFB 1245.

HK 27.37 Di 16:45 F Foyer

A silicon vertex tracker for experiments with light particles at SAMURAI — •Florian Dufter, Roman Gernhäuser, Laura Fabbietti, Sebastian Reichert, Christian Berner, and Lukas Werner for the SAMURAI19-Collaboration — Technische Universität München

The tetraneutron has attracted a lot of experimental and theoretical attention in recent years. The observation of a 4-neutron ground state resonance could deliver information about a three nucleons interaction and may contribute to further understanding of the equation of state in neutron stars. The ^4n ground state resonance is created by using the ^8He(p,pα)^4n knock-out reaction. Two layers of silicon detectors determine the position of the reaction vertex in a liquid hydrogen target. The energy of the resonance is determined by the full kinematic reconstruction of the scattered charged particles with the SAMURAI spectrometer at the RIKEN facility in Japan. We developed a new setup of highly segmented 100 μm thin silicon detectors for vertex reconstruction in a 5 cm LH_2 target. The detector concept, its implementation and tests of the first prototypes as well as a GEANT4 simulation of the expected performance will be presented. This work is supported by the SFB1245 of TU Darmstadt (DFG) and the DFG Cluster of Excellence "Origin and Structure of the Universe".

HK 27.38 Di 16:45 F Foyer

Investigations of ^{55}Fe energy spectra in Ne-CO_2 gas mixtures for GEM detectors — •Viktor Ratza, Markus Ball, Mathias Liebtrau, and Bernhard Ketzer for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, DE

With the planned upgrade of the ALICE Time Projection Chamber the current multi-wire proportional chambers will be replaced by a Gas Electron Multiplier (GEM) - based technology in order to allow for a continuous operation at high interaction rates up to 50 kHz. A stack of four GEM stages was chosen to achieve a suppression of the ion backflow below 1%. At the same time an energy resolution of σ/E lower than 12% has to be maintained for ^{55}Fe in Ne-CO_2-N_2 (90-10-5) at a total gain of 2000. This requires a reliable determination of the width of the photopeak.

Typically a simple Gaussian is fitted to the ^{55}Fe K_α-peak in order to determine the enery resolution. However, the obtained fit is strongly biased by the K_β-peak and an underlying background, resulting in a systematic shift of the estimated energy resolution. This effect can be of the order of one percentage point.

In order to obtain a more appropriate description of the energy spectrum the background was investigated in detail. Taking the K_β-peak and the underlying background into account a fit model was introduced to achieve a more realistic and consistent description of the energy spectrum and thus the energy resolution.

Supported by BMBF.

HK 27.39 Di 16:45 F Foyer

Search for double beta decay processes of ^{124}Xe with XENON100 and XENON1T — •Alexander Fieguth for the XENON-Collaboration — Institut fuer Kernpyhsik WWU, Muenster, Deutschland

Driven by the search for dark matter particles the XENON collaboration installed its next stage multi-ton experiment XENON1T, which will probe the spin-dependent and spin-independent-WIMP-nucleon cross section, where for the latter a sensitivity down to 1.6x10^{-47}cm^2 will be reached. Adding to its main purpose different particle physics topics can be addressed. One example are double beta decay processes of the isotope ^{124}Xe. It is expected to decay via two-neutrino double electron capture (2νECEC). Due to its Q-value of 2864keV the positron including processes 2vECβ^+ and 2$\nu\beta^+\beta^+$ are also allowed. With its fiducial mass of one ton, XENON1T will be the most sensitive detector for these decays to date and detection the 2vECEC and 2vECβ+ decays is within reach providing information on nuclear matrix element (NME) models. Within this work the search for 2νECEC has been carried out on 225 live days of XENON100 data setting a lower limit of 6.5x10^{20}yr@90% C.I. for the half-life of this decay. Despite of not being competitive with the best limit >4.7x10^{21}yr set by the XMASS-I experiment, it supersedes a published external analysis of this data. Moreover the possibilities of the running XENON1T experiment are studied by a simulation, which shows that it will be the most sensitive experiment for this decay channel. This work is supported by BMBF under contract number 05A14PM1 and DFG(GRK 2149).

HK 27.40 Di 16:45 F Foyer

Determination of the tritium Q-value at the KATRIN experiment — •Rudolf Sack for the KATRIN-Collaboration — WWU Münster

KATRIN is a next generation tritium $\beta-$decay experiment which will allow a model independent investigation of the sub eV neutrino mass scale. With an estimated sensitivity of 0.2 eV/c^2 (90 % C.L.) it will improve the sensitivity on direct neutrino mass measurements by one order of magnitude. To reach this goal, it is important to understand the systematic effects of this experiment. All systematic uncertainties combined must not exceed an uncertainty of 0.017 eV^2/c^4 on m_ν^2. The measurement of the Q-value of tritium $\beta-$decay, which is closely related to the endpoint E_0 of the electron energy spectrum, has great potential to check the whole experiment for systematic effects. The value obtained at KATRIN can be compared to results of Penning trap experiments, performed e.g. EG Meyers et al. at Florida SU, who published this value with an uncertainty of only 70 meV. This will allow us to check the systematics of the experiment, assuming that we can control our energy scale at this level. The estimated statistical error will be $\Delta E_0 = 2 - 3$ meV after the full three years of measurement time.

This work is supported by the Research and Training Group GRK2149.

HK 27.41 Di 16:45 F Foyer

The neutron lifetime experiment τSPECT — •Kim Ross[1], Marcus Beck[1], Christopher Geppert[2], Jan Haack[1], Werner Heil[1], Jan Kahlenberg[1], Jan Karch[1], Sergei Karpuk[2], Yuri Sobolev[2], and Norbert Trautmann[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz

The decay of the free neutron into a proton, electron, and antineutrino is the prototype semileptonic weak decay and is the simplest example of nuclear beta decay. The present “neutron lifetime puzzle” shows that some subtle and not understood effects in some of the experiments does not allow to quote a rather complete systematic confidence interval. Rather than relying on neutron reflection from a material wall, where neutron up-scattering and capture cause significant wall losses, magnetically trapped neutrons do not interact with matter during the storage interval. That is the obvious appeal to the use of magnetic and gravitational confinement, where, at least in principle, the dynamics of the neutron-trap interaction is straightforward. The τSPECT spectrometer provides a 3D magnetic storage of ultracold neutrons (UCN) up to 60 neV and is presently setup at the pulsed UCN source at TRIGA Mainz. By measuring both the decay protons and the surviving neutrons, an accurate neutron lifetime measurement with $\delta t \approx 1$ s is envisaged for phase I of this project.

This poster discusses the current status of τSPECT.

HK 27.42 Di 16:45 F Foyer

Implementation and test of a setting generator for the GSI fragment separator FRS in the LHC Software Architecture LSA — •Jan-Paul Alexander Hucka[1], Joachim Enders[1], Stephane Pietri[2], Helmut Weick[2], David Ondreka[2], Hanno Hüther[2], Jutta FItzek[2], and Holger Liebermann[2] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

At the GSI facility the LSA [1] framework from CERN is used to implement a new control system for accelerators and beam transfers. This was already completed and tested for the SIS18 accelerator. The implementation of experimental rings such as CRYRING and ESR is currently under development. In addition, the Fragmentseparator FRS [2] and - in a later stage - also the superconducting Fragmentseparator S-FRS at FAIR will be controlled within this framework.

The challenge posed by the implementation of the control system for the FRS arises from the interaction of the beam with matter in the beamline and the beam*s associated energy loss. This energy loss will be determined using input from ATIMA [3] and has been included into the code of the LSA framework. The implemented setting generator was simulated and benchmarked by comparison to results of earlier measurements.

Work supported in part by the state of Hesse (LOEWE center HIC for FAIR) and BMBF (05P15RDFN1). [1] M. Lamont et al., LHC Project Note 368 [2] H. Geissel et al., NIM B 70, 286 (1992) [3] H. Weick et al., NIM B 164/165 (2000) 168.

HK 27.43 Di 16:45 F Foyer

RF Tuning of the Coupled FRANZ RFQ - IH-DTL — •Ali Almomani and Ulrich Ratzinger — IAP - Frankfurt University

The neutron beam at the FRANZ facility will be produced by the 7Li(p,n)7Be reaction using an intense 2 MeV proton beam. A coupled 4-Rod-type RFQ and a 8 gap interdigital H-type structure (IH-DTL) will be used to accelerate the protons from 120 keV to 2 MeV. This coupled RFQ - IH-DTL will be operated at 175 MHz in cw mode and it has a total length of about 2.3 m. The two structures (RFQ, IH-DTL) are internally coupled inductively, and consequently only one RF-amplifier providing a total power up to 250 kW is needed for operation. The IH-DTL is RF tuned together with an Al-RFQ model, before final IH installation in the FRANZ cave, while the original RFQ was already installed in the beam line. After RF power and beam tests the coupled structure will be installed and continued with RF and beam.

This paper will be focused on the RF tuning process and the main results will be presented.

HK 27.44 Di 16:45 F Foyer

Status of the modulated 3 MeV 325 MHz Ladder-RFQ — •Maximilian Schütt, Marc Syha, Marcus Obermayer, and Ulrich Ratzinger — Institut für Angewandte Physik, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

Based on the positive results of the unmodulated 325 MHz Ladder-RFQ from 2013 to 2016, we develop a modulated 3.3 m Ladder-RFQ. The unmodulated Ladder-RFQ features a very constant voltage along the axis. It could withstand more than 3 times the operating power of which is needed in operation at a pulse length of 200 micro seconds. That corresponds to a Kilpatrick factor of 3.

The 325 MHz RFQ is designed to accelerate protons from 95 keV to 3.0 MeV according to the design parameters of the p-linac at FAIR. This particularly high frequency for a 4-Rod type RFQ creates difficulties, which are challenging in developing an adequate cavity. The results of the unmodulated prototype have shown, that the Ladder-RFQ is a suitable candidate for that frequency.

Inspired by the successful rf power test, the nominal vane-vane voltage was increased from 80 kV to 96 kV. The basic design and tendering of the RFQ has been successfully completed in 2016. Electromagnetic simulations of a modulated full structure, especially in terms of field-flatness and frequency tuning, will be shown. Furthermore, the mechanical design, which includes a direct cooling of the structure for duty cycles up to about 5%, will be discussed.

HK 27.45 Di 16:45 F Foyer

Beam Dynamics Simulations for the SC CW Heavy Ion Linac at GSI — •Malte Schwarz[1], Holger Podlech[1], Kurt Aulenbacher[3], Winfried Barth[2,3], Markus Basten[1], Marco Busch[1], Florian Dziuba[1,3], Viktor Gettmann[2,3], Manuel Heilmann[2], Sascha Mickat[2,3], Maksym Miski-Oglu[2,3], Ulrich Ratzinger[1], Rudolf Tiede[1], and Stepan Yaramyshev[2] — [1]IAP, Goethe-Universität, Frankfurt am Main — [2]GSI Helmholtzzentrum, Darmstadt — [3]HIM Helmholtzinstitut, Mainz

For future experiments with heavy ions at the coulomb barrier within the SHE (super-heavy elements) research project a multi-stage R&D program of GSI, HIM and IAP is currently under progress. It aims at developing an energy-variable superconducting (sc) continuous wave (cw) LINAC for A/q up to 6. The beam dynamics concept is based on multicell constant-beta CH-DTL cavities. The next milestone will be the full performance test of the first LINAC section (Demonstrator) with beam, after an accomplished performance test already showed promising results. In addition, as intermediate step towards the full LINAC an Optimized Advanced Demonstrator is proposed. The corresponding simulations, mainly made with LORASR and TraceWin will be presented.

HK 27.46 Di 16:45 F Foyer

Beam Dynamics for a High Current 3 MeV, 325 MHz Ladder-RFQ — •Marc Syha, Maximilian Schütt, Marcus Obermayer, and Ulrich Ratzinger — Institut für Angewandte Physik, Goethe-Universität Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

After the successful measurements with a 0.8 m prototype a 3.3 m Ladder-RFQ is under construction at IAP, Goethe University Frankfurt. It is designed to accelerate protons from 95 keV to 3.0 MeV according to the design parameters of the p-linac at FAIR.

The development of an adequate beam dynamics was done in close collaboration with the IAP resonator design team. The Los Alamos RFQGen-code was used for the beam simulations. A constant vane curvature radius and at the same time a flat voltage distribution along the RFQ was reached by implantation of the modulated vane geometry into MWS-CST RF field simulations.

Point of reference for the beam dynamics layout are the beam dynamics designs of C. Zhang* and A. M. Lombardi**. This poster presents the simulation results with the main vane modulation parameters.

Footnotes

* Chuan Zhang, "Beam Dynamics for the FAIR Proton-Linac RFQ", IPAC 2014, Dresden ** C. Rossi et al., "The Radiofrequency Quadrupole Accelerator for the LINAC4", LINAC08, Victoria, BC, Canada

HK 27.47 Di 16:45 F Foyer

Tests of ionisation chambers for photofission experiments — •Marius Peck[1], Joachim Enders[1], Martin Freudenberger[1], Alf Göök[2], Andreas Oberstedt[3], and Stephan Oberstedt[2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]European Commission, JRC-IRMM, Geel, Belgium — [3]ELI-NP, Măgurele, Romania

Photofission in the barrier region suffers from relatively low cross sections. Hence, besides using intense bremsstrahlung (S-DALINAC) or monochromatic γ-ray beams (ELI-NP), significant amounts of target material needs to be placed in the beam to reach sufficient luminosity. We set up and tested a multi-stack Frisch-grid ionisation chamber and obtained angular and mass distributions as well as total kinetic energy of fission fragments in neutron-induced fission of ^{232}Th and ^{238}U.
For the measurement of the azimuthal angular distribution segmented anodes have been used.
Supported by BMBF (05P15RDENA).

HK 27.48 Di 16:45 F Foyer

Automatic Energy and Efficiency Calibration of HPGe Detectors — •Elena Hoemann, Jan Mayer, Mark Spieker, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

HDTV[1] is a γ-ray spectrum analyzing tool created at the University of Cologne. It is written in python and based upon the ROOT framework from CERN. This poster deals with the enhancements of HDTV. The new automation of energy calibration for HPGe detectors, which is obtained by matching literature data of the observed nuclide to the fitted peaks, will be introduced. In addition the behavior of different functions for the extrapolation of the efficiency in the high-energy range was investigated and an automatic fit to the experimental data will be presented.

Supported by the BMBF (05P2015PKEN9/ELI-NP). J.M. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

[1] HDTV - Institut for Nuclear Physics, University of Cologne, https://gitlab.ikp.uni-koeln.de/staging/hdtv

HK 27.49 Di 16:45 F Foyer

High resolution picoamperemeters for high voltage applications — •Dimitri Schaab, Justus Rödel, Markus Ball, Reinhard Beck, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, DE

Modern tracking detectors, as the future Time Projection Chambers for ALICE and the CBELSA/TAPS experiment, are based on Micro Pattern Gaseous Detector technology. In either case, Gaseous Electron Multipliers (GEM) will be used for the amplification of primary charges. In this scope, several studies at GEM-based test detectors are done which involve current measurements down to the order of picoamperes. For this purpose, current-meters with a high-impedance op-amp are used. Since GEM-related measurements have to be performed at voltages of several kilovolts, the current-meter must be designed such that it is decoupled from any external ground potential. At the present time, they are powered by batteries and read out wirelessly in order to avoid an external ground connection. To do measurements independently of the battery lifetime, a potential-free optical power supply was developed and tested. Moreover, a fully automatic calibration station was built to calibrate the current-meters at controlled temperature conditions. Latest investigations revealed a non-negligible temperature dependence that can be compensated by software if the temperature is known. Thus, a temperature monitoring is necessary which implies a revision of the devices. At stable temperatures, the absolute precision was determined to be below 2pA.

Supported by SFB/TR16.

HK 27.50 Di 16:45 F Foyer

Konzeption eines Flüssig-Heliumtargets für Elektronenstreuexperimente — •Michaela Hilcker, Andreas Krugmann, Thorsten Kürzeder, Norbert Pietralla und Peter von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

Am Institut für Kernphysik der TU Darmstadt werden mittels hochauflösender, inelastischer Elektronenstreuung Untersuchungen der Kernstruktur bei niedrigen Impulsüberträgen durchgeführt. Das QClam-Spektrometer, eines der beiden großen Magnetspektrometer des Instituts, dient der Bestimmung des Impulses der gestreuten Elektronen.

Im Rahmen des Sonderforschungsbereich 1245 „Nuclei: From Fundamental Interaction to Structure and Stars“ ist ein Elektronenstreuexperiment bei niedrigem Impulsübertrag zur Untersuchung des ersten angeregten 0^+ Zustandes in ^{4}He geplant, da bisherige Experimente [1] stark von aktuellen „ab initio“ Rechnungen im Rahmen der chiralen EFT [2] abweichen. Um eine ausreichend gute Statistik der Messdaten in annehmbarer Messzeit erhalten zu können, ist die Verwendung von flüssigem Helium als Targetmaterial notwendig. Die Konstruktion eines geeigneten Aufbaus inklusive Heliumkryostat und einer dazu passenden neuen Streukammer werden vorgestellt.

[1] T. Walcher, Phys. Lett. B **31**, 442 (1970).
[2] S. Bacca, N. Barnea, W. Leidemann, and G. Orlandini, Phys. Rev. Lett. **110**, 042503 (2013).
Gefördert durch die DFG im Rahmen des SFB 1245.

HK 27.51 Di 16:45 F Foyer

Automatisierte Kalibrierung von NeuLAND mithilfe von kosmischen Strahlen — •Vadim Wagner[1,2], Dmytro Kresan[2] und Joachim Enders[1] — [1]TU Darmstadt, Darmstadt, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

Der New Large Area Neutron Detektor (NeuLAND) wird beim zukünftigen Reactions with Relativistic Radioactive Beams (R3B) Experiment in der Facility for Antiproton and Ion Research (FAIR) die Energien von bis zu vier Neutronen gleichzeitig mithilfe von Flugzeitmessungen bestimmen. Um die Relativenergie auf 20 keV genau auflösen zu können, muss die Flugzeitmessung eine Auflösung von $\sigma_t <$ 150 ps haben. Um dies zu erreichen müssen die Photodetektoren genau kalibriert und synchronisiert werden. Dieses Verfahren wurden in R3BRoot implementiert und ermöglicht in wenigen Schritten eine vollständige Kalibrierung von NeuLAND. Die Qualität der Kalibrierung wird anhand einer kleinen Analyse von experimentellen Daten veranschaulicht. Unterstützt durch das BMBF (05P15RDFN1)

HK 27.52 Di 16:45 F Foyer

Track-based Misalignment Corrections for the CBM Silicon Tracking Detector — •Susovan Das for the CBM-Collaboration — Physikalisches Institut, Eberhard karls Universität Tübingen

The Silicon Tracking System (STS) is the central tracking detector of the CBM experiment. It consists of 8 layers of altogether ∼900 double-sided silicon strip sensors. The sensors have a strip pitch of 58μm yielding an intrinsic resolution of ∼20μm. On the other hand, we expect a mechanical precision of the STS assembly not better than ∼100μm. Therefore, the intrinsic resolution has to be recovered by software based alignment methods. The software correction is based on the MILLEPEDE package.

In this contribution we present different misalignment scenarios which reflect the hierarchy of the mechanical assembly of the STS, i.e., stations, units, ladders, sensors. We evaluate the effect of the misalignment of the various components onto the tracking efficiency and momentum resolution of the detector by simulations using UrQMD events.

In a further step we explore how well, and within which limits, the track-based MILLEPEDE algorithms are able to recover the ideal resolution of an undistorted detector.

- This work was supported by grant **BMBF-05P16VTFC1**

HK 27.53 Di 16:45 F Foyer

A high density readout system for TREX at MINIBALL — •Christian Berner, Christoph Berger, Shawn Bishop, Michael Böhmer, Roman Gernhäuser, Stefanie Hellgartner, Ralf Lang, Lukas Werner, and Sonja Winkler — Technische Universität München, Physik-Department

TREX is a versatile silicon detector for measuring transfer and Coulex reactions with heavy, neutron-rich beams at CERN/ISOLDE. It is an array of position-sensitive ΔE-E-detector telescopes in a compact setup, covering 66% of the full solid angle. Currently the resolution of reconstructed energies and the efficiency of the setup is limited by the angular resolution, the trigger threshold, and the electronics noise. An upgrade of the silicon sensors using highly segmented $d = 100\mu$m thick DSSDs with 100μm pitch with a high density readout system using an ASIC-based solution with calorimetric performance is discussed. The SKIROC2-ASIC offers - despite of its low ENC, the possibility to have an analogue, as well as a fully digitized readout. Its large dynamic range and the ability to power-pulse the different ASIC-stages only during the beam pulses are perfect features for TREX at ISOLDE. System control, trigger and readout of the new detector array will be implemented on a FEBEX-based data-platform, also used for the surrounding Germanium-array MINIBALL. We will present the detection concept, first prototype test and the performance estimations from Geant4 simulations. This work is supported by BMBF (05P15WOCIA).

HK 27.54 Di 16:45 F Foyer

Construction of a neutron source for silicon detector irradiation — •Eduard Friske — Uni Tübingen, Tübingen, Germany

The silicon strip sensors of the Silicon Tracking System used for the CBM experiment at FAIR are subject to high doses of ionizing and non-ionizing radiation. Simulations predict the total non-ionizing dose to reach $\approx 10^{14}$ $\mathrm{n_{eq}/cm^2}$.

To verify the predicted changes in detector performance due to radiation damage, a tunable neutron source has been constructed. It uses the deuteron beam of a Van-de-Graaf accelerator to produce neutrons using D-D fusion. The gas cell containing the deuterium gas is cooled to cryogenic temperatures with liquid nitrogen to maximize gas density and increase the neutron output while retaining a compact source design.

The goal of the setup is to reach the simulated dose within several weeks. This long irradiation time allows to monitor the degradation and change in electrical properties of the irradiated sensor under realistic conditions. Live monitoring of the sensor is achieved by a collimated beta source creating hits which are read out by a commercial readout system.

HK 27.55 Di 16:45 F Foyer

Quality assurance measurements for the PANDA Barrel DIRC quartz radiators — •Marvin Krebs[1,2], Klaus Peters[1,2], Georg Schepers[1], Carsten Schwartz[1], and Jochen Schwiening[1] — [1]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH — [2]Goethe-University Frankfurt

The PANDA experiment at the Facility for Antiproton and Ion Research in Europe (FAIR) at GSI, Darmstadt, will study fundamental questions of hadron physics and QCD. A fast focusing DIRC (Detection of Internally Reflected Cherenkov light) counter will provide hadronic particle identification (PID) in the barrel region of the PANDA detector. To meet the PID requirements, the Barrel DIRC has to provide precise measurements of the Cherenkov angle, which is conserved for Cherenkov photons propagating through the radiator by total internal reflection. The radiators, rectangular quartz bars, have to fulfill strict optical and mechanical requirements. This includes the squareness and parallelism of the sides of the bars, sharp corners, and a very smooth surface polish, ensuring that the Cherenkov photons reach the optical sensors without angular distortions. Two possible radiator shapes are being considered for the final detector design: either a conservative design with narrow bars or a cost-saving option using a wide plate An optical setup, consisting of a computer-controlled positioning and multi-wavelength laser system, is used to evaluate the radiators to obtain critical values like transmittance and reflectivity. The Setup, measuring procedure and results from radiator bar- and plate measurements will be presented on this poster. Work supported by HGS-HIRe.

HK 27.56 Di 16:45 F Foyer

Radiation Hardness of pcCVD Detectors and precise IC Calibration — •Steffen Schlemme[1,2], Mladen Kis[1], Chiara Nociforo[1], Fabio Schirru[1], Joachim Enders[2], P. Figuera[3], J. Frühauf[1], A. Kratz[1], N. Kurz[1], S. Löchner[1], A. Musumarra[3,4], S. Salamone[3], B. Szczepanczyk[1], M. Träger[1], and R. Visinka[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]TU Darmstadt, Darmstadt, Germany — [3]LNS-INFN Catania, Italy — [4]University of Catania, Italy

A new in-flight separator Super-FRS is under construction at FAIR/Darmstadt. Ion rates up to 3×10^{11} ^{238}U/spill demand an adaptation of detectors to a high radiation environment. A test experiment to investigate the radiation hardness of polycrystalline diamond detectors(pcCVD) was performed at the LNS-INFN in Catania using a ^{12}C beam at 62MeV/u and intensities of up to 1.5pnA. The setup consisted of pcCVD strip detectors to measure the beam profile, a single crystal diamond detector to calibrate the IC working in current mode as a beam intensity monitor and a pcCVD sample to be irradiated. The IC used was designed for FAIR and showed a stable counting rate allowing us to calibrate and perform beam intensity measurements with it. The results showed no decrease of the signal quality before and after the irradiation of 3.5MGy. A second experiment at GSI aimed at a very precise calibration of this IC using a plastic scintillator as reference, achieving a relative precision below 1%.

Gefördert durch HGS-HIRe, den GSI-TU Darmstadt-Kooperationsvertrag und das BMBF (05P15RDFN1).

HK 27.57 Di 16:45 F Foyer

Status of the scatterer component of a Compton camera for ion beam range verification in proton therapy — •S. Liprandi[1], S. Aldawood[1,2], V. Beck[1], M. Mayerhofer[1,3], T. Binder[1], I. V.-Lozano[1], J. Bortfeldt[1], L. Maier[4], R. Lutter[1], R. Gernhäuser[4], G. Pausch[5], W. Enghardt[5,6], F. Fiedler[6], G. Dedes[1], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU München, Germany — [2]King Saud Univ., Riyadh, Saudi Arabia — [3]Univ. Hamburg, Germany — [4]TU München, Germany — [5]OncoRay and TU Dresden, Germany — [6]Helmholtz-Zentrum Dresden-Rossendorf, Germany

At LMU we are developing a Compton camera, designed to detect prompt γ-rays induced by nuclear reactions, during the irradiation of tissue in particle therapy. Our prototype consists of a stack of double-sided silicon strip detectors acting as scatterers and an absorber formed by a $LaBr_3$(Ce) scintillator. Both detectors have been characterized off- and online at different accelerator facilities, showing good agreement with MC simulations. Here, the present readout for the DSSSDs (based on the GASSIPLEX ASIC chip) revealed several limitations that urge for an improved upgrade. This poster will focus on the status of the scatterer component and its readout: a characterization of the detectors and specifications for their readout will be shown. Different readout options will be presented, together with first tests performed using a system based on the AGET ASIC chip.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MAP) and KSU, Riyadh, Saudi Arabia.

HK 27.58 Di 16:45 F Foyer

Untersuchung systematischer Effekte für das P2-Experiment — •Sebastian Baunack[1], Niklaus Berger[1], Kurt Aulenbacher[1,2], Jürgen Diefenbach[1], Kathrin Gerz[1], Ruth Herbertz[1], Frank Maas[1,2], Matthias Molitor[1], David Rodriguez Pineiro[1,2], Iurii Sorokin[1], Hubert Spiesberger[1,3], Alexey Tyukin[1], Valerie Tyukin[1] und Marco Zimmermann[1] — [1]PRISMA Cluster of Excellence und Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence und Institut für Physik, Johannes Gutenberg-Universität Mainz

Die P2-Kollaboration bereitet derzeit eine Messung des schwachen Mischungswinkels $\sin^2 \theta_w$ mittels elastischer Elektron-Proton-Streuung vor. Die angestrebte relative Genauigkeit beträgt 0.15% und ist damit vergleichbar mit den derzeit genauesten Messungen am Z-Pol. Das Experiment soll am neu zu errichtenden Elektronenbeschleuniger MESA in Mainz durchgeführt werden.

Die erreichbare Präzision hängt sowohl von der zu erreichenden statistischen Unsicherheit in der Messung der paritätsverletzenden Asymmetrie also auch von zahlreichen systematischen Effekten ab, z.B. den helizitätskorrelierten Differenzen in den Parametern Lage, Intensität und Energie des Elektronenstrahls. Eine Untersuchung dieser Effekte wird vorgestellt.

HK 27.59 Di 16:45 F Foyer

P2 - A fused silica Cherenkov detector for the high precision determination of the weak mixing angle — •Kathrin Schier[1], Dominik Becker[1], Sebastian Baunack[1], Michael Gericke[2], and Frank Maas[1] for the P2-Collaboration — [1]Institut für Kernphysik Mainz — [2]University of Manitoba

The weak mixing angle is a central parameter of the standard model and its high precision determination is tantamount to probing for new physics effects.

The P2 experiment at the MESA accelerator in Mainz will perform such a measurement of the weak mixing angle via parity violating electron-proton scattering. We aim to determine sin 2 (Θ W) to a relative precision of 0.13%. Since the weak charge of the proton is small compared to its electric charge, the measurable asymmetry is only 33ppb, requiring a challenging measurement to a precision of only 0.44ppb. In order to achieve this precision we need to collect very high statistics and carefully minimize interfering effects like apparatus induced false asymmetries.

We present the status of the development of an integrating fused-silica Cherenkov detector, which is suitable for a high precision and high intensity experiment like P2. The contribution will focus on the investigation of the detector*s response to incoming signal and background particles determined by both MC simulations and by measurements at the MAMI facility in Mainz.

HK 27.60 Di 16:45 F Foyer

Feature extraction and calibration concepts for a prototype of the PANDA barrel EMC — •Stefan Diehl, Kai-Thomas Brinkmann, Rainer Novotny, Christoph Rosenbaum, and Hans-Georg Zaunick for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The electromagnetic calorimeter (EMC) of the PANDA detector at the future FAIR facility will consist of more than 15,000 lead tungstate (PWO) crystals which are operated at -25 °C to increase the light yield of PWO. It will be one of the central components of PANDA to achieve the physics goals in studying the interaction of cooled antiprotons with a fixed target. The focus of the contribution will be on the barrel part of the target EMC. The signals from the APD read out of the crystals, which are shaped and amplified by a customized ASIC, will be digitized by a sampling ADC. Based on the response of a close-to-final prototype to photons in the energy range between 50 MeV and 800 MeV, different feature extraction and calibration concepts will be compared. It has been shown, that a feature extraction via a fit of the signal shape provides a significant improvement of the energy resolution in the energy range below 100 MeV, compared to a simple peak sensing feature extraction. In addition it has been shown that a calibration based on the energy deposition of cosmic muons, in comparison to detailed GEANT4 simulations, taking all light collection effects into account, can be an excellent first step for a calibration of the calorimeter. *The Project is supported by BMBF, GSI and HIC for FAIR. S. D. is supported by JLU Gießen through a JUST'us scholarship grant.

HK 27.61 Di 16:45 F Foyer

Construction and Assembly of the first Barrel Slice for the Electromagnetic Calorimeter of the PANDA experiment — •Markus Moritz[1], Hans-Georg Zaunick[1], Valera Dormenev[1], Andrey Ryazantsev[2], Thomas Wasem[1], Benjamin Wohlfart[1], Christopher Hahn[1], René Schubert[1], Stefan Diehl[1], and Kai-Thomas Brinkmann[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen — [2]IHEP Protvino, Russia

The first major assembly stage of the barrel part of the electromagnetic calorimeter of the PANDA experiment at the future FAIR facility by assembling one single barrel slice segment will be presented. The calorimeter is composed of two endcaps and a barrel covering the major part of the solid angle consisting of more than 11.300 tapered PbWO4 crystals. Each scintillator module is readout via two large area avalanche photo diodes connected to custom made ASIC-preamplifier. The construction of the first segment comprises a full length slice beam holding in total 18 module blocks. Each block consists of a matrix of 4x10 crystals. The assembly procedure of single detector modules, module blocks and the overall slice segment, respectively will be discussed. Test results of single components and fully assembled detector modules will be discussed and compared with earlier prototype in-beam and lab tests. Supported by BMBF, GSI and HIC for FAIR.

HK 27.62 Di 16:45 F Foyer

Development and Detector Characterization of COBRA GEMs — •Thomas Klemenz — TU München, Physik Department E62, Excellence Cluster 'Universe', Garching

The requirements of the next generation experiments in particle physics are the driving factors for the development of new technologies. Detectors have to handle harsh radiation in high luminosity environments providing stability at high read out rate. In Time Projection Chamber (TPC) detectors, in addition, a low ion back flow (IBF) is needed not to introduce distortion of the drift field. Multi Wire Proportional Chambers (MWPCs), commonly used as read out for the TPC, provide IBF suppression by introducing a gating grid. Because of its limited read out rate, however, the MWPC is now being gradually replaced. Instead, Gas Electron Multiplier (GEM) foils are being used since they provide continuous operation due to the intrinsic IBF suppression. A new type of GEM, the COBRA GEM, was proposed, which may provide a further reduction of the IBF. By implementing ring-like electrodes around the GEM holes, yet another degree of freedom for controlling the IBF is provided.

We report on the effective gain and IBF suppression measurements with a single thick COBRA GEM as a function of various HV settings.

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

HK 27.63 Di 16:45 F Foyer

Charge transfer properties of Gas Electron Multipliers —

•Jonathan Ottnad, Markus Ball, Viktor Ratza, and Bernhard Ketzer — Helmholtz-Institut für Strahlen und Kernphysik, Bonn, DE

Gas Electron Multipliers (GEM) are state-of-the-art technology to achieve charge multiplication in gaseous detectors. While GEMs proved their reliable operation and excellent behaviour in terms of energy and spatial resolution and high rate capability in experiments like COMPASS, LHCb and others, the characteristics of the charge transfer and multiplication processes have not yet been studied in full detail.

The optimization of a GEM-based readout requires the study of several parameters. The GEM geometry as well as the electric field configuration influence the transfer of the charges. The poster shows the results of a set of systematic measurements for the electron charge transfer. The measurements are compared to the data of a microscopic simulation. Furthermore the agreement with the calculation of a charge density model is presented.

Supported by SFB/TR 16.

HK 27.64 Di 16:45 F Foyer

Folienbasierte Auslesestrukturen für GEM-Detektoren am MAGIX-Experiment bei MESA — •Yasemin Schelhaas für die MAGIX-Kollaboration — Institut für Kernphysik der Universität Mainz

Das MAGIX-Experiment ist Teil des neuen Beschleunigerkomplexes MESA am Institut für Kernphysik in Mainz, der in den kommenden Jahren in Betrieb genommen werden soll. Im energierückgewinnenden Modus, der einen hohen Strahlstrom von bis zu 1 mA ermöglicht, wird das MAGIX-Experiment installiert. Hier können Präzisionsmessungen im Niederenergiebereich mit hoher Statistik durchgeführt werden. Dazu zählt die Suche nach dunklen Photonen, die Bestimmung des magnetischen Protonenradius oder auch die Bestimmung des astrophysikalischen S-Faktors.

Diese Posterpräsentation befasst sich insbesondere mit der Auslesestruktur der ortsauflösenden GEM-Detektoren in der Fokalebene der geplanten Magnetspektrometer. Diese Detektoren sollen eine finale Größe von $1,20\,\mathrm{m} \times 0,30\,\mathrm{m}$ haben. Da die Energien von MAGIX im Bereich von 5 MeV bis 105 MeV liegen, müssen die Detektoren eine sehr geringe Strahlungslänge aufweisen. Im Rahmen einer Masterarbeit werden verschiedene folienbasierte Layouts der Auslesestrukturen bezüglich ihrer Vor- und Nachteile diskutiert. Im Detail wird eine kombinierte Auslesestruktur aus Streifen und verbundenen Pads (Strads) beschrieben.

HK 27.65 Di 16:45 F Foyer

Measurements with CBM-TRD Prototypes at the CERN SPS in 2015 — •Patrick Schneider and Dennis Spicker for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

CBM as the heavy-ion experiment at FAIR is designed to investigate the properties of strongly interacting matter at highest net-baryon densities. The main purpose of the Transition Radiation Detector (TRD) will be to discriminate electrons and pions over a large region of particle momenta.

We present two analyses of data acquired in a test-setup with two TRD prototypes in a Pb beam at the SPS at CERN in November and December 2015. These prototypes already have the full size (59x59 cm^2) of the final TRD chambers and used SPADIC v1.0 read out electronics.

The first part investigates the capability of the TRD to operate at high hit-rates by analyzing the current measurements at the anode wires, while the second part displays the spatial resolution of the protoypes by analysing time-correlated events measured in the two chambers.

Generally, a good performance of the TRD in the high-rate environment is observed.

Supported by the German BMBF-grant 05P15RFFC1

HK 27.66 Di 16:45 F Foyer

Study of the spatial resolution of a monolithic $LaBr_3$:Ce scintillator — •Michael Mayerhofer[1,2], S. Aldawood[1,3], T. Binder[1], G. Dedes[1], R. Gernhäuser[5], S. Liprandi[1], R. Lutter[1], L. Maier[5], A. Miani[1,4], K. Parodi[1], D.R. Schaart[6], I. Valencia Lozano[1], and P.G. Thirolf[1] — [1]LMU München, Germany — [2]Univ. Hamburg, Germany — [3]King Saud Univ., Riyadh, Saudi Arabia — [4]Univ. degli Studi di Milano, Italy — [5]TU München, Germany — [6]TU Delft, Netherlands

We develop a Compton camera for ion-beam range verification during hadron therapy by detecting prompt γ rays from nuclear reactions between the beam and organic tissue. The camera consists of a scatterer (6 layers of double-sided Si-strip detectors) and a $LaBr_3$(Ce) scintillator as absorber, read out by a multianode photomultiplier. Key ingredient of the γ-source reconstruction is the determination of the γ-ray interaction position in the scintillator. This contribution will focus on the "k-Nearest Neighbor" (k-NN) and the "Categorical Average Pattern" (CAP) algorithm [1]. Both require a large reference library of 2D light amplitude distributions, derived by scanning the scintillator front surface with tightly collimated ^{60}Co and ^{137}Cs sources and a fine step size (0.5 mm). The determination of the spatial resolution as a function of the photon energy, the PMT granularity and the systematic performance of the two algorithms will be present.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MPA).

[1]van Dam et al., IEEE TNS 58 (2011).

HK 27.67 Di 16:45 F Foyer

Evaluation of a scintillator readout system based on a Silicon Photomultiplier (SiPM) Array and an ASIC-based readout system for a Compton camera — •Tim Binder[1,2], S. Aldawood[1,4], G. Dedes[1], T. Ganka[2], R. Gernhäuser[5], S. Liprandi[1], R. Lutter[1], L. Maier[5], M. Mayerhofer[1,3], A. Miani[1,6], K. Parodi[1], F. Schneider[2], and P.G Thirolf[1] — [1]LMU München, Germany — [2]Ketek GmbH, Munich, Germany — [3]Univ. Hamburg, Germany — [4]King Saud Univ., Riyadh, Saudi Arabia — [5]TU München, Germany — [6]Univ. degli Studi di Milano, Italy

The LMU Compton camera prototype consists of a scatterer (6 layers of double-sided Si-strip detectors) and an absorber ($LaBr_3$) with a photomultiplier tube (PMT) and NIM/VME based readout. In order to optimize the system for different applications, a set of alternative components was evaluated. Firstly, a $CeBr_3$ crystal, providing an increased S/N ratio, due to the absence of internal radioactivity compared to $LaBr_3$, is read out with the present electronics and the spatial resolution is determined. Secondly, a SiPM array and an ASIC-based readout system, allowing the Compton camera to be used in multimodal imaging devices (e.g. combined with MRI), is evaluated. Therefore results of nonuniformity and temperature dependence measurements of the single component's channels, as well as for the combined system are presented. Finally, energy spectra are reconstructed and the energy resolution is compared to results from a standard readout system.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MAP) and KETEK GmbH.

HK 27.68 Di 16:45 F Foyer

Study of the spatial resolution of a monolithic $LaBr_3$:Ce scintillator — •Michael Mayerhofer[1,2], S. Aldawood[1,3], T. Binder[1], G. Dedes[1], R. Gernhäuser[5], S. Liprandi[1], R. Lutter[1], L. Maier[5], A. Miani[1,4], K. Parodi[1], D.R. Schaart[6], I. Valencia Lozano[1], and P.G. Thirolf[1] — [1]LMU München, Germany — [2]Univ. Hamburg, Germany — [3]King Saud Univ., Riyadh, Saudi Arabia — [4]Univ. degli Studi di Milano, Italy — [5]TU München, Germany — [6]TU Delft, Netherlands

We develop a Compton camera for ion-beam range verification during hadron therapy by detecting prompt γ rays from nuclear reactions between the beam and organic tissue. The camera consists of a scatterer (6 layers of double-sided Si-strip detectors) and a $LaBr_3$(Ce) scintillator as absorber, read out by a multianode photomultiplier. Key ingredient of the γ-source reconstruction is the determination of the γ-ray interaction position in the scintillator. This contribution will focus on the "k-Nearest Neighbor" (k-NN) and the "Categorical Average Pattern" (CAP) algorithm [1]. Both require a large reference library of 2D light amplitude distributions, derived by scanning the scintillator front surface with tightly collimated ^{60}Co and ^{137}Cs sources and a fine step size (0.5 mm). The determination of the spatial resolution as a function of the photon energy, the PMT granularity and the systematic performance of the two algorithms will be present.

This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MPA).

[1]van Dam et al., IEEE TNS 58 (2011).

HK 27.69 Di 16:45 F Foyer

Energy resolution measurements with the CBM-TRD using a ^{55}Fe-Source — •Marcel Raabe for the CBM-Collaboration — Institut für Kernphysik Goethe Universität Frankfurt

The goal of the Compressed Baryonic Matter (CBM) experiment at

FAIR is to measure the QCD phase diagram at high net-baryon densities. The Transition Radiation Detector (TRD) of CBM is designed for electron pion discrimination over a large region of particle momenta. It consists of radiators and multi wire proportional chambers filled with a gas mixture of 85% Argon and 15% CO_2. A full-size (59 x 59 cm^2) prototype has been build at the Institut für Kernphysik in Frankfurt (IKF) and is equipped with a plane of anode wires with alternating high voltages. The produced charge is measured with a pad plane on the backside.
We present energy resolution measurements with the current IKF TRD design using a Fe55-Source. The results obtained from the pad plane readout with the SPADIC v1.0 electronics will be compared with measurements using the anode wires for readout.
Supported by the German BMBF-grant 05P15RFFC1

HK 27.70 Di 16:45 F Foyer

Testing prototype Micron X5 silicon-strip detectors for the R^3B setup — •Sonja Storck[1], Ina Syndikus[1,2], Dominic Rossi[1,2], Thomas Aumann[1,2], and Stefanos Paschalis[1,2,3] for the R3B-Collaboration — [1]TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]University of York, United Kingdom

With the R^3B (Reactions with Relativistic Radioactive Beams) setup at GSI in Darmstadt, it is possible to perform kinematically complete measurements with relativistic radioactive beams. In order to identify the incoming and outgoing particles, various detector systems are necessary. Among other systems, silicon-strip detectors are used with which the positions and the energy loss of particles before and after the target are measured.

Two new prototypes of double-sided silicon-strip detectors, Micron X5, were tested in-beam during a beam time at GSI in 2016. The detectors have 32 strips on each side which are arranged perpendicularly to each other to give an x and y position in the same detector. The strips have a resistive surface and are read out either along or across each strip. The detectors were tested regarding the energy and position resolution in addition to their efficiency.

This work is supported in part by BMBF contract 05P15RDFN1 and GSI-TU Darmstadt cooperation agreement.

HK 27.71 Di 16:45 F Foyer

Investigation of CO_2-based Cooling for the CBM Silicon Tracking System — •Kshitij Agarwal for the CBM-Collaboration — Physikalisches Institut der Universität Tübingen

As the core detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet provides track reconstruction & momentum determination of charged particles from beam-target interactions. Due to the expected irradiation damage, the sensors will dissipate some power and have to be kept at or below -5°C by complete removal of the heat dissipated by the front-end electronics (FEE) boards (∼40kW). The heat must be removed to avoid thermal runaway and reverse annealing of the irradiated silicon sensors. So the STS will be operated in a thermal insulation box and will use bi-phase CO_2 cooling system for the FEE.

Thermal conductivity measurements between different thermal interfaces will be shown by using higher thermal conductivity interface materials to replace all the space that otherwise would be occupied by air. Water will be used as the coolant for measurements, which will then be verified by using bi-phase CO_2. This effort is towards building a cooling demonstrator for two STS half-stations to show that the CBM-STS cooling concept is viable. Thermal interface results, both experimental and simulation, followed by the initial construction R&D of thermal insulation box and their respective future plans will be presented.

This work is supported by GSI/FAIR.

HK 27.72 Di 16:45 F Foyer

The primary target for the hypernuclear experiment at $\overline{\text{P}}$ANDA — Sebastian Bleser[1], Michael Bölting[1], Felice Iazzi[2], Josef Pochodzalla[1,3], Alicia Sanchez Lorente[1], •Falk Schupp[1], Marcell Steinen[1], and Christian Tiefenthaler[1] — [1]Helmholtz-Inst. Mainz — [2]Politec. and INFN, Torino — [3]Inst. für Kernphysik, JGU Mainz

A key aspect of the $\overline{\text{P}}$ANDA experiment at the future FAIR facility is the production and spectroscopy of $\Lambda\Lambda$ hypernuclei. The double hypernuclei are produced in a two-stage target system consisting of a primary in-beam filament to produce low momentum Ξ^- hyperons which are stopped and converted into two Λ hyperons in a secondary external target.

A system of piezo motors will be used to steer the primary target in two dimensions. This allows to achieve a constant luminosity by adjusting the position and provides the replacement of eventually broken target wires.

The poster shows the first prototype mounted with vacuum-capable motors. The optical wire-based sensor in development for position control is presented. Motion and position control is managed using the EPICS framework.

HK 27.73 Di 16:45 F Foyer

Thickness monitoring at the Cluster-Jet Target for $\bar{\text{P}}$ANDA — •Ann-Katrin Hergemöller, Daniel Bonaventura, Silke Grieser, Benjamin Hetz, Matthias Seifert, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The first internal target which will be operated at the $\bar{\text{P}}$ANDA experiment at FAIR is a cluster-jet target. Within this target the cluster beam itself is formed by the expansion of pre-cooled gases within a Laval nozzle. To prepare the cluster beam two orifices are used, the skimmer and the collimator. For $\bar{\text{P}}$ANDA a target thickness of more than $10^{15}\ \frac{\text{atoms}}{\text{cm}^2}$ in a distance of 2.1 m behind the nozzle is required to achieve the designated luminosity. With the target prototype, operating successfully for years at the University of Münster, it is routinely possible to provide thicknesses of more than $2\times10^{15}\ \frac{\text{atoms}}{\text{cm}^2}$ in the required distance. Based on the experimental results of the cluster target prototype the final cluster-jet target source was designed and set into operation in Münster as well. To monitor the cluster beam and to determine the thickness two different monitor systems are included in the setup. In this presentation an overview of the target design, the monitor systems and their performance will be presented and discussed.
Supported by BMBF, HGS HIRe and GSI F+E.

HK 27.74 Di 16:45 F Foyer

Test of a PCIe based readout option for PANDA — •Simon Reiter[1], Heiko Engel[2], Sören Lange[1], and Wolfgang Kühn[1] — [1]Justus-Liebig-Universität Giessen, Germany — [2]Goethe-Universtität Frankfurt, Germany

The future PANDA detector will achieve an event rate at about 20 MHz resulting in a high data load of up to 200 GB/s. The data acquisition system will be based on a triggerless readout concept with intelligent sampling ADCs, leading to the requirement of large data bandwidth. The data reduction will be guaranteed on the first level by an array of FPGAs running a full online reconstruction followed by a CPU/GPU cluster on the second level. This is foreseen to achieve a reduction factor of more than 1000.

The C-RORC (Common Readout Receiver Card), originally developed for ALICE (A. Borga et al., JINST 10 (2015) 02, C02022), is an expansion card which can establish the connection between the first and the second level.

A test system with 12 links (SFP, 1 Gbps) sending in parallel was tested, writing the data to memory with a PCIe 2.0 interface (8 lanes). A bandwidth of 1149.6 MB/s was reached in a long-term test of 48 hours without errors. Detailed test results will be presented.

*This work is supported by BMBF(05P15R6FPA).

HK 27.75 Di 16:45 F Foyer

The ARAGORN Front-End - FPGA Based Time-to-Digital Converter with Superior Optical Readout Capabilities — •Maximilian Büchele, Horst Fischer, Florian Herrmann, and Carl Schaffer — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, 79104 Freiburg, Germany

The ARAGORN front-end offers high-performance readout capabilities for state-of-the-art high-energy physics experiments. The design constraints aim to develop a cost-effective, fully configurable Time-to-Digital Converter (TDC) platform with considerable channel density at smallest form factor possible, allowing for precise time-of-flight or drift-time measurements. The front-end module employs 4+1 Xilinx Artix-7 FPGAs, four of which implement the TDC feature processing a total of 384 channels with an average time resolution of 165 ps. The acquired data is passed on to the fifth on-board FPGA acting as data hub and generic master for auxiliary board components. The board has been designed to set up a multi-tiered optical readout network. Therefore, a SFP transceiver socket for data output and a CXP compliant receptacle reside on the ARAGORN front-end to optionally enable fiber-optic communication with up to seven boards through a star topology. The hot-pluggable CXP module connects to the satellite boards through an optical breakout cable. This novel approach permits to read out in total eight boards yielding 3072 input channels via a single optical fiber at a bandwidth of 6.6 Gb/s. This work is supported by BMBF.

HK 27.76 Di 16:45 F Foyer

Research and Development for the PANDA Backward End-Cap of the Electromagnetic Calorimeter — Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[1], Alaa Dbeyssi[1], Bertold Fröhlich[1,2], Phillip Grasemann[1,2], Sebastian Haasler[1,2], David Izard[1], Dmitry Khaneft[1,2], Jörg Köhler[1,2], Frank Maas[1,2,3], Maria Carmen Mora Espí[1], Oliver Noll[1,2], •David Rodríguez Piñeiro[1], Javier Jorge Rico[1], Sahra Wolff[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[1,2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The PANDA experiment will be one of the key projects of the new accelerator facility FAIR in Darmstadt. With its mature detector system it will be able to observe a variety of physical channels. Thus it will make a huge contribution to the understanding of the strong interaction. The electromagnetic process group (EMP) in Mainz is developing the backward end-cap (BWEC) of the electromagnetic calorimeter. For its construction various tests regarding mechanics have been carried out and are foreseen within the R&D framework. A full prototype of the moving supporting system was built and tested, comprising insertion rails and a movable trolley base. The rails were divided in two sections (fixed and removable in PANDA). A big change in the crystal support is being implemented as well and will be validated with a test setup, using FR4 as supporting material. In addition thermal studies using our current proto16 will be carried out.

HK 27.77 Di 16:45 F Foyer

Forward Detector for physics at FAIR with HADES — •Rafal Lalik for the HADES-Collaboration — Technische Universität München, Excellence Cluster Universe

The Forward Detector is an upcoming upgrade of the HADES spectrometer meant to enhance its geometrical acceptance for experiments with higher energies as planned at the upcoming FAIR facility. It contains three new detector systems: straws tubes for tracking particles, a RPC and a Forward Wall for measuring the time of flight. The Forward Detector will allow HADES to extend the angular acceptance of the spectrometer into very forward direction, from 0° to 7° in the polar angle. It will play a leading role in the identification of decays of highly anisotropic resonances, providing signal statistics higher by factor of a few in respect to the original HADES geometry. Together with future Electromagnetic Calorimeter, it will open possibility to measure for the first time hyperons radiative decays branching ratios, specifically $\Lambda(1405) \to \Lambda\gamma$ and $\Lambda(1405) \to \Sigma^0\gamma$, which are unknown. The Branching ratios according Kaxiras et al (PRD32), will allow to determine the internal structure of $\Lambda(1405)$ resonance, which is heavily discussed either as a two pole KN-$\Sigma\pi$ resonance or penta-quark. With the increased acceptance HADES will be able to measure the production of Ξ in proton-proton reactions. These measurements are a crucial reference to understand the production of Ξ in heavier system at HADES, which showed enhancement of this baryon in sub-threshold range, an effect which is not explainable by any of the existing transport models. * This work is supported by BMBF 05P15WOFCA.

HK 27.78 Di 16:45 F Foyer

Feature extraction of the electromagnetic calorimeter preamplifier (APFEL ASIC) for the $\bar{\text{P}}$ANDA experiment at FAIR — S. Ahmed[1,2], A. Aycock[1,2], L. Capozza[1], A. Dbeyssi[1], B. Fröhlich[1,2], P. Grasemann[1,2], S. Haasler[1,2], D. Izard Hernandez[1], D. Khaneft[1,2], J. Köhler[1,2], F. Maas[1,2,3], M. C. Mora Espí[1], O. Noll[1,2], D. Rodríguez Piñeíro[1], J. Jorge Rico[1], •S. Wolff[1,2], M. Zambrana[1,2], and I. Zimmermann[1,2] — [1]HIM, Mainz — [2]KPH, Mainz — [3]PRISMA, Mainz

The $\bar{\text{P}}$ANDA experiment at the upcoming FAIR accelerator facility will study antiproton annihilation reactions at antiproton beam momenta from 1.5 GeV/c up to 15 GeV/c. With its modular multi purpose detector system it will be able to observe a variety of physical channels. The electromagnetic process group (EMP) in Mainz is developing the Backward-End-Cap (BWEC) of the electromagnetic calorimeter. A prototype calorimeter, PROTO16, has been developed to improve different components of the BWEC. PROTO16 employs a very realistic setup as in the BWEC such as cooling, insulation and signal processing. In addition, PROTO16 is equipped with a proper slow control, which is capable of controlling and reading out all relevant components of the detector. During three different test beamtimes at the MAMI (Mainzer Mikrotron), the prototype properties have been intensely studied and improved. An energy resolution of 2,5% at 1GeV and a lowest single threshold of 3MeV has been achieved. Our poster explains the main features of the $\bar{\text{P}}$ANDA -calorimeter and provides information about the latest analysis results for the PROTO16 test with electron beam.

HK 27.79 Di 16:45 F Foyer

Development of a beam profile monitor using thin scintillator stripes with SiPM readout — •Gerrit Keller, Josef Pochodzalla, Patrick Achenbach, Philipp Herrmann, Pascal Klag, and Maik Biroth — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz

MAMI is a microtron accelerator at the Institute for Nuclear Physics at the University of Mainz. It provides electron beams with submillimetre diameter. For precision measurements it is important to have well defined beam parameters. We have developed a beam profile monitor using thin plastic scintillator. The setup consists of stacked scintillator stripes readout by Silicon Photomultipliers (SiPM). The single stripes consist of 6 mm wide and 150 μm thick BC400 plastic scintillator by Saint-Gobain. Each is read out by two SiPMs using coincidence technique to supress dark noise. Used SiPMs are 6 mm $\times$ 6 mm by SensL. We'll report on tests using radioactive sources and general detector performance.

HK 27.80 Di 16:45 F Foyer

Simulations and experiments for the next-generation cryogenic stopping cell of the Super-FRS — •Ivan Miskun for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

A design of a new-generation cryogenic stopping cell (CSC) for the Low-Energy Branch of the Super-FRS at FAIR has been recently developed. It is based on the experience obtained with the CSC prototype, which was successfully commissioned over a series of beamtimes at the FRS Ion Catcher at GSI.

The new system will have improved performance parameters due to the implementation of novel concepts in its design. The extraction direction will be changed from inline to perpendicular to the axis of the incident beam, hence decreasing the path of ions inside the CSC. In combination with high electrical fields applied, this will shorten the extraction times by a factor of 5 ($\sim$ 5 ms in comparison with $\sim$ 25 ms for CSC prototype) and also improve the rate capabilities of the system by three orders of magnitude. The inner chamber will be divided in two parts: high-density stopping region ($\sim$ 30 mg/cm^2 of He) and low-density extraction region. Simulation investigations of ion transport in the system have been performed and an experimental confirmation of some of the novel concepts for the future system has been made.

HK 27.81 Di 16:45 F Foyer

An electroluminescence tracking TPC for high rates — •Markus Ball, Bernhard Ketzer, and Konstantin Muenning — Helmholtz Institut für Strahlen und Kerphysik, Universität Bonn

We will discuss a novel method to amplify primary charges for a tracking Time Projection Chamber (TPC) in high energy physics (HEP). The goal is to develop an ion backflow-less TPC detector to overcome the major drawback of this detector type for future HEP applications. Back drifting ions are inhomogeneous space charges that can distort the‘next incoming electron clouds. With the purpose of performing high-resolution spectrometry of low energy X-rays, detector designs exploiting electroluminescence in noble gases were developed in Coimbra and CERN. Here the primary charges are not amplified by ionising, but exciting the gas atoms. This forms dimers between the noble gas atoms. When the dimers decay they emit photons with a gas specific wavelength, which is typically in the deep uv region.
We want to adapt this concept for for high rate tracking TPCs. This requires to add an quencher to the noble gas that on the one hand reduces the light yield, but on the other hand increases to drift velocity of the electrons in the gas to typical values for tracking TPCs. We have designed a demonstrator detector and a gas system to measure the reduction of light yield as a function of the amounts of quencher. The drift velocity can be calculated using the software package Garfield+. A list of suitable gas mixtures that will be evaluated with the prototype, as well as, first results will be presented.

HK 27.82 Di 16:45 F Foyer

Untersuchungen zur Bestimmung von absoluten Folienab-

ständen bei Plungermessungen — •Marcel Beckers, Alfred Dewald, Thomas Braunroth, Julia Litzinger und Claus Müller-Gatermann — Institut für Kernphysik, Universität zu Köln, Köln

Unter bestimmten experimentellen Bedingungen wird bei der Auswertung von RDDS-Messungen die Kenntnis der absoluten Fluglänge und damit des absoluten Abstandes zwischen Target- und Stopperfolie im Plunger notwendig. Unsicherheiten bei dessen Bestimmung führen in der Folge zu teils deutlichen Unterschieden in den extrahierten Lebensdauern. Die gebräuchliche Methode der Abstandsbestimmung über eine Kapazitätsmessung nach Alexander und Bell [1] wird in der Praxis durch systematische Fehler, etwa durch Streukapazitäten, beeinträchtigt.
Um die dadurch entstehenden Unsicherheiten zu minimieren, wurde der Einsatz eines geerdeten Ringes zwischen den Folien untersucht, der den Einfluss dieser Kapazitäten verringern soll. Außerdem wurde die Verwendung einer direkten Methode der Abstandsbestimmung überprüft, bei der Kontaktpunkte zwischen den Folien und einer Nadelspitze bestimmt werden. Die Ergebnisse dieser Untersuchungen und mögliche Folgeprojekte sollen vorgestellt werden. Dieses Projekt wurde gefördert von der DFG, Fördernummer DE 1516/3-1.
[1] T. K. Alexander, A. Bell, *Nucl. Instr. Meth.* **81** (1970).

HK 27.83 Di 16:45 F Foyer

Target thickness distribution studies using the $\overline{\mathrm{P}}$ANDA cluster-jet target — •B. Hetz, D. Bonaventura, S. Grieser, A.-K. Hergemöller, A. Khoukaz, E. Köhler, and M. Matthias — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The internal cluster-jet target build up at the University of Münster will be the first of the two planned targets for the upcoming $\overline{\mathrm{P}}$ANDA experiment at the antiproton accelerator and storage ring HESR at FAIR. This cluster-jet target in close to $\overline{\mathrm{P}}$ANDA geometry including vacuum and beam monitor systems and the final beam dump for the $\overline{\mathrm{P}}$ANDA experiment is by now succefully set into operation.
Since main interest is put on antiproton-proton interaction at the experiment, the properties of the used hydrogen target cluster beam are from highest interest. Studies on the areal and volume thickness distributions inside the cluster beam revealed regions of higher thickness inside the beam itself, so called core beams. This core beams allow target thicknesses up to more than $\rho \approx 10^{15}$ atoms/cm^2 after two meters from the nozzle. The automated control of skimmer, collimator and a special spherical joint allow to extract parts of the beam. Additionally other means of control given by used gas stagnation conditions enable the possibilty for a continous variation of the target thickness during operation mode.
The devices for this density structure studies using the automated control of the $\overline{\mathrm{P}}$ANDA cluster-jet target and first results will be presented.

HK 27.84 Di 16:45 F Foyer

A laser ablation carbon cluster ion source for MR-TOF-MS — •Christine Hornung[1], Timo Dickel[1,2], Hans Geissel[1,2], Florian Greiner[1], Wolfgang Plass[1,2], Ann-Kathrin Rink[1], and Christoph Scheidenberger[1,2] — [1]Justus-Liebig Universität Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The FRS Ion Catcher at GSI serves as test facility for the future Low-Energy Branch of the Super-FRS at FAIR. Here, short-lived nuclei produced and in-flight separated in the FRS and thermalized in a cryogenic stopping cell and identified and measured with high accuracy in a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).

For calibration and systematic studies of the MR-TOF-MS calibrants over a broad mass range and close to the ions of interest are essential. For this purpose a new diagnostics unit including a laser ablation carbon cluster ion source and a dedicated RFQ mass filter has been designed, commissioned and tested. The system can be operated at repetition rates that are two orders of magnitude higher (100 Hz) than existing systems and is thus ideally suited for the needs of the MR-TOF-MS (cycle frequency ∼100 Hz). Several measures (small laser spot size, special ion optics, x-y-movable targettable) have been taken into account to ensure long term stable operation (∼weeks) at the highest repetition rate. Results of the commissioning and first tests with different targets will be presented.

HK 27.85 Di 16:45 F Foyer

Status of the Precision High Voltage Divider for CRYRING — •V. Hannen[1], W. Nörtershäuser[2,3], H.-W. Ortjohann[1], O. Rest[1], Ch. Weinheimer[1], and D. Winzen[1] — [1]Institut für Kernphysik, Uni Münster — [2]Technische Universität Darmstadt — [3]GSI, Darmstadt

To cool ion beams in the heavy ion storage ring CRYRING and thus achieve a low momentum spread, CRYRING features an electron cooler, where the ion beam is superimposed with a monoenergetic electron beam. In order to calculate the velocity of the electrons and therefore of the cooled ion beam, it is mandatory to continously monitor the cooler voltage with a high-precision divider. For that purpose a high-precision voltage divider for voltages up to 35 kV is currently being constructed in Münster, similar in design to the ultrahigh-precision voltage dividers in use at the KATRIN experiment. The precision of the divider will be in the low ppm range and will, if other sources of systematic uncertainties like e.g. space charge effects are under control, allow for measurement uncertainties in the $< 10^{-5}$ region. Special care is taken to ensure a fast time response of the divider, for measurements where the cooler voltage is modified in regular intervals.
This project is supported by BMBF under contract number 05P15PMFAA. D. Winzen thanks HGS-HIRe for FAIR for funding his scholarship.

HK 27.86 Di 16:45 F Foyer

A slow control and TDC calibration system for the HADES RICH upgrade * — •Adrian Amatus Weber[1], Peter Zumbruch[2], and Jan Michel[3] for the HADES-Collaboration — [1]Justus-Liebig-Universität Gießen — [2]GSI Darmstadt — [3]Goethe-Universität Frankfurt

The HADES experiment is a high resolution dilepton spectrometer at the SIS18 accelerator of GSI. One of the goals of the Ring-Imaging Cherenkov Detector (RICH) is to identify electron-positron pairs. To enhance the detector performance new multianode photomultipliers from the CBM-collaboration will be used to replace the existing gaseous photo detectors.

Therefore a new EPICS based slow control system is being developed. This system is used to control the TDK Lambda low voltage and the ISEG high voltage power supplies of the RICH detector. It is also used for temperature and humidity monitoring inside and outside the detector with DS18B20 and HDC1000 sensors.

The readout of the RICH detector is done by DiRICH modules. The modules consist of FPGA based TDCs. To cope with high time precision, an online calibration will be implemented. The status of this work will be shown.

* supported by BMBF(05P15RGFCA)

HK 27.87 Di 16:45 F Foyer

Development of an automatic calibration routine for the preamplifier of the electromagnetic calorimeter for PANDA at FAIR — A. Ahmed[1,2], A. Aycock[1,2], L. Capozza[1], A. Dbeyssi[1], B. Fröhlich[1,2], •P. Grasemann[1,2], S. Haasler[1,2], D. Izard[1], D. Khaneft[1,2], J. Köhler[1,2], F. Maas[1,2,3], M. Carmen Mora Espí[1], O. Noll[1,2], D. Rodríguez Piñeíro[1], J. Jorge Rico[1], S. Wolff[1,2], M. Zambrana[1,2], and I. Zimmermann[1,2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The PANDA experiment will be one of the key projects of the new accelerator facility FAIR in Darmstadt. With its mature detector system, it will be able to observe a variety of physical channels. Thus, it will make a huge contribution to the understanding of the strong interaction. The electromagnetic process group (EMP) in Mainz is developing the backward end-cap (BWEC) of the electromagnetic calorimeter (EMC). The EMC produces scintillation light which is detected by Avalanche Photodiodes. The charge is collected and amplified by the so-called APFEL-ASIC preamplifier. To fit the ASIC signals to the operating area of the ADC, it is possible to set reference voltages at the preamplifier. Considering that the BWEC itself has 524 crystals with 2096 signals in total, an automatic process to get the signals into this operating area is necessary. On my poster I will point out a routine to set the reference voltages of the preamplifier automatically and explain the device for the implementation of the routine.

HK 27.88 Di 16:45 F Foyer

A database program for the search for nuclides of interest in nuclear physics experiments — •Christian Will[1], Florian Greiner[1], Julian Bergmann[1], Timo Dickel[1,2], Jens Ebert[1], Hans Geissel[1,2], Lars Liebschwager[1], Wayne Lippert[1], Wolfgang Plass[1,2], Moritz Pascal Reiter[1,3], and Christoph

Scheidenberger[1,2] for the FRS Ion Catcher-Collaboration — [1]JLU Giessen, Germany — [2]GSI, Darmstadt, Germany — [3]TRIUMF, Vancouver, Canada

Mass and lifetime measurements of exotic nuclei yield key information for the understanding of nuclear structure and the nucleosynthesis. These measurements are subject to experimental boundary conditions such as beam intensity and production cross sections. Additionally, databases for nuclear properties of known and expected isotopes have thousands of entries, thus making a candidate search by hand practically impossible. Due to this reason, a database program has been developed which allows the import and combination of several databases such as NUBASE, ENSDF, and production yields or models. The program provides both common table tools as well as many physics related tools, for instance it is possible to calculate EPAX cross sections. To automate the program, a simple script language and a log-function have been implemented. The resulting output can be exported in different formats, including a direct re-import and visualisation in Nucleus Win. The findings of a candidate search have already been used for the preparation of different experiments, including an experiment with the FRS Ion Catcher at GSI in 2016.

HK 27.89 Di 16:45 F Foyer

Damages of plunger targets due to swift heavy ion irradiation — •Christoph Fransen, Andrey Blazhev, Thomas Braunroth, Alfred Dewald, Alina Goldkuhle, Claus Müller-Gatermann, Dorothea Wölk, and Karl-Oskar Zell — Institut für Kernphysik, Universität zu Köln

For lifetime measurements of excited nuclear states with the recoil distance Doppler-shift (RDDS) method and the plunger target foils with very good surface qualities, i.e., roughnesses in the micrometer range, are often essential. Therefore, these targets are typically stretched over highly precisely made cones and careful estimates on the target temperature in the beam spot are required to avoid the formation of bumps in these foils due to beam-induced heating up caused by the energy transfer. However, when performing RDDS experiments with heavy ion beams with energies of several MeV/u an additional effect must be considered: the sensitivity of several (metallic) target materials to the electronic stopping power (S_e) of swift heavy ions causing structural changes [1]. This effect is known in material science since several years, but in RDDS experiments it was only observed in very recent experiments by our group where extreme wrinkles appeared in some target foils with amplitudes of the order of 100 μm. Such can hamper a RDDS measurement completely. Based on the results and predictions in [1,2] we will discuss these observations with respect to the choice of target materials including the use of multilayer targets.

[1] Z.G. Wang, et al., J. Phys. Condens. Matter 6 (1994) 6733
[2] M. Toulemonde et al, Nucl. Instr. Meth. B 277 (2012) 28

HK 27.90 Di 16:45 F Foyer

Ein schnelles Trigger-System für den CALIFA Detektor — Roman Gernhäuser, Benjamin Heiss, •Philipp Klenze, Patrick Remmels, Felix Stark und Max Winkel — Physik Department, Technische Universität München

Das CALIFA Kalorimeter mit seinen etwa 2600 Szintillationskristallen ist eine der wesentlichen Komponenten des R^3B-Experiments. Für viele Experimente muss CALIFA komplexe Trigger-Entscheidungen mit einer minimalen Latenz ($< 1\,\mu$s) treffen. Hier ist die Auswahl von bestimmten Triggermustern ein wesentliches Werkzeug zur präzisen Vorauswahl von relevanten Ereignissen.

Triggertypen, Energiesummen und Multiplizitäten werden in einer sternförmigen Architektur vom gesamten Detektor eingesammelt. Schnelle FPGAs fassen dabei die anfallenden Daten zusammen und senden die Ergebnisse an die nächsthöhere Ebene. Parallel dazu erzeugen sie spezielle Triggerereignisse im Datenstrom. Wir haben erste Prototypen für die FEBEX (GSI) Plattform entwickelt und im Labor getestet. Gefördert durch BMBF (05P15WOFNA).

HK 27.91 Di 16:45 F Foyer

Magnetically driven piston pump for the XENON1T experiment — •Denny Schulte, Axel Buss, Alexander Figuth, Christian Huhmann, Michael Murra, Hans-Werner Ortjohann, and Christian Weinheimer — Westfälische Wilhelms-Universität, Münster, Germany

The XENON1T experiment, constructed in the Laboratori Nationali del Gran Sasso (LNGS) in Italy, uses a dual-phase xenon Time Projection Chamber (TPC) for the direct detection of the Weakly Interacting Massive Particle (WIMP). The TPC is filled with pure xenon and is geared towards scattering of WIMPs with xenon nuclei. In order to reach the desired high sensitivity of $2 \cdot 10^{-47}$ cm^2 for a 50 GeV/c^2 WIMP, a high purity of the xenon is crucial. According to that, the xenon has to be kept extremely clean of electro-negative impurities and radioactive backgrounds. For this purpose, the xenon must be continously circulated through the purification system. Therefore, a convenient pump out of high purity components, e.g. for a low radon emanation, has been developed in Münster in cooperation with the nEXO group at Stanford University and the nEXO/XENON group at Rensselaer Polytechnic Institute. With this pump both extremely cleanness and saveness with respect to contamination of the xenon can be reached by the magnetically driven piston and the hermetically sealing. This poster will deal with the current status of this magnetically driven piston pump and the set of problems in longterm stability represented by heat evolution and gasket design. This project is supported by BMBF under contract 05A14PM1.

HK 27.92 Di 16:45 F Foyer

Development of the focal plane detectors for the NEPTUN photon tagger — •Yevhen Kozymka[1], Thomas Aumann[1,2], Martin Baumann[1], Michael Beckstein[1], Norbert Pietralla[1], Heiko Scheit[1], Dmytro Symochko[1], and Sebastian Vaupel[1] — [1]Institut für Kernphysik TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany

The low energy photon tagging facility NEPTUN currently undergoes the major upgrade aimed to significantly improve overall performance of the setup. Upgraded tagger will be able to operate with 70 MeV electron beam and will have extended focal plane with energy bite of around 35 MeV. After completion of upgrade it will be possible to perform total dipole response measurement in the energy region 5-35 MeV for one target using single settings of the spectrometer.

The poster is going to address the design and testing of the new focal plane detector array.

Supported by DFG (SFB 1245)

HK 27.93 Di 16:45 F Foyer

The common GBTX based prototype readout board for CBM — •Jörg Lehnert for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at FAIR is a fixed target heavy ion experiment planned to operate at high interaction rates up to 10 MHz using self-triggering frontend electronics.

The readout chains for most subsystems in CBM consist of: (1) detector specific frontend boards with custom ASICs, (2) readout boards (ROB) for data aggregation from many electrical links and conversion to optical data transmission, and (3) common FPGA based data processing boards (DPB) for data preprocessing, time slice building and interfacing to slow and fast control.

Several CBM subsystems will employ ROBs based on the radiation hard GBTX data aggregation ASIC and the Versatile Link optical modules developed at CERN.

A common CBM prototype readout board (C-ROB) has been developed providing the full GBTX and Versatile Link functionality needed by all systems to readout moderately sized detector assemblies in laboratory and beam tests. It implements 3 GBTX ASICs, one GBT-SCA slow control ASIC and one VTRx and VTTx module each, and provides 42 320 Mb/s frontend readout links on an FPGA mezzanine card (FMC) connector.

The concept, realization and current status of the C-ROB will be presented.

HK 27.94 Di 16:45 F Foyer

First characterization of the PASTA chip for the microstrip part of the PANDA MVD — •Alberto Riccardi[1], Kai-Thomas Brinkmann[1], Daniela Calvo[2], Valentino Di Pietro[1], Alessandra Lai[3], Tommaso Quagli[1], James Ritman[3], Angelo Rivetti[2], Manuel Rolo[2], Robert Schnell[1], Tobias Stockmanns[3], Richard Wheadon[2], André Zambanini[3], and Hans-Georg Zaunick[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany — [2]INFN Sezione di Torino, Torino, Italy — [3]Forschungszentrum Jülich GmbH, Jülich, Germany

PANDA is a key experiment of the future FAIR facility, under construction at Darmstadt, Germany. The Micro Vertex Detector (MVD) is the innermost component of the experiment and its main task is to reconstruct the primary and secondary vertexes.

The PASTA (PAnda STrip ASIC) chip has been developed to read out the strip sensors of the MVD and its architecture is based on the Time-over-Threshold technique. Time to Digital converters with analog interpolators are used to obtain a very good time resolution with low power consumption.

A first full-size prototype was produced in a commercial 110 nm technology and is currently under test. An overview of the chip, of its readout systems and of the first results of its characterization will be presented.

Supported by BMBF, HIC for FAIR and JCHP.

HK 27.95 Di 16:45 F Foyer

Signal time reconstruction for GEM detectors read out by the APV chip — •Rocio Reyes Ramos, Mikhail Mikhasenko, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, 53115 Bonn, Germany

The APV25 chip is an analog sampling ASIC that preamplifies the signals on each of its 128 input channels and samples them into a 160-cell switched capacitor array. Upon reception of a trigger signal, the sample values corresponding to a predefined latency are multiplexed and sent to a pipelined ADC for digitization.

While the chip was designed for Silicon microstrip detectors for the CMS experiment, they are also used for COMPASS GEM detectors, where 3 samples on the leading edge of the signal separated by 25 ns are read out. A pulse-shape analysis technique is used to reconstruct the signal time from the three samples taking into account the known signal shape. The time calibration of the system is performed by scanning the signal shape using different latencies. It is based on calculating sample amplitude ratios as a function of the trigger latency, corrected by the relative phase of the synchronized trigger signal and the passage of the particle. A Gaussian fit is performed over slices perpendicular to the time axis. Finally a phenomenological function representing the signal shape is fitted over the Gaussian mean values.

Recent improvements of the method like smearing of digital values (considering resolution and dynamic range of the ADCs) and removing large signals (saturating the dynamic range of the chip) will be shown.

Supported by BMBF.

HK 28: Hadron Structure and Spectroscopy IV

Zeit: Mittwoch 16:45–19:00 Raum: F 5

Gruppenbericht HK 28.1 Mi 16:45 F 5

recent progress of charmonium spectroscopy at BESIII — •Zhiqing Liu for the BESIII-Collaboration — Joh-Joachim-Becher-Weg 45

After the discovery of the Zc(3900) by BESIII, we believe that charmonium-like states are good candidates for potential four-quark states. However, the exact structure of four-quark states are still a puzzle presently, and more detailed experimental study about them are urgently needed. In this talk, I will reported the recent progress about charmonium spectroscopy at the BESIII experiment, including the spin-parity measurement of Zc(3900), and the precise measurement of vector Y-states by using the scan data.

HK 28.2 Mi 17:15 F 5

Effects of meson loops on a spectrum of quark states — •Inka Hammer[1], Christoph Hanhart[1], and Alexey V. Nefediev[2] — [1]Forschungszentrum Jülich, Institut für Kernphysik, Jülich, Germany — [2]Institute for Theoretical and Experimental Physics, Moscow, Russia

In recent years, many so called "XYZ" states have been discovered, which were not anticipated from conventional quark models. In their simplest form, quark models describe the confining interaction between effective constituent quarks which leads to the formation of hadrons as bound states. However it has been argued for a long time that when building quark models with coupled channels, unitarization cannot be neglected. In addition to introducing an imaginary part to the masses and resulting in considerable mass shifts, it has been found to have many interesting and unexpected consequences. To come to an understanding of the heavy quarkonium spectrum and the nature of the "XYZ" mesons, it is essential to systematically investigate how the inclusion of meson loops effects a quark spectrum.

As a step in this direction, we study simple unitarized models. We demonstrate that in general quark states do not tend to get very broad if their coupling to the continuum increases, but instead they decouple from the latter in the large coupling limit. However a few of them behave very differently and demonstrate a kind of collectivity. While the actual calculations are done within particular, very simplified models, we argue that the findings might well be general.

HK 28.3 Mi 17:30 F 5

Study of χ_c Decays into $\eta'\pi^0\pi^0$ at BES III — •Maximilian Hegenbarth for the BESIII-Collaboration — Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44780 Bochum

The BESIII experiment, which is located at the symmetric e^+e^- collider BEPCII in Beijing, has recorded a data sample corresponding to about 448×10^6 ψ(2S) events. In the radiative transitions ψ(2S)$\rightarrow \gamma\chi_{cJ}$ the charmonium P-wave states are copiously produced. Their decays into light hadrons provide a clean source in search for exotic hadrons. A spin-exotic 1^{+-} state decaying into $\pi^+\eta$ has recently been reported by the CLEOc collaboration in the decay $\chi_{c1} \rightarrow \eta'\pi^+\pi^-$. To search for neutral partner states we study the decay $\chi_{cJ} \rightarrow \eta'\pi^0\pi^0$. Preliminary results of this study will be presented.

This work is supported by the DFG (FOR 2359)

HK 28.4 Mi 17:45 F 5

Study of χ_{cJ} Decays into $\eta\pi^0\pi^0$ at BESIII — •Christian Mertes for the BESIII-Collaboration — Ruhr-Universität Bochum, Institut für Experimentalphysik I

The BESIII experiment located at the symmetric electron-positron ring BEPCII in Beijing has recorded large data samples at center of mass energies corresponding to the $\psi(2S)$ charmonium resonance and other energies in the tau-charm mass range. In the radiative transitions $\psi(2S) \rightarrow \gamma\chi_{cJ}$ the charmonium P wave states are copiously produced. Their decays into light hadrons provide a clean source in search for exotic hadrons. Based on a data sample corresponding to about $448 \cdot 10^6$ $\psi(2S)$ events, the decay $\chi_{cJ} \rightarrow \eta\pi^0\pi^0$ is studied. Preliminary results of this study will be presented.

Supported by the DFG (FOR 2359)

HK 28.5 Mi 18:00 F 5

Description of the $X(3872)$ using a Galilean-invariant EFT — •Wael Elkamhawy, Maximilian Jansen, and Hans-Werner Hammer — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

The proximity of the $\bar{D}^0 D^{*0}$ threshold to the mass of the $X(3872)$ suggests the interpretation of the $X(3872)$ as a hadronic molecule of neutral $D^{(*)}$ mesons. In this molecular picture, the $X(3872)$ is either a loosely bound state or a shallow resonance. The corresponding energy is small compared to the energy scale set by charged $D^{(*)}$ mesons. Exploiting this separation of scales, we construct a low-energy effective field theory for neutral charm mesons and pions exhibiting exact Galilean invariance. We discuss the implications of exact Galilean invariance on the dynamics of the $X(3872)$. This theory provides a systematically improvable description of the $X(3872)$. It is used to calculate the scattering length to next-to-leading order. Moreover, the dependence of the pole energy on the light quark masses is derived. This dependence can be used to extrapolate, e.g., binding energies calculated on the lattice at unphysical light quark masses to the physical value.

* This work has been supported by the DFG through Grant SFB 1245.

HK 28.6 Mi 18:15 F 5

Dispersive approach to the triangle diagram in the decay of the $a_1(1260)$ resonance — •Mathias Wagner, Mikhail Mikhasenko, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, 53115 Bonn, Germany

Recently a resonance-like signal was observed by the COMPASS experiment in the $J^{PC} = 1^{++}$ partial wave decaying to $f_0(980)\pi$, the

$a_1(1420)$. One possible explanation of this signal is a triangle singularity located close to the physical axis, which is produced when the decay of the $a_1(1260)$ into K^*K is kinematically allowed.

In my talk I am going to present a dispersive approach to calculate the amplitude of the reaction $a_1(1260) \to f_0(980) + \pi$ via a triangle diagram. First the general procedure how to reconstruct the full amplitude using a dispersion relation will be explained. This requires the calculation of the discontinuity of the corresponding matrix element, which can be done by applying the Cutkosky cutting rules.

The result will be compared to calculations employing Feynman rules for hadronic processes.

In the end a fit of this theoretical result to the COMPASS data of 3π production will be presented.

Supported by BMBF.

HK 28.7 Mi 18:30 F 5

Isoscalar Single Pion Production in the Energy Region of Roper and d*(2380) Resonances — •Tatiana Skorodko[1], Mikhail Bashkanov[2], and Heinz Clement[1] for the WASA-at-COSY-Collaboration — [1]Physikalisches Institut, Uni Tübingen — [2]School of Physics and Astronomy, University of Edinburgh, UK

The isoscalar and isovector parts of the single pion production in NN collisions provide important information about the role of isoscalar and isovector resonance excitations in the course of the reaction process.

Wheareas the isovector pion production is reasonably well known from threshold up to several GeV, the isoscalar pion production has been determined experimentally so far only for beam energies below 1 GeV.

In order to obtain information about the isoscalar strength above 1 GeV, WASA data for the reactions $pp \to pp\pi^0$ and $pn \to pp\pi^-$ at T_p = 1.2 GeV have been analyzed. Since these reactions were taken in the quasifree mode by use of a deuterium target, the beam energy region of 1.0 - 1.3 GeV is covered, which is just the region of the Roper $N(1440)$ baryon resonance and of the $d^*(2380)$ dibaryon resonance. In the isoscalar $N\pi$-invariant mass spectrum we observe a pronounced, isolated signal from the Roper resonance. We find no evidence for a decay $d^*(2380) \to NN\pi$, hence only an upper limit is given.

*supported by DFG (CL 214/3-1 and 3-2) and STFC (ST/L00478X/1)

HK 28.8 Mi 18:45 F 5

Coherent production of pion pairs in the reaction $pd \to pd\pi\pi$ with the intermediate two-baryon-resonance excitation — Vladimir Komarov[1], Tatyana Azaryan[1], Sergey Dymov[1,2], and •Dmitry Tsirkov[1] — [1]Laboratory of Nuclear Problems, Joint Institute for Nuclear Research, RU-141980 Dubna, Russia — [2]Institut für Kernphysik and Jülich Centre for Hadron Physics, Forschungszentrum Jülich, D-52425 Jülich, Germany

The reaction $pd \to pd + X$ was studied at 0.8–2.0 GeV energies with the ANKE setup at the COSY storage ring. The proton-deuteron pairs emerging with high momenta 0.6–1.8 GeV/c were detected at small angles with respect to the proton beam. Distribution over the reaction missing mass M_x reveals an enhancement near the threshold of the pion pair production specific for the so-called ABC effect. The invariant mass of the $d\pi\pi$ system in this enhancement region exhibits a resonance-like peak at $M_{d\pi\pi} = 2.37$ GeV/c^2 with the width $\Gamma \approx 0.10$ GeV/c^2, corresponding to the position of the d'(2370) two-baryon resonance. A possible interpretation of these features is discussed.

HK 29: Heavy Ion Collisions and QCD Phases VI

Zeit: Mittwoch 16:45–19:00 Raum: F 1

Gruppenbericht HK 29.1 Mi 16:45 F 1

Recent results on two-particle correlation measurements in pp and Pb–Pb collisions from ALICE — •Alice Ohlson for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

Two-particle correlation measurements are commonly performed in high energy heavy-ion collision experiments to investigate diverse phenomena such as jet fragmentation and its modification in a heavy-ion environment, collectivity and the hydrodynamic-like behaviour of the quark–gluon plasma (QGP), and femtoscopic effects. Surprising results have also arisen from angular correlation studies in smaller collision systems, which normally serve as a baseline for heavy-ion measurements. In particular, the presence of correlations between particles separated by large pseudorapidity intervals (known as the 'ridge') in pp and p–Pb collisions has recently led to reevaluations of our understanding of collective effects in both small and large collision systems. In this talk we will present the latest two-particle correlation results from the ALICE Collaboration, including new results on the multiplicity evolution of correlation functions in pp collisions at $\sqrt{s} = 7$ and 13 TeV, the pathlength-dependence of jet quenching in Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, and correlations of identified particles which inform our understanding of particle production throughout the collision evolution.

Supported by BMBF and SFB 1225 ISOQUANT.

HK 29.2 Mi 17:15 F 1

Magnetic field influence on microscopic dynamics in heavy-ion collisions — •Moritz Greif — Goethe Universität Frankfurt

In heavy-ion collisions, strong magnetic fields occur at very early times after the collision. We show, how the Lorentz force influences the dynamics of quarks in the quark-gluon plasma. For this study, we use the microscopic transport approach BAMPS (Boltzmann Approach To Multi-Parton Scatterings) including magnetic fields. BAMPS, solving the 3+1D Boltzmann equation, is ideally suited for explicit nonequilibrium phenomena. We prove, that thermalization is not affected by external fields, but show that the isotropisation of quark momenta is largely influenced. The asymmetric nature of the magnetic fields gives rise to several interesting phenomena, such as momentum asymmetries of quarks and electromagentic probes produced by quark scattering. We furthermore show first efforts to simulatneously solve the Maxwell- and Boltzmann equation in a common numerical framework to get a more precise picture of the evolution of magnetic fields in the quark-gluon plasma.

HK 29.3 Mi 17:30 F 1

Constraining the contribution of the chiral magnetic effect to charge dependent correlations in heavy ion collisions — •Jacobus Onderwaater and Ilya Selyuzhenkov for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The moving charges in heavy-ion collisions give rise to a strong magnetic field in the overlap region, where the quark-gluon plasma (QGP) is formed. It is thought that sphaleron and instanton transitions, that change chirality, produce an imbalance between left- and right-handed quarks inside the QGP. This imbalance results in a separation of charges along the magnetic field direction, a phenomenon called the chiral magnetic effect (CME). The search for the CME consists of the analysis of charge-dependent correlations along the magnetic field. Observations of a charge separation by STAR and ALICE in Pb-Pb collisions, and recently by CMS in p-Pb collisions, indicate the importance of understanding background correlations not related to the CME.

We present recent results from ALICE which aim to separate the CME signal from background correlations, the latter arising mainly from local charge conservation. We use different techniques, such as higher order mixed harmonic correlations that probe the shape of the charge separation, event-shape-engineering to measure the dependence of the charge separation on the strength of the elliptic flow, and particle identification to study quark type and mass dependence of charge correlations.

HK 29.4 Mi 17:45 F 1

Analysis of charged-dependent azimuthal correlations with HADES — •Frederic Kornas[1], Tetyana Galatyuk[1,2], and Ilya Selyuzhenkov[2] for the HADES-Collaboration — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany

Charge-dependent azimuthal correlations relative to reaction plane have been proposed as a probe in the search for the chiral magnetic effect in heavy-ion collisions. These type of correlations have been measured at the RHIC BES by STAR and at the LHC by ALICE.

The contribution will report about the status of the two charged particle correlations measured with high statistic sample of Au+Au collisions at 1.23 AGeV collected by HADES. Efficiency and Acceptance corrected spectra will be shown and compared to previous measurements.

This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI

HK 29.5 Mi 18:00 F 1

Collective flow in heavy-ion collisions at $E_{\mathrm{lab}} = 1 - 2A$ GeV — •Markus Mayer[1,2], LongGang Pang[1], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced Studies — [2]Goethe Universität Frankfurt — [3]GSI Helmholtzzentrum für Schwerionenforschung

In this talk the elliptic flow v_2 and the triangular flow v_3 of nucleons and pions at beam energies of $1 - 2A$ GeV are investigated within the hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons). Collective flow is a good observable to gain information about the transport properties of the fireball matter. The anisotropic flow is characterized by the anisotropies in the pressure gradients and thus depends on the shape of the initial density profile. The largest contribution to this anisotropic flow comes from the elliptic flow v_2. Since the distribution of the fireball matter is inhomogeneous, there are also higher anisotropic coefficients, for example the triangular flow v_3. The elliptic flow v_2 is compared to HADES and FOPI data while predictions for v_3 are performed. Especially the effects of potentials and Fermi motion on these flow coefficients are investigated.

HK 29.6 Mi 18:15 F 1

Flow harmonics in Au-Au collisions at 1.23 AGeV measured with HADES — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study di-electron and hadron production in heavy-ion collisions with unprecedented precision. Due to the high statistics of seven billion Au+Au collisions at 1.23 AGeV collected in 2012, a multi-differential (p_t, rapidity and centrality) analysis of collective flow phenomena and as well as a systematic study of higher-order flow harmonics is possible.

Multi-particle azimuthal correlation techniques can be utilized to disentangle the contribution from collective and non-flow process involved in the dynamical evolution of heavy-ion reactions. At low energies directed and elliptic flow has been measured for pions, charged kaons, protons, neutrons and fragments at the BEVALAC and SIS18, but so far high-order harmonics have not been studied. They allow to characterize the properties of the dense hadronic medium produced in these collisions, such as its viscosity, and provide thus an important reference to measurements at higher energies.

Supported by BMBF (05P15RFFCA), HGS-HIRe and H-QM.

HK 29.7 Mi 18:30 F 1

CBM performance for anisotropic flow measurements of charged hadrons — •Vitalii Blinov[1,2] and Ilya Selyuzhenkov[2] for the CBM-Collaboration — [1]Goethe-Universitat, Frankfurt am Main — [2]GSI, Darmstadt

The Compressed Baryonic Matter experiment (CBM) at FAIR aims at the investigation of the QCD phase diagram in the region of high net baryon densities and moderate temperatures. Anisotropic transverse flow is one of the key observables to study the properties of matter created in heavy-ion collisions.

The performance of CBM for anisotropic flow measurements of charged pions, kaons and protons and their anti-particles as a function of rapidity and transverse momentum in different centrality classes is reported. Gold ion collisions at SIS-100 energies were simulated with Monte-Carlo event generators including spectator fragments. The CBM tracking system as well as the projectile spectator detector were used for the investigation. The extracted signal was corrected for effects of detector azimuthal non-uniformity. The possible systematic bias due to non-flow correlations was also studied.

Supported by Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe) and GSI Helmholtzzentrum für Schwerionenforschung.

HK 29.8 Mi 18:45 F 1

Data-driven particle composition correction of tracking efficiency for charged particles with ALICE — •Patrick Huhn for the ALICE-Collaboration — IKF, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to investigate the properties of the Quark-Gluon Plasma by studying high energy pp, p-Pb and Pb-Pb collisions. The parton energy loss in the medium can be examined by measuring the production of charged particles and their nuclear modification factor at high transverse momentum. In ALICE, charged particles are measured with the Time Projection Chamber. An accurate estimate of the tracking efficiency is a key ingredient for such measurements.

In this talk, we show how tracking efficiencies are obtained based on Monte Carlo simulations with PYTHIA and HIJING event generators for particle production and GEANT to simulate the detector response. In particular, we focus on the data-driven procedure being performed to re-weight the tracking efficiencies of identified particle that account for the different abundances of the various particle species in Monte-Carlo and data.

We present results on the tracking efficiency obtained from this data-driven procedure for the measurement of charged particles, especially in pp and Pb– Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV.

Supported by BMBF and the Helmholtz Association.

HK 30: Heavy Ion Collisions and QCD Phases VII

Zeit: Mittwoch 16:45–19:00 Raum: F 3

Gruppenbericht HK 30.1 Mi 16:45 F 3

The Compressed Baryonic Matter experiment at FAIR — •Jörg Lehnert for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter experiment (CBM) aims to investigate the QCD phase diagram in the region of high baryon densities. In this region a rich structure is expected, which may include a first-order phase transition between hadronic and partonic matter eventually terminating in a critical point, or even exotic phases.

The CBM experiment at the future Facility for Antiproton and Ion Research (FAIR) is designed to measure nucleus-nucleus collisions at SIS100 beam energies (4-14 AGeV) where strongly interacting matter with densities about 10 times as high as normal nuclear matter is expected to be produced. For high-statistics measurements of rare probes, event rates of up to 10 MHz are needed. To meet these demands, the CBM experiment uses fast and radiation hard detectors, self-triggered detector front-ends and a free-streaming readout architecture.

In this presentation the physics program of CBM will be reviewed and the current status of the experiment and its subsystems will be reported.

HK 30.2 Mi 17:15 F 3

Lattice simulations of Two-Colour QCD at finite density — •Lukas Holicki, Jonas Wilhelm, Dominik Smith, and Lorenz von Smekal — Institut fuer Theoretische Physik, Justus Liebig Universitaet Giessen, 35392 Giessen, Germany

Lattice Monte Carlo simulations of QCD-like gauge theories can be performed at finite density without sign problem and by now have a long history already. Such simulations allow a direct comparison to effective theories. The physics of the bosonic diquark baryons in two-colour QCD is believed to be fairly well understood and qualitatively resembles QCD at finite isospin density with pion condensation. There is good guidance from effective field theory predictions and model studies of the BEC-BCS crossover inside the condensed phase. Lattice studies suffer from discretization artifacts when the lattice is too coarse. We therefore use an improved gauge action and lattice couplings that are somewhat larger than those of the early studies. This implies that we have to worry about additive renormalization in the chiral condensate before we can compare our results with the effective field theory predictions. We also confirm that the Polyakov-loop does not respond to the finite density in the staggered formulation. However, we find evidence that the flavour symmetry breaking pattern restores to its continuum form, which is reflected in the pseudo-Goldstone spectrum at high densities.

HK 30.3 Mi 17:30 F 3

Influence of Van der Waals interactions between hadrons on observables from heavy-ion collisions and lattice QCD — •Volodymyr Vovchenko[1,2], Paolo Alba[1], Mark Gorenstein[1,3], and Horst Stoecker[1,2,4] — [1]FIAS, Frankfurt, Germany — [2]ITP, Uni-Frankfurt, Frankfurt, Germany — [3]Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine — [4]GSI, Darmstadt, Germany

Extension of the ideal hadron resonance gas (HRG) model is constructed which includes attractive and repulsive van der Waals (VDW) interactions between hadrons. The VDW parameters a and b are fixed by the ground state properties of nuclear matter, and this VDW-HRG model yields the nuclear liquid-gas transition at low temperatures and high baryonic densities.

The predictions of the model are confronted with the lattice QCD calculations at zero chemical potential. The inclusion of VDW interactions between baryons leads to a qualitatively different behavior of cumulants of fluctuations of conserved charges, for many observables closely resembling the lattice QCD results. Calculations also suggest that strange baryons have weaker VDW interactions compared to non-strange ones. We also explore the effect of VDW interactions on the thermal fits to heavy-ion hadron yield data and find that existing agreement of ideal HRG is not spoiled in the VDW-HRG model. Finally, we find that VDW interactions have a rather substantial influence on the higher orders of fluctuations of conserved charges at finite chemical potential, in the regions where chemical freeze-out in heavy-ion collisions is expected to occur.

HK 30.4 Mi 17:45 F 3

Freeze-out parameters of hadrons produced in Au+Au collisions at 1.23A GeV — •Heidi Schuldes for the HADES-Collaboration — Goethe-Universität Frankfurt

The collective motion of final state hadrons reveals important information about both, the properties of the hot and dense medium created in a heavy-ion collision and the collision dynamics. The HADES collaboration has measured a comprehensive set of hadrons (p, d, $\pi^{\pm}$, $K^{\pm}$, K^0, ϕ, Λ) produced in Au+Au collisions at 1.23A GeV.
The inverse slope parameters of the transverse mass spectra assuming a static thermal source show a mass dependent rise, indicating an additional radial expansion of the fireball. In this contribution we investigate the kinetic freeze-out conditions by applying simultaneous blast wave fits to the transverse mass spectra of hadrons and discuss to which extent the assumption of global freeze-out parameters can describe the observed kinematics. These results are compared to the chemical freeze-out parameters obtained by fitting the measured particle yields with a statistical hadronization model. Furthermore, the influence of resonance decays on the measured particle spectra will be addressed.
This work has been supported by BMBF (05P15RFFCA), GSI and HIC for FAIR.

HK 30.5 Mi 18:00 F 3

Momentum anisotropy at freeze out — •Steffen Feld and Nicolas Borghini — Universität Bielefeld, Bielefeld, Germany

The transition from a hydrodynamical modelling to a particle-based approach is a crucial element of the description of high-energy heavy-ion collisions. Assuming this "freeze out" happens instantaneously at each point of the expanding medium, we show that the local phase-space distribution of the emitted particles is asymmetric in momentum space. This suggests the use of anisotropic hydrodynamics for the last stages of the fluid evolution. We discuss how observables depend on the amount of momentum-space anisotropy at freeze out and how smaller or larger anisotropies allow for different values of the freeze-out temperature.

HK 30.6 Mi 18:15 F 3

The Baryon Diffusion Constant of a Hot Hadron Gas — •Jan Alexander Fotakis, Moritz Greif, and Carsten Greiner — Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main, Germany

We present results for the baryon diffusion constant of a hot hadron gas which were achieved within a linear response approach in kinetic theory. We discuss the behaviour of this transport coefficient both at zero and at finite baryo-chemical potential and for temperatures underneath the critical temperature of a QGP. Furthermore, we compare to baryon diffusion constants of the QGP at the critical temperature calculated within other approaches.

HK 30.7 Mi 18:30 F 3

Gluonic hot spots and spatial correlations inside the proton — •Alba Soto-Ontoso[1,2], Hannah Petersen[2,3,4], and Javier L. Albacete[1] — [1]Universidad de Granada, Granada, Spain — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]Goethe University, Frankfurt am Main, Germany — [4]GSI, Darmstadt, Germany

In this talk, based on arXiv:1605.09176, we present a microscopic realization of the *hollowness* effect observed in proton-proton scattering at $\sqrt{s}=7$ TeV. Additionally, we show how the initial collision geometry proposed in our model influences significantly the eccentricities of p+p collisions. This is a highly debated topic as the analysis of the LHC experimental data have indicated suggestive signals of collective phenomena in high multiplicity p+p collisions.

The hollowness effect, not observed at lower energies, consists in a depletion of the inelasticity density at zero impact parameter of the collision. Our analysis is based on three main ingredients: we rely on gluonic hot spots inside the proton as effective d.o.f for the description of the scattering process. Next we assume that non-trivial correlations between the transverse positions of the hot spots inside the proton exist. Finally we build the scattering amplitude from a multiple scattering, Glauber-like series of collisions between hot spots. In our approach, the onset of the hollowness effect is naturally explained due to the diffusion of the hot spots in the transverse plane with increasing collision energy.

HK 30.8 Mi 18:45 F 3

Studies of $\langle p_{\mathrm{T}}\rangle$ vs. N_{ch} in pp collisions at $\sqrt{s}=5.02$ TeV with ALICE — •Mario Krüger for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at CERN-LHC is designed to study the properties of a hot, deconfined QCD matter, the so called Quark-Gluon Plasma, which is created in ultrarelativistic heavy-ion collisions. This study is complemented by measurements in proton-proton and proton-lead collisions as a reference. In proton-proton collisions one can especially investigate effects of multiple-parton interactions and hadronization beyond independent string fragmentation.

The transverse-momentum spectra of particles produced in the collisions can be characterized by their mean-value $\langle p_{\mathrm{T}}\rangle$ and variance σ as a function of event multiplicity. Due to detector effects, the measured multiplicities differ from the actual particle multiplicities N_{ch}.

In this talk, we use a Bayesian unfolding procedure exploiting the correlation between measured and true multiplicities known from MC simulations. We present $\langle p_{\mathrm{T}}\rangle$ and σ of inclusive charged particles as a function of the multiplicity N_{ch} in pp collisions at $\sqrt{s}=5.02$ TeV within a pseudorapidity range of $|\eta|<0.8$.
Supported by BMBF and the Helmholtz Association.

HK 31: Structure and Dynamics of Nuclei IV

Zeit: Mittwoch 16:45–19:00 Raum: F 2

HK 31.1 Mi 16:45 F 2

Präzise Bestimmung von Kernzustandsbreiten mittels relativer Selbstabsorption* — •Marcel Schilling, Carsten Albe, Tobias Beck, Udo Gayer, Norbert Pietralla, Philipp C. Ries, Jochen Rohrer, Christopher Romig, Volker Werner und Markus Zweidinger — TU Darmstadt

Eine Hochpräzisionsmessung der Kernzustandsbreite Γ des ersten 0^+-Zustands von ^{6}Li in $^6Li_2CO_3$ wurde mit der Methode der relativen Selbstabsorption (RSA) durchgeführt. Hierbei ist die Geschwindigkeitsverteilung der Lithiumatome im Compound eine entscheidende

Größe zur korrekten Bestimmung von Γ. Die klassische Vorgehensweise zur Beschreibung dieser Geschwindigkeitsverteilung über die Debye-Näherung ist aufgrund des Compounds nicht möglich. Die Berechnung der Phononendichte ermöglicht eine wesentlich genauere Beschreibung der effektiven Temperatur des Lithiums als über die Debye-Theorie. Dies führt zu einem Kalibrierungspunkt mit einer kleineren Unsicherheit zur genauen Bestimmung von Photonenflüssen bei niederenergetischen Kernresonanzfluoreszenzexperimenten im Vergleich zu dem aktuellen Literaturwert.

In einem RSA-Experiment an ^{11}B soll ein weiterer präziser Kalibrierungspunkt bei höherer Energie bestimmt werden.

* gefördert durch SFB1245

HK 31.2 Mi 17:00 F 2

NeuLAND Demonstrator at SAMURAI and first Experiments — •Julian Kahlbow for the NeuLAND-SAMURAI-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The high-resolution neutron time-of-flight spectrometer with large acceptance NeuLAND is the new neutron detector being developed for the R^{3}B setup (Reactions with Relativistic Radioactive Beams) at FAIR. NeuLAND is dedicated to the detection of high-energy neutrons up to 1GeV. The NeuLAND Demonstrator (400 out of finally 3000 scintillator bars) is currently part of the SAMURAI setup (Superconducting Analyzer for Multi-particle from Radio Isotope Beams) at the RI Beam Factory in Japan.

The machine study experiment of the NeuLAND Demonstrator will be discussed in detail. In this experiment, quasi-monoenergetic neutrons were applied in order to determine the specific one-neutron detection efficiency of the detector at two different energies, in particular 110 MeV and 250 MeV. The NeuLAND Demonstrator together with NEBULA (Neutron-detection system for Breakup of Unstable-Nuclei with Large Acceptance) leads to a large multi-neutron detection efficiency at the SAMURAI experimental setup. An illustrative example applying the invariant-mass spectroscopy to neutron-unbound states of fluorine isotopes will be introduced.

This work is supported by the BMBF project 05P15RDFN1 and the GSI-TU Darmstadt cooperation agreement.

HK 31.3 Mi 17:15 F 2

Lifetime Measurement of Higher-Lying Excited States in ^{16}C — •Michael Mathy[1] and Marina Petri[2,1] — [1]IKP, TU Darmstadt, Germany — [2]DoP, University of York, United Kingdom

Electromagnetic properties of the neutron-rich carbon isotopes provide an exciting opportunity to directly test theoretical models using NN+3N Hamiltonians derived from chiral EFT. Indeed, the EM properties of ^{16}C are particularly sensitive to the inclusion of 3N forces in the calculations [1]. However, the experimental information on ^{16}C are limited to the lifetime of the first excited state and an upper limit of 4 ps for the higher-lying states [2,3]. To investigate lifetimes and branching ratios of the higher-lying states (2_2^+, 3^+, 4^+) a fusion-evaporation reaction has been performed at the Argonne National Laboratory. Evaporated charged particles were identified using the μ-Ball detector and emitted gamma rays were identified using the Gammasphere array. Lifetimes of the excited states can be extracted using the doppler shift attenuation method. In the talk the measurement techniques and preliminary gamma spectra of ^{16}C, which can be used to give a first approximation of the magnitude of the lifetime, will be presented. This work was supported by the DFG under contract No. SFB 1245.

[1] C. Forssén, et al., Nucl. Part. Phys. 40, 055105 (2013). [2] M. Wiedeking et al., PRL 100 152501 (2008). [3] M. Petri et al., Phys. Rev. C 86 044329 (2012).

HK 31.4 Mi 17:30 F 2

Proton Knockout Reactions from Neutron-Rich N Isotopes at R^{3}B — •Ina Syndikus[1,2] and Marina Petri[3] for the R3B-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]GSI, Germany — [3]University of York, UK

The R^{3}B/LAND setup at GSI was used to measure the proton-knockout reaction on neutron-rich N isotopes in a kinematically complete way.

The aim of this study is to determine the proton amplitude of the first 2^+ excited state of ^{16,18,20}C isotopes. This can be achieved by studying the proton-knockout reaction from ^{17,19,21}N to ^{16,18,20}C. By measuring the ratio of the cross sections for the population of the first excited 2^+ state and the ground state the proton amplitude can be determined.

An increase in the proton amplitude approaching the dripline can be explained by the reduction of the spin-orbit splitting between the proton $p_{3/2}$ and $p_{1/2}$ orbits due to the tensor and two-body spin-orbit components of the force between the protons and the added neutrons in the sd-shell [1]. This would explain the increase in the transition strength as observed in previous studies [2].

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

[1] A. O. Macchiavelli et al., Phys. Rev. C **90** 067305 (2014)
[2] M. Petri et al., Phys. Rev. Lett. **107**, 102501 (2011)

HK 31.5 Mi 17:45 F 2

Electromagnetic transition rates in ^{21}O — •Sebastian Heil[1] and Marina Petri[2] — [1]IKP, TU Darmstadt, Germany — [2]University of York, UK

Experimental studies of electromagnetic transition rates in neutron-rich nuclei are very important for testing NN+3N calculations. The case of ^{21}O is particularly interesting because calculations show that the transition strengths from the first $\frac{1}{2}^+$ and second $\frac{3}{2}^+$ excited states to the ground state $\frac{5}{2}^+$ will discriminate between the NN+3N and USDB interactions.

An experiment at NSCL was performed, producing ^{21}O. The usage of the TRIPLEX plunger allows the determination of the lifetime of the state of interest. The S800 spectrometer and GRETINA were used for the fragment identification and gamma-ray detection. This presentation will report on the experiment as well as the current status of the analysis.

This work was supported by the DFG within the framework of the SFB 1245 and by HIC for FAIR within the framework of the LOEWE program launched by the State of Hesse.

HK 31.6 Mi 18:00 F 2

The investigation of quasi-free scattering reactions with the two-proton-halo nucleus ^{17}Ne — •Christopher Lehr[1], Thomas Aumann[1], Felix Wamers[2], and Justyna Marganiec[1] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

^{17}Ne is a Borromean two-proton-halo nucleus located at the proton-dripline and therefore an interesting candidate for nuclear-structure studies.

Reactions of the nucleus ^{17}Ne have been measured in complete kinematics at the R3B/LAND setup at GSI in Darmstadt. The experimental method is based on exclusive measurements of one-proton-removal reactions. Polyethylene (CH_2) and carbon (C) were used as targets. Thus it is possible to reconstruct the pure hydrogen (H) contribution of the CH_2 data by subtracting the carbon background.

The resulting events are clean quasi-free-scattering (p,2p) reactions showing the typical angular correlations known from p-p scattering. Thereby quasi-free (p,2p) and carbon-induced one-proton removal reactions are studied separately.

Quasi-free-scattering reactions are compared with carbon-induced one-proton removal reactions and shown to be a clean tool for nuclear-structure studies.

This work is supported by HIC for FAIR, the GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

HK 31.7 Mi 18:15 F 2

Lifetime measurements in neutron-rich Mn isotopes — •Thomas Braunroth[1], Alfred Dewald[1], Christoph Fransen[1], Hironori Iwasaki[2], and Jan Jolie[1] — [1]Institut für Kernphysik, Universität zu Köln, Germany — [2]National Superconducting Cyclotron Laboratory, MSU, USA

The observation of a sudden increase in collective behavior along neutron-rich even-even chromium and iron isotopes toward $N = 40$ triggered several studies in recent years. Within the shell-model this sudden increase can only be reproduced by choosing an expanded valence space which allows excitations beyond $N = 40$ and into the $g_{9/2}$ and $d_{5/2}$ orbitals [1].

Less attention has been spent on neighboring odd-mass manganese isotopes with $Z = 25$, although they are able to provide complementary sensitivity to state-of-the-art (shell model) interactions. Within this talk we will present lifetimes of low-lying excited states in ^{59,61,63}Mn, which were deduced from a recoil distance Doppler-shift measurement. These isotopes were produced in side reactions of an experiment whose central aim was the determination of level-lifetimes in ^{58,60,62}Cr [2].

This work is supported by the BMBF under contract number 05P15PKFNA.

[1] S. M. Lenzi *et al.*, Phys. Rev. C **82**, 054301 (2010).
[2] T. Braunroth *et al.*, Phys. Rev. C **92**, 034306 (2015).

HK 31.8 Mi 18:30 F 2

Constraining nuclear matrix elements for $0\nu\beta\beta$ decay between ^{82}Se and ^{82}Kr* — •Udo Gayer[1], T. Beck[1], J. Kleemann[1], Fnu Krishichayan[3], B. Löher[2], O. Papst[1], N. Pietralla[1], P. C. Ries[1], D. Savran[2], W. Tornow[3], and V. Werner[1] — [1]Institut fuer Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany — [3]Duke University, Durham NC, USA

The nuclei ^{82}Se and ^{82}Kr are candidates for the hypothetic exotic neutrinoless double-beta ($0\nu\beta\beta$) decay process, and a precise knowledge of their nuclear structure is necessary to estimate decay rates [1] and - should it be detected - to extract neutrino masses from this quantity. In a study of Gd isotopes [2], a connection between the decay behavior of the M1 scissors mode and $0\nu\beta\beta$ decay rates was established. We intend to study decay properties of low-lying magnetic dipole excitations in the $0\nu\beta\beta$ candidates ^{82}Se and ^{82}Kr in nuclear resonance fluorescence experiments with quasi-monochromatic, polarized photons at the High-Intensity Gamma-Ray Source (HIγS) in Durham, NC, USA. In a first experiment, the γ^3 setup [3] was used to identify magnetic dipole states of ^{82}Se and to study branching transitions. Preliminary results of this experiment will be presented and discussed.

*Supported by DFG research grant CRC 1245

[1] T. R. Rodriguez, G. Martínez-Pinedo, Phys. Rev. Lett. **105** (2010) 252503
[2] J. Beller et al., Phys. Rev. Lett. **111** (2013) 172501
[3] B. Löher et al., NIMA **723** (2013) 136-142

HK 31.9 Mi 18:45 F 2

Zerfallsverhalten der Scherenmode in der $0\nu\beta\beta$-Tochter ^{150}Sm* — •J. Kleemann[1], T. Beck[1], U. Gayer[1], J. Isaak[2,3], B. Löher[1,2], L. Mertes[1], H. Pai[1,4], O. Papst[1], N. Pietralla[1], P. C. Ries[1], C. Romig[1], D. Savran[2], M. Schilling[1], W. Tornow[5], V. Werner[1] und M. Zweidinger[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]RCNP, Osaka, Japan — [4]SINP, Kalkutta, Indien — [5]Duke University, Durham NC, USA

Zur Untersuchung des Zerfallsverhaltens der Scherenmode in ^{150}Sm wurde 2015 ein Kernresonanzfluoreszenz-Experiment am γ^3-Messaufbau [1] an der High Intensity γ-Ray Source (HIγS) des Triangle Universities Nuclear Laboratory durchgeführt. Dabei war eine mögliche Verzweigung des Zerfalls der Scherenmode in den 0^+_2 Zustand und deren Stärke relativ zur Grundzustandsübergangsstärke von besonderem Interesse, da sich aus dieser Modellparameter festlegen lassen, die sensitiv auf die nuklearen Matrixelemente und somit auf die Zerfallsrate eines potentiellen neutrinolosen doppelten β-Zerfalls von ^{150}Nd zu ^{150}Sm sind [2]. Mittels der durch HIγS erzeugten, linear polarisierten, quasimonochromatischen γ-Strahlung wurden die Paritäten beobachteter Zustände direkt aus der Winkelverteilung ihres Grundzustandsübergangs bestimmt und somit Scherenmodenzustände identifiziert. Des Weiteren konnten Verzweigungsverhältnisse und Übergangsstärken ermittelt werden. Die Ergebnisse werden vorgestellt und diskutiert.

*Gefördert durch die DFG im Rahmen des SFB 1245

[1] B. Löher *et al.* Nucl. Instr. Meth. Phys. Res. A **723**, 136 (2013)
[2] J. Beller *et al.* Phys. Rev. Lett. **111**, 172501 (2013)

HK 32: Structure and Dynamics of Nuclei V

Zeit: Mittwoch 16:45–19:00 Raum: F 33

Gruppenbericht HK 32.1 Mi 16:45 F 33

Experimental evidence for broken axial symmetry in most heavy stable nuclei — •Eckart Grosse[1], Arnd R. Junghans[2], and Ralph Massarczyk[3] — [1]IKTP, Technische Universität Dresden, 01062 Dresden, Germany — [2]IKP, Helmholtz-Zentrum Dresden-Rossendorf, 01314 Dresden, Germany — [3]Los Alamos National Laboratory, New Mexico 87545, USA

Using an approximation suggested by Bohr and Mottelson nearly all analysis of experimental data is still based on axial symmetry, although hints on its breaking were found in HFB calculations published recently by Delaroche et al. in PRC 81 as well as by spectroscopic studies. For a clarification we performed a re-analysis for two types of experimental data known for their sensitivity to nuclear deformation: The electric dipole response in the region of giant resonances and the collective enhancement of nuclear level densities. For both nearly no parameters remain free to be adjusted by a separate fit, if previous information about nuclear masses, radii etc. are used to fix parameters for the Gogny force, the droplet model and the surface dissipation model as based on hydrodynamics. For the IVGDR energies only an effective mass and for their strength the blocking of p-n pair absorption in nuclei has to be adjusted, when a triple Lorentzian (TLO) is used; for the level densities only shell and pairing effects as well as the symmetry have to be known, if the Fermi gas theory with its Tcrit is applied. In both cases the axial symmetry breaking in heavy nuclei already shows up already in the valley of stability indicating a nuclear Jahn-Teller effect as mentioned long ago by Reinhard and Otten in NPA 420.

HK 32.2 Mi 17:15 F 33

Coulomb excitation of ^{142}Xe — •Corinna Henrich[1], Thorsten Kröll[1], Mirko von Schmid[1], Gary Simpson[2], and Michael Thürauf[1] for the IS548-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]LPSC, Grenoble, France

The neutron rich nucleus ^{142}Xe lies in the vicinity of the doubly magic nucleus ^{132}Sn and is only two protons below ^{144}Ba, which exhibits the largest octupule collectivity in the region. To study the onset of octupole collectivity and follow the evolution of quadrupole collectivity in this area a "safe" Coulomb excitation experiment was carried out at the new HIE-ISOLDE facility (CERN) in the end of 2016. Both beam and target nuclei were measured using C-REX, i.e. an array of segmented Si detectors, covering forward as well as backward angles. The MINIBALL spectrometer was used to detect the emitted gamma rays in coincidence. The experimental setup will be presented along with the first stages of the analysis.

This work is supported by BMBF under contract 05P15RDCIA, by the EU under contract ENSAR 262010 and by ISOLDE.

HK 32.3 Mi 17:30 F 33

Multinucleon transfer as a gateway to $\mathbf{Z > 50, N < 82}$ nuclei — •Andreas Vogt[1], Benedikt Birkenbach[1], Peter Reiter[1], Andrey Blazhev[1], Marco Siciliano[2,3], Kasia Hadyńska-Klek[2], Carl Wheldon[4], Eri Teruya[5], and Naotaka Yoshinaga[5] — [1]IKP, Universität zu Köln — [2]INFN - LNL, Italy — [3]INFN Padova, Italy — [4]University of Birmingham, UK — [5]Saitama University, Japan

Multinucleon-transfer reactions (MNT) provide access to hard-to-reach nuclei in the vicinity of the $Z = 50$ and $N = 82$ shell closures. Nuclei in this region serve as a benchmark for nuclear shell-model calculations based on modern effective interactions. Excited reaction products were measured after MNT in ^{136}Xe + ^{238}U at 1 GeV and ^{136}Xe + ^{208}Pb at 930 MeV with the γ-ray tracking array AGATA coupled to the mass spectrometer PRISMA at LNL (INFN, Italy) as well as in the ^{136}Xe + ^{198}Pt MNT reaction employing GAMMASPHERE in combination with the gas-detector array CHICO. Furthermore, Xe and Ba isotopes were populated in fusion-evaporation reactions using the HORUS γ-ray array at the University of Cologne. The high-spin level schemes of ^{132}Xe, ^{133}Xe, ^{134}Xe, ^{135}Xe and ^{137}Ba are considerably extended to higher energies. The 2058-keV $(19/2^-)$ state in ^{135}Xe is identified as an 9.0(9)-ns isomer, closing a gap in the systematics along the $N = 81$ isotones. Latest shell-model calculations reproduce the experimental findings. The experimentally-deduced reduced transition probabilities of the isomeric states are compared to shell-model predictions. Supported by the German BMBF (05P12PKFNE TP4, 05P15PKFN9), ENSAR-TNA03, BCGS.

HK 32.4 Mi 17:45 F 33

Saturation of $B(E2)$-strength near mid-shell? Lifetimes of ^{174,176,178,180}Hf. — •Johannes Wiederhold[1], Ralph Kern[1], Volker Werner[1,4], Norbert Pietralla[1], Nicu Marginean[2], Raluca Marginean[2], Cristina R. Nita[2], Sorin Pascu[2], Dorel Bucurescu[2], Dan M. Filipescu[2], Nicoleta Florea[2], Dan G. Ghita[2], Constantin Mihai[2], Razvan Lica[2], Patrick Regan[3], Robert Carroll[3], Terver Daniel[3], Laila Gurgi[3], Ralitsa

Ilieva[3,4], Nathan Cooper[4], and Farheen Naqvi[4] — [1]IKP, TU-Darmstadt — [2]IFIN-HH, Bucharest — [3]Physics Department at Surrey — [4]Yale University

Deformed nuclei in the rare earth region should show a saturation of the $B(E2; 0_1^+ \rightarrow 2_1^+)$-transition strength near mid-shell. Recent measurements of lifetimes of W-isotopes show discrepancies to literature values and seem to maximize the $B(E2)$-strength off mid-shell. An analog investigation is done on Hf-isotopes. Several lifetimes of excited states of the even-even isotopes ^{174,176,178,180}Hf have been measured with fast electronic scintillation timing (FEST) using the same experimental setup to minimize systematic deviations among the values. Excited States were populated via Coulomb excitation (^{180}Hf) and via β^+-decay following fusion-evaporation reactions (^{174,176,178}Hf) at the 9 MV tandem accelerator of the IFIN-HH near Bucharest. Obtained lifetimes of the Hf-isotopes will be presented. This work was supported by the DFG under Grants No. SFB 634 and No. SFB 1245, the U.S. DOE Grant No. DE-FG02-91ER40609 and the BMBF under the grant 05P15RDFN9 within the collaboration 05P15 NuSTAR R&D.

HK 32.5 Mi 18:00 F 33

Finite-size effects of nuclei - Transitions from the scissors mode to the γ-vibrational band of ^{164}Dy ⋆ — •Tobias Beck[1], Udo Gayer[1], Johann Isaak[2,3], FNU Krishichayan[4], Bastian Löher[1,2], Norbert Pietralla[1], Deniz Savran[2], Werner Tornow[4], and Markus Zweidinger[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]RCNP, Osaka, Japan — [4]Duke University, Durham, NC, USA

The understanding of collective phenomena of nuclei is attempted by a variety of theoretical models of microscopic, geometrical, and algebraic nature. In the algebraic Interacting Boson Model effects based on the finite size of the quantum system are predicted which are not incorporated in geometrical models. The observation of electromagnetic transitions between the isovector, low-lying $J_K^\pi = 1_1^+$ scissors mode and the 2_γ^+ state provides a sensitive test of finite-size effects. A photon-scattering experiment with linearly-polarized quasi monoenergetic $\vec{\gamma}$-rays has been performed at the High Intensity γ-ray Source (HIγS) at Duke University, Durham, NC, exploiting the γ^3 setup. We have unambiguously identified the $1_{sc}^+ \rightarrow 2_\gamma^+$ transition from $\gamma\gamma$-coincidences, extracted the decay branching ratio and compared it to IBM-2 predictions. First results will be presented along with the ongoing analysis.
⋆ Supported by the DFG under grant nos. SFB 634 and SFB 1245 and by the Alliance Program of the Helmholtz Association under grant no. HA216/EMMI.

HK 32.6 Mi 18:15 F 33

Studying the angular distribution of the reaction ^{94}Mo(p,p'γ)^{94}Mo @ 13.5 MeV with SONIC@HORUS — •Michelle Färber, Simon G. Pickstone, Mark Spieker, Michael Weinert, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The SONIC@HORUS setup of the Institute for Nuclear Physics in Cologne is used to investigate the low-energy response of the nucleus. Low spin states, e.g., the pygmy dipole resonance, can be studied by performing inelastic proton scattering reactions. An important observable for the investigation of these modes is the γ branching ratio which can be accessed with the setup. Furthermore, spins and parities can be assigned by measuring the angular correlation of the ejectile and the deexciting γ-ray. The obtained experimental distribution is in good agreement with the distorted wave born approximation (DWBA).

In this contribution, the results for the experimental angular distributions of the reaction ^{94}Mo(p,p'γ)^{94}Mo as well as the corresponding theoretical description will be shown.

Supported by DFG(ZI 510/7-1). J.W. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 32.7 Mi 18:30 F 33

Possible hexadecapole states in ^{96}Ru and ^{128}Te studied with the sdg-IBM-2 — •Oriana Diessel, Mark Spieker, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Quadrupole excitations of fully-symmetric and mixed-symmetric nature are well established in atomic nuclei [1]. Octupole excitations of both types have also been discussed [2]. Recently, first candidates for mixed-symmetry hexadecapole states have been proposed based on a comparison of experimental data and sdg-IBM-2 calculations [3, 4].

In this contribution, the sdg-IBM-2 calculations for ^{96}Ru and ^{128}Te will be presented and compared to experimental data. Special emphasis will be put on possible hexadecapole-type excitations of both fully-symmetric and mixed-symmetric nature. To further test the hexadecapole phonon as a building block of nuclear structure, possible multiphonon couplings in ^{128}Te will be discussed as well.

Supported by the DFG (ZI 510/7-1).

[1] N. Pietralla *et al.*, Phys. Rev. C **61** (2000) 021301 [2] M. Scheck *et al.*, PRC **81** (2010) 064305 [3] R.J. Casperson *et al.*, Physics Letters B **721** (2013) 51 [4] A. Hennig *et al.*, Phys. Rev. C **90** (2014) 051302

HK 32.8 Mi 18:45 F 33

Struktur des Grundzustands vom doppelt-magischen Kern ^{208}Pb — •Andreas Heusler — Gustav-Kirchhoff-Str. 7/1 69120 Heidelberg

Die Entdeckung von Vibrations- und Zweiteilchen-Zweilochkonfigurationen in ^{208}Pb [1] regt zur Klärung der lange anstehenden Frage an, wie die Struktur des Grundzustands des doppelt-magischen Kerns aussieht. Neben dem bekannten Neutron-Paarungszustand und den Doppeloktupolzuständen sind inzwischen zwei weitere 0^+ Zustände entdeckt worden, der Proton-Paarungszustand [2] und ein Zweiteilchen-Zweilochzustand mit der Struktur Einteilchen-Einlochzustand gekoppelt an den Oktupolvibrationszustand. Lange bekannte Anregungsfunktionen der inelastischen Protonstreuung an ^{208}Pb für tiefliegende Zustände werden durch Interferenzeffekte aus der bekannten Struktur von Einteilchen-Einlochzuständen erklärt. Zweiteilchen-Zweilochkonfigurationen im Grundzustand können diese Effekte bewirken. Wesentlich hierbei ist ein genaueres Verständnis der Asymmetrie von Anregungsfunktionen beim Protonzerfall von Analogresonanzen im ^{209}Bi.

[1] A. Heusler et al. Phys. Rev. C 93:054321 (2016)
[2] A. Heusler et al. Phys. Rev. C 92:011302(R) (2015)

HK 33: Instrumentation VII

Zeit: Mittwoch 16:45–19:00 Raum: F 072

Gruppenbericht HK 33.1 Mi 16:45 F 072

Performance of the COMPASS Trigger — •Benjamin Moritz Veit — Institut fuer Kernphysik Universitaet Mainz

The Common Muon Proton Apparatus for Structure and Spectroscopy or short COMPASS is running since 2001 in different setups to study the hadron structure and hadron spectroscopy with high intensity muon and hadron beams.
For the 2016/2017 run a liquid hydrogen target with a 160 Gev/c polarised muon beam is used to extract the Generalized Parton Distributions (GPDs) from beam and spin cross section differences. Thus measurements with positively and negatively charged muons were performed. Stable working conditions for both beam polarities during the whole data taking of ∼200 days are mandatory for the extraction of cross section differences. The performance and stability of the 2016 GPD Trigger setup in comparison to the previous runs will be presented.

HK 33.2 Mi 17:15 F 072

Tracking with the Transition Radiation Detector in the High Level Trigger of ALICE — •Marten Ole Schmidt for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

During the LHC Run 2, which started in 2015, unexpected localized cm-scale distortions caused by space-charge were observed in the ALICE Time Projection Chamber (TPC). The distortions are corrected for employing the detectors inside (Inner Tracking System) and outside (Transition Radiation Detector - TRD) the TPC. The correction is currently done within the offline reconstruction procedure.

In order to speed up the reconstruction, it is planned to move parts of the calibration procedure online in the Hight Level Trigger (HLT). As a first step the TRD tracking is implemented in the HLT. For this, TPC tracks are extrapolated towards the TRD and used as seeds for tracking. In contrast to the offline correction procedure, the new tracking algorithm is based on online TRD tracklets instead of clusters. The implementation is also a preparation for LHC Run 3 (beyond 2020) where the whole reconstruction and calibration will be moved online. First results of this tracking algorithm will be presented and the next steps necessary to correct the space charge distortions online in the HLT will be discussed.

HK 33.3 Mi 17:30 F 072

Time based track reconstruction in the CBM experiment — •Timur Ablyazimov[1,2] and Volker Friese[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]LIT JINR, Dubna, Russia

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to cope with high track-densities and extreme interaction rates of up to 10 MHz. Because of the interaction rates events are unavoidably overlap in time. Accordingly the reconstruction in the CBM experiment becomes possible only taking into account time measurements. This approach was first implemented for the Silicon Tracking System (STS), which is the main tracking detector of the CBM experimental setup. Now the time based reconstruction concept is being extended to other detectors, whose measurements can be used for STS reconstructed tracks extrapolation through the CBM setup.

We will present that status of the time-based simulation and reconstruction for the Time of Flight (TOF) detector. This is because of its excellent time resolution and crucial importance for determining the physical properties of the particles and the particles identification. We are developing approaches for time based hit finding in TOF and for using them for STS tracks extrapolation to the TOF detector.

HK 33.4 Mi 17:45 F 072

Speed up approaches in the Cellular Automaton (CA) track finder — •Grigory Kozlov[1,2] and Ivan Kisel[1,3] for the CBM-Collaboration — [1]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [2]Joint Institute for Nuclear Research, Dubna, Russia — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Tracking procedure is an important part of event reconstruction in high energy physics experiments. One of the fastest and efficient track finding algorithm is a cellular automaton. It is used in various experiments including CBM at FAIR and STAR at RHIC. CBM and STAR CA track finders have similar implementations. But standard track finding procedure may be not fast enough for online calculations, especially in case of high particle multiplicity.

In this work we consider several methods to speed up CA track finders in STAR and CBM. Different approaches were implemented and investigated. For instance, grid structure allows us to seriously reduce the number of calculations when hits are combined into segments. Using of multimap for merging of segments help us quickly exclude impossible combinations. In addition, CA track finder was vectorized taking into account scalability for CPUs with SSE, AVX and MIC instructions (128, 256 and 512 bit registers).

Most of used approaches are common and can be easily applied to different versions of CA tracking algorithms.

HK 33.5 Mi 18:00 F 072

New track seeding techniques for the CMS Experiment during Phase-1 — •Felice Pantaleo[1,2], Alexander Schmidt[2], Andreas Meyer[3], Vincenzo Innocente[1], Andreas Pfeiffer[1], and Benedikt Hegner[1] — [1]CERN, Geneva, Switzerland — [2]Hamburg University, Hamburg, Germany — [3]DESY, Hamburg, Germany

Starting from 2019 the Large Hadron Collider will undergo upgrades in order to increase its luminosity. Many of the algorithms executed during track reconstruction scale linearly with the pileup. Others, like seeding, due to the increasing combinatorial complexity, will dominate the execution time, due to their factorial complexity with respect to the pileup. We will show the results of the effort in reducing the effect of pile-up in CMS Tracking by redesigning the seeding with novel algorithms which are intrinsically parallel and by executing these new algorithms on massively parallel architectures.

HK 33.6 Mi 18:15 F 072

Cellular Automaton tracking algorithm for PANDA Forward Tracking System — •Mykhailo Pugach[1,2,4], Ivan Kisel[1,2], and Maksym Zyzak[3] — [1]Goethe-Universität, Frankfurt am Main — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [4]KINR, Kyiv, Ukraine

The Forward Tracking System (FTS) is the tracking detector of PANDA experiment. Located in the dipole magnet, FTS requires a complex yet efficient algorithm capable to reconstruct tracks and determine momentum of charged particles originating from beam-target interactions as well as from secondary vertices. In this talk the Cellular Automaton approach implemented in the PandaRoot-framework is presented in conjunction to the FTS.
Results, problems and perspectives are shown and discussed.
Supported by HIC for FAIR and HGS-HIRe.

HK 33.7 Mi 18:30 F 072

Tracking of charged particles in the central region of the BGO-OD experiment using a cylindrical MWPC* — •Patrick Bauer for the BGO-OD-Collaboration — Physikalisches Institut, Bonn, Nußallee 1

The BGO-OD experiment at the ELSA accelerator facility at Bonn investigates the mechanisms of photoproduction of mesons from nucleons. One focus is associated strangeness production, i.e. $\gamma p \to (KY)^+$ or $\gamma n \to (KY)^0$. Generally the strange-particle decays yield multiple charged particles in the final state, as for example $\Lambda K^0 \to (p\pi^-)(\pi^+\pi^-)$. The capability to reconstruct precise tracks and vertices of reactions and decays is therefore crucial. At BGO-OD, the charged particle trajectories are reconstructed using a cylindrical MWPC, which is surrounding the target cell inside the BGO calorimeter. The reconstruction procedure, as well as its impact on the identification of reaction channels will be presented.

* Supported by the DFG (SFB/TR-16)

HK 33.8 Mi 18:45 F 072

Parallel Algorithms for Online Trackfinding at PANDA — •Ludovico Bianchi[1], Andreas Herten[2], James Ritman[1], and Tobias Stockmanns[1] for the PANDA-Collaboration — [1]IKP — [2]JSC, Forschungszentrum Jülich GmbH, Germany

The PANDA experiment, one of the four scientific pillars of the FAIR facility under construction in Darmstadt, is a next-generation particle detector that will study collisions of antiprotons with beam momenta of 1.5–15 GeV/c on a fixed proton target.

Because of its broad physics scope and the similar signature of signal and background events in the energy region of interest, PANDA's strategy for data acquisition is to continuously record data from the entire detector and use this global information to perform online event reconstruction and selection. A real-time rejection factor of up to 1000 is required to match the incoming data rate to the available offline storage.

Online particle track identification and reconstruction is an essential step, since track information is used as input in all following phases. Online tracking algorithms must ensure a delicate balance between high tracking efficiency and quality, and minimal computational footprint. To satisfy these requirements, a solution based on massively parallel algorithms running on hardware processors such as Graphic Processing Units (GPUs) is under investigation.

The talk will present the core concepts of the novel algorithms being developed for primary trackfinding, along with performance measurements of their physical and computational parameters.

HK 34: Instrumentation VIII and Accelerators

Zeit: Mittwoch 16:45–19:00 Raum: F 073

Gruppenbericht HK 34.1 Mi 16:45 F 073

Ein Spurdetektor zur Luminositätsmessung bei PANDA — •Christof Motzko[1,2], Miriam Fritsch[3], Florian Feldbauer[3], Roman Klasen[1,2], Heinrich Leithoff[1,2], Stephan Maldaner[1,2] und Stefan Pflüger[1,2] für die PANDA-Kollaboration — [1]Helmholz-Institut Mainz — [2]Universität Mainz — [3]Ruhr-Universität Bochum

Das PANDA-Experiment, welches im Antiproton-Speicherring HESR an der im Bau befindlichen Beschleunigeranlage FAIR in Darmstadt stehen wird, ist für Fragen der Hadronenphysik optimiert. Mit dieser Anlage wird es möglich sein, neue Zustände zu entdecken und die Linienform dieser wie auch bereits bekannter Zustände sehr präzise zu vermessen. Zur Normierung der dafür verwendeten Energie-Scan-Messungen wird die exakte Kenntnis der Luminosität benötigt.

Die Luminosität wird bei PANDA anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung bestimmt. Um eine absolute Messgenauigkeit von 3 % zu erreichen werden die Spuren der gestreuten Antiprotonen gemessen. Dazu werden 4 Detektorebenen mit gedünnten Siliziumsensoren verwendet (HV-MAPS). HV-MAPS sind Pixelsensoren mit integrierter Ausleseelektronik. Sie werden mit einer Sperrspannung von 60 V betrieben um die Strahlenhärte zu erhöhen. Die 4 Ebenen, die verfahrbar montiert sind, bestehen aus CVD-Diamanten auf denen die Sensoren aufgeklebt sind. Zur Reduktion der Vielfachstreuung wird der Aufbau im Vakuum betrieben.

Das Konzept des Luminositätsdetektors wird vorgestellt und dabei technische Aspekte wie Vakuumsystem, Kühlung und Elektronik diskutiert, sowie Einblicke in die Datenanlyse gegeben.

HK 34.2 Mi 17:15 F 073

Absolute photon flux measurement at the BGO-OD experiment and Cross-Check with $\pi^0 p$ production* — •Katrin Kohl for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment at the ELSA accelerator facility at Bonn investigates the internal reaction mechanisms of meson photoproduction off the nucleon. Absolute normalisation of the flux of tagged photons is indispensable for cross section determination. In this talk the measurement principle is presented and the obtained flux is checked with the known cross section of the reaction $\gamma p \to \pi^0 p$.

* Supported by the DFG (SFB/TR-16)

HK 34.3 Mi 17:30 F 073

Concept and design of an alignment monitoring system for the CBM RICH mirrors* — •Jordan Bendarouach and Claudia Höhne for the CBM-Collaboration — Justus Liebig University, Gießen

The Compressed Baryonic Matter (CBM) experiment at the future FAIR complex will investigate the phase diagram of strongly interacting matter at high baryon density and moderate temperature in A+A collisions from 2-11 AGeV (SIS100).

One of the key detectors of CBM to explore this physics program is the RICH (Ring Imaging CHerenkov) detector, which is developed for efficient and clean electron identification and pion suppression. About 80 trapezoidal glass mirror tiles equally distributed in two half-spheres will serve as focusing elements with spectral reflectivity down to the UV range.

An important aspect to guarantee a stable operation of the RICH detector is the mirror alignment. To determine and quantify mirror misalignments, a method inspired from the HERA-B experiment is employed. The misalignment information is used in a correction cycle to allow a proper operation of the detector under these conditions.

First results of a study comparing the accuracy of the reconstruction method between inner and outer tiles will be presented. Results from an automated correction routine and the impact of the corrections on the matching efficiency will also be shown.

(*Supported by BMBF grants 05P15RGFCA, HIC for FAIR and HGS-HIRe)

HK 34.4 Mi 17:45 F 073

Precsion beam energy measurement by undulator radiation at MAMI — •Pascal Klag, Patrick Achenbach, Philipp Herrmann, Werner Lauth, and Josef Pochodzalla — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The Mainz microtron is an electron accelerator, which delivers electron energies up to 1.6 GeV, with a small spread of the energy σ_{beam} < 13keV. Over time, the energy drifts, less than 1keV. On the other hand, presently the absolute energy can be determined with an systematic uncertainty of 160keV. In 2016 a complementary method which does not rely on magnetic field measurement is tested. The method is based on interferometry with two spatial separated light sources (Undulators) driven by relativistic electrons. A high resolving Monochromator is used to analyse the spectrum of the light. Noise in the camera has limited the error of the pilot measurement to 10^{-3}. In the future, systematic effects have to be understood and it is planned to use a cooled camera to reduce uncertainties to $\frac{\Delta E}{E} < 10^{-4}$.

HK 34.5 Mi 18:00 F 073

Data analysis of the high-accuracy electron beam energy measurement at the Mainz Microtron — •Philipp Herrmann — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz

The Mainz Microtron MAMI delivers an electron beam of up to 1.6 GeV. The absolute energy is measured inside the third stage of the accelerator with an accuracy of $\delta E_{beam} = 160$ keV independent of the beam energy, with an energy spread $\sigma_{beam} < 13$ keV and long-term drifts of less than 1 keV when stabilized. To obtain an absolute energy measurement within $\delta E_{beam} \sim 20$ keV uncertainty, a 42°-dipole of the beam-line leading to the spectrometer facility is used as a high-accuracy beam spectrometer. A high-precision field mapping device was developed and a dedicated beam detection system of RF cavity position monitors and YAG:Ce screens was implemented. Therefor the goal was to achieve 10 μT, 10 μm uncertainties in the field mapping and an electron beam deflection angle measurement with $\delta\theta/\theta < 10^{-5}$.
With this setup we were able to obtain 10000 data points, in x, y and z field direction, for different field values and probe positions. Thus enabling us to use a linear approximation in order to calculate a complete field map along the path of the electrons through the dipole.
Using the the YAG:Ce screens to measure the offset of the RF cavity monitors every 30 min, we archived the high accuracy measurement of the beam position/deflection angle. In this presentation the results and difficulties will be presented, in regard to provide a well known incident particle energy for scattering experiments at MAMI.

HK 34.6 Mi 18:15 F 073

Absolute calibration of reference dividers for the KATRIN experiment — •Patrik Herud for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische-Wilhelms-Universität, Münster

The goal of the KATRIN (KArlsruhe TRItium Neutrino) experiment is to search for the neutrino mass with a sensitivity of 200 meV/c^2 by measuring the endpoint region of the tritium β-decay spectrum. This sub-eV sensitivity is achieved by using a MAC-E-filter as the electron spectrometer. The precision of the retarding potential of the MAC-E-filter (up to −35 kV) has to be monitored with an uncertainty of 60 mV at the endpoint region (18.6 keV).
To measure the retarding potential we had build custom-made high precision voltage dividers in coorperation with the Physikalisch-Technische Bundesanstalt Braunschweig. To ensure the required stability, regular high precision calibrations are needed. For the complicated calibrations an absolute calibration of voltages up to 1 kV by commercially available voltage dividers (FLUKE 752A) is required.
In this talk we will present a new absolute calibration method for these 1 kV dviders and show first calibration tests.

HK 34.7 Mi 18:30 F 073

Energy calibration of the KATRIN experiment — •Oliver Rest for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The KATRIN experiment will measure the endpoint region of the tritium-β-decay spectrum to determine the neutrino mass with a sensitivity of 200 meV/c^2. To achieve this sub-eV sensitivity the energy of the decay electrons will be analyzed using a MAC-E-filter type spectrometer. The retarding potential of the MAC-E-filter of -18.6 kV has to be monitored with a relative precision of $3 \cdot 10^{-6}$.
For this purpose the potential will be measured directly via two custom made precision high voltage dividers, which were developed in cooperation with PTB, the German national metrology center. In order to

determine the absolute values and the stability of the scale factors of the voltage dividers, regular calibration measurements with ppm precision are essential.
In addition the HV will be compared to a natural standard given by monoenergetic conversion electrons from the decay of ^{83m}Kr. This will be done continuously in parallel with the KATRIN monitor spectrometer and regularly with a gaseous and a condensed Krypton source to guarantee a redundant calibration system.
The talk will give an overview of the energy calibration of the KATRIN experiment and will show a summary of the calibration measurements over the last years.
This project is supported by BMBF under contract number 05A11PM2.

HK 34.8 Mi 18:45 F 073

Detailed Cavity Design for the FAIR p-Linac — •Ali Almomani[1], Ulrich Ratzinger[1], Marco Busch[1], Rudolf Tiede[1], and Florian Dziuba[2] — [1]IAP - Frankfurt University — [2]GSI - Darmstadt

The research program of antiproton beams for the FAIR facility requires a dedicated 70 MeV, 70 mA proton injector. This injector will consist of a ladder RFQ and followed by six room temperature "Crossbar H-type" CH-cavities operated at 325 MHz. The MEBT section behind the RFQ has been optimized for beam matching into the CH-DTL. The beam dynamics for the DTL had been revised to reduce the emittance growth. As a consequence cavity voltage, gap numbers, lens layouts, and cavity end geometry were optimized. Consequently, the construction of cavities can be started in 2017. In this paper, the detailed design of these cavities with integrated focusing triplets will be presented and the main issues will be discussed.

HK 35: HK+T Joint Session V: Silicon Strip Detectors

Zeit: Mittwoch 16:45–19:00 Raum: F 102

HK 35.1 Mi 16:45 F 102

Bau von 2S-Modul-Prototypen für das Phase-2-Upgrade des CMS-Trackers — Lutz Feld, Waclaw Karpinski, Katja Klein, Marius Preuten, Max Rauch, •Nicolas Röwert 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 2023. Im neuen Tracker werden u.A. etwa 8000 Stück der neuartigen 2S-Siliziumstreifenmodule eingesetzt werden.
Das Grundgerüst eines 2S-Moduls besteht aus zwei ca. 10 cm × 10 cm großen Siliziumstreifensensoren, die auf zwei Abstandshalter (Spacer) aus einem Aluminium-Kohlefaser-Verbundmaterial geklebt sind. Die Klebeschichtdicken sollen aus thermischen Gründen 20 μm oder weniger betragen und die Sensoren müssen gegenüber den Spacern gegen Hochspannung isoliert sein. Für den Winkel zwischen den beiden Streifensensoren wird eine Toleranz von 400 μrad verlangt. Es wird ein auf einer mechanischen Vorrichtung basierendes Verfahren zum Bau von 2S-Modulen vorgestellt und die Ergebnisse vom Bau erster Prototypen werden diskutiert.

HK 35.2 Mi 17:00 F 102

Wirebonding auf den 2S Modulen des Outer Trackers für das Phase-2-Upgrade des CMS Experiments — Lutz Feld[1], Katja Klein[1], Oliver Pooth[2] und •Tim Ziemons[2] — [1]I. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen — [2]III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen

Vor dem Start des HL-LHC müssen am CMS-Detektor aufgrund von Strahlenschäden und den bevorstehenden höheren Luminositäten Upgrades vorgenommen werden. Im sogenannten Phase-2-Upgrade des CMS-Detektors werden viele Subdetektoren durch solche mit moderneren Technologien ersetzt. Dazu zählt auch der neue Silizium Outer Tracker, in dem sogenannte PS Module (pixel and strips) und 2S Module (strips and strips) Signale liefern sollen, die in den Level-1 Trigger integriert werden.

Ein 2S Modul besteht aus zwei Silizium-Streifen Sensoren, die durch Wire-Bonds mit der Ausleseelektronik verbunden werden. Im Vortrag werden die 2S Module im Hinblick auf Machbarkeit der Wire-Bonds vorgestellt und erste Schritte in Richtung des Bondings bei einer Massenproduktion diskutiert. Die Optimierung der Bondqualität und der Schutz vor Beschädigung der Bondverbindungen sind wichtig, um die Lebensdauer der Detektormodule zu maximieren.

HK 35.3 Mi 17:15 F 102

A high resolution tracker for (p,2p) reactions — •Lukas Werner for the TUM-RIKEN-p2p-Collaboration — Technical University of Munich

Models of the r-process predict a strong influence of fission barrier heights on the distribution of r-process nuclei, manly through termination of the r-process and simultaneously by a recycling of the fission products , refueling the r-process with neutron rich , medium mass nuclei.

The (p,2p)-reaction in inverse kinematics allows for the study of fission barrier heights for even the most exotic, experimentally available nuclei. For this purpose a missing mass spectroscopy of the reaction has to be performed. A silicon tracker system has been developed using highly segmented, thin silicon detectors with an APV25 based low noise readout. Tests of the system have been performed at the HIMAC facility in Japan, using a stable 16-O beam at energies of E=290 MeV/u.

Even at a readout speed of up to 100 kiloevents per second the experimental resolution of a vertex reconstruction is in excellent agreement with expectations from Geant4 simulations.

Supported by BMBF 05P15WOFNA (Germany) and Outstanding Individual Research Grant (Japan).

HK 35.4 Mi 17:30 F 102

Test-beam results of an unirradiated and an irradiated module for the ATLAS ITk Strip detector — •Edoardo Rossi — DESY, Hamburg, Germany

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

The ITk strip detector will be subject to a radiation more than one order of magnitude higher than the maximum radiation fluence expected for the SCT, the current strip detector. For this reason, new radiation-hard sensors and front-end chips will be used and are now under development. Among other measurements, a test-beam campaign is on going to determine the performance of the new modules at the end of the lifetime of the HL-LHC. Some strict requirements are set on the performance to provide efficient pattern recognition and track reconstruction and to fulfill the needs of the physics program.

In this presentation, test-beam results obtained with unirradiated and proton-irradiated prototype barrel modules are compared. The measurements were performed at DESY and CERN. The main focus is on the degradation of the efficiency, collected charge and noise occupancy after irradiation.

HK 35.5 Mi 17:45 F 102

Long Term Annealing Studies on ATLAS12 Sensors — •Leena Diehl, Riccardo Mori, Marc Hauser, Susanne Kühn, Ulrich Parzefall, Ines Messmer, and Karl Jakobs — Albert-Ludwigs-Universität Freiburg

Non-ionizing energy loss (NIEL) causes damage to silicon particle detectors, resulting for p-type sensors in an increased effective doping concentration, growing depletion voltage and leakage current. Defects in the lattice are mobile with an exponential temperature dependence.

Therefore, a long-term study of damage parameters is performed as a function of time at Room Temperature and 60°C, using irradiated p-type sensors up to a fluence of 2e15 n_{eq}/cm^2. Measurements include the charge collection and leakage current behavior, the scaling factor between the two temperatures and the behavior of the effective doping concentration. A strong deviation from the conventional scaling factor is found.

HK 35.6 Mi 18:00 F 102

Cold IV measurements of highly irradiated silicon strip detectors — •Sven Mägdefessel[1], Eva Sicking[1,2], Ulrich Parzefall[1], and Karl Jakobs[1] — [1]Albert-Ludwigs-Universität Freiburg, Germany — [2]now at CERN, Switzerland

Highly irradiated silicon strip detectors show a strong increase of the leakage current. Thus a intense cooling is nescessary to perform an IV measurement. On the one hand it has to be ensured that the detector is kept at the lowered temperature and on the other hand the heat being produced by the leakage current has to be removed.

We present a actively cooled and temperature stabilized setup which provides temperatures down to -40°C for detectors up to 8" size. Furthermore we show the latest results of planar and 3D silicon strip detectors.

HK 35.7 Mi 18:15 F 102

Electrical quality assurance of silicon microstrip sensors for the CBM experiment — •Iaroslav Panasenko for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen, Germany — Institute for Nuclear Research, Kiev, Ukraine

The CBM experiment at FAIR will investigate the properties of nucler matter at extreme conditions created in ultrarelativistic heavy-ion collisions. Its core detector — the Silicon Tracking System (STS) — will determine the momentum of charged particles from beam-target interactions.

The STS will be constructed from about 900 double-sided silicon microstrip sensors with $58\,\mu$m pitch and a total area of about $4\,\mathrm{m}^2$ with all together 2.1 million channels will be read out.

In this talk the electrical quality assurance of double-sided silicon microstrip sensors will be discussed. For this purpose dedicated equipment including a custom-built probe station has been set up in the clean room at Tübingen University. Results of the electrical characterization of prototype microstrip sensors CBM06 will be presented, which include basic checks like current-voltage and capacitance-voltage measurements, as well as specific tests like coupling and interstrip capacitances.

Work supported by BMBF under grant 05P12VTFCE.

HK 35.8 Mi 18:30 F 102

Optical quality assurance procedures for the sensors of the CBM Silicon Tracking System — •Evgeny Lavrik for the CBM-Collaboration — Physikalisches Institut der Universität Tübingen, Tübingen, Deutschland

The Compressed Baryonic Matter (CBM) experiment at FAIR aims to study the properties of nuclear matter at high net-baryon densities. The Silicon Tracking System is the key detector to reconstruct charged particle tracks created in heavy-ion interactions. In order to assure the quality of more than 1000 silicon sensors including spares, highly efficient and highly automated procedures need to be developed.

In this contribution we report on the optical quality assurance setup built at the University of Tübingen and the progress in the development preparing for the mass inspection of the silicon sensors arriving from the manufacturers in 2017. We will as well as summarize the results and experience obtained from inspecting prototype sensors.

This work was supported by grant BMBF-05P16VTFC1

HK 35.9 Mi 18:45 F 102

DC-DC Powered Silicon Microstrip Modules for the CMS Phase-II Tracker — Lutz Feld, Waclaw Karpinski, Katja Klein, •Marius Preuten, and Max Rauch — I. Physikalisches Institut B - RWTH Aachen

To prepare the CMS experiment for the High Luminosity LHC and its planned instantaneous luminosity of $5\cdot10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ the CMS Silicon Tracker will be replaced in the Long Shutdown 3 (around 2025). The new Tracker will comprise about 15000 conceptually new modules: Two identical vertically spaced silicon microstrip sensors are integrated into a single module and read out by the same front-end chip. The displacement of the hits between both sensors - caused by the bending of charged particle tracks within the 3.8 T magnetic field - can be used to infer a lower bound on the pT of the track within a single module. In order to satisfy the increased power demand of the new front-end electronics at minimal material budget an on-board DC-DC converter scheme was chosen. These converters, the high voltage circuit and the electro-optical conversion are merged into a single PCB (Service Hybrid) and are an integral part of the new tracker modules. First full size module prototypes have been produced and are currently tested. Results on the electrical performance during system tests including a Service Hybrid, will be presented in this talk.

HK 36: HK+T Joint Session VI: Radiation Damage

Zeit: Mittwoch 16:45–19:00 Raum: F 234

HK 36.1 Mi 16:45 F 234

Proton-energy dependent damage to Si sensors — •Elena Donegani, Eckhart Fretwurst, and Erika Garutti — University of Hamburg

Silicon bulk damage is the limiting factor of detector lifetime for future HL-LHC experiments. Nowadays, the knowledge of radiation-induced bulk defects and their effects on the sensor properties are especially limited after proton irradiation. Therefore, 200μm silicon pad-sensors (n- and p-type bulk materials: FTH, MC and dd-FZ) were irradiated with 23 MeV, 188 MeV and 23 GeV protons (with $\Phi_{neq} \leq 3\cdot10^{14}\mathrm{cm}^{-2}$). I-V, C-V-f and TSC measurements were performed at subsequent annealing steps at 353K. In particular, the main experimental challenges will be addressed regarding the TSC filling temperature (at T=10K) and filling forward current (I≈1mA). The TSC spectra are analyzed with a revisited SRH statistics, modified to account for defect clusters after hadron irradiation.

A proton-energy dependent introduction of defects is found, except for deep cluster-related defects. Shallow defects are present in different concentrations according to the material type. A correlation is notable between the leakage current and the concentrations of three deep defects (the V2, E5 and H(220K) defects). Other defects affect the space charge, with positive contributions from e.g. the E(30K) and BiOi defects, or negative contributions from deep acceptors (namely the H(116K), H(140K) and the H(152K)).

This information will be exploited as input for a physics-based and measurement-driven radiation damage model.

HK 36.2 Mi 17:00 F 234

X-ray dose and electric field dependence of oxide charges at the Si-SiO$_2$ interface of high-ohmic Si — •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 the Si-SiO$_2$ system on high-ohmic Si has been investigated. Circular p- and n-MOSFETs biased to an electric field of about 500 kV/cm at the Si-SiO$_2$ interface, have been irradiated up to an X-ray dose of about 17 kGy(SiO$_2$). From the measured drain-source current the change of oxide charge density during irradiation has been determined. Cycling the gate voltage before and after irradiation the oxide charge density N_{ox}, the interface traps N_{it} and the charging and discharging of border traps as function of X-ray dose and field direction has been determined. The study has been performed for two field directions at an electric field of 500 kV/cm, which according to TCAD simulations is the maximum field at the Si-SiO$_2$ interface in segmented sensors under normal operation.

The N_{ox} increases and decreases as function of dose depending on the field direction in the SiO$_2$. An increase of N_{it} has been observed for all the conditions. The observations predict that the position dependence of the electric field at the Si-SiO$_2$ interface in segmented silicon sensors will result in a non-uniform oxide charge density due to surface damage. The results presented can be used to improve simulations of the surface radiation damage of silicon sensors.

HK 36.3 Mi 17:15 F 234

Studies of radiation field impact on microstrip sensors for the CBM Silicon Tracking System — •Ievgeniia Momot[1,2,3], Olga Bertini[2], Maksym Teklishyn[3,4], Anton Lymanets[2,3], Hanna Malygina[1,2,3], Johann Heuser[2], and Christian Sturm[2] for the CBM-Collaboration — [1]Goethe-Universität, Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [3]KINR, Kyiv Institute for Nuclear Research, Kyiv, Ukraine — [4]FAIR,

Facility for Antiproton and Ion Research, Darmstadt, Germany

The Silicon Tracking System (STS) is the main tracking detector of CBM experiment. Located in the dipole magnet, reconstructs tracks and determines momentum of charged particles originating from beam-target interactions. The response of double-sided silicon micro-strip sensors to hits is very depended on the radiation load on the detector, which is expected to reach 10^{14} 1 MeV n_{eq}/cm^2. It is vital to maintain signal-to-noise ratio at the level of ≈ 10 to keep 98% hit reconstruction efficiency after irradiation up to the CBM lifetime dose. Results of testing newest prototypes of sensors from two different vendors to fluences between 10^{13} and $2{\times}10^{14}$ n_{eq}/cm^2 will be reviewed. Thus the total effect of the different radiation doses on the signal-to-noise ratio will be presented.

Supported by HIC for FAIR and HGS-HIRe.

HK 36.4 Mi 17:30 F 234

Characterization and calibration of radiation-damaged double-sided silicon strip detectors — •Levent Kaya[1], Andreas Vogt[1], Peter Reiter[1], Benedikt Birkenbach[1], Rouven Hirsch[1], Christian Stahl[2], and Norbert Pietralla[2] — [1]Institut für Kernphysik, Universität zu Köln — [2]Institut für Kernphysik, Technische Universität Darmstadt

Double-sided silicon strip detectors (DSSSD) are commonly used for event-by-event identification of charged particles as well as the reconstruction of particle trajectories in nuclear physics experiments with stable and radioactive beams. Individual pixel segments are given by intersecting areas of both p- and n-doped front- and backside segments resulting in a high detector granularity. Typically, charged particles do not homogeneously illuminate the detector surface during in-beam experiments. Consequently, radiation damages of the detector are distributed non-uniformly. Position-dependent incomplete charge collection due to radiation damage limits the performance and lifetime of the detectors; the response of different channels may vary drastically. Position-resolved charge-collection losses for front- and back-side segments were investigated for an in-beam experiment and by performing radioactive source measurements. A novel position-resolved calibration method for radiation-damaged DSSSDs, based on mutual consistency of p-side and n-side charges, was developed. It yields a significant enhancement of the energy resolution and the performance of radiation-damaged parts of the detector. Supported by Bonn-Cologne Graduate School for Physics and Astronomy (BCGS).

HK 36.5 Mi 17:45 F 234

Applikations- und Bestrahlungsstudien für die Wire-Bond-Enkapsulierung in zukünftigen Siliziumsensormodulen des CMS Spurdetektors — Tobias Barvich, Felix Boegelsbacher, Alexander Dierlamm, •Stefan Maier und Pia Steck — 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 Wire-Bond-Verbindungen zwischen Siliziumsensoren und Auslesechips sollen hierbei durch eine Enkapsulierung geschüzt werden. Neben den herkömmlichen Voraussetzungen wie Temperaturbeständigkeit, hohe Strahlungslänge und Strahlenhärte muss das verwendete Material die richtige Viskosität besitzen. Diese muss in einem Bereich liegen der einerseits ein leichtes Benetzen der Bonddrähte ermöglicht, andererseits aber ein Verlaufen auf darunter liegende Modulkomponenten verhindert. Am Karlsruher Institut für Technologie wird mit Hilfe eines selbst entwickelten halbautomatischen Roboters die Applikation und Eigenschaften der Materialien untersucht. Der Vortrag gibt Einblicke in eine Auswahl an Materialien, deren Eigenschaften und Applikationsmöglichkeiten.

HK 36.6 Mi 18:00 F 234

Dark Current of Neutron Irradiated SiPMs — •Svenja Nadine Sonder[1], Matteo Centis Vignali[1,2], Erika Garutti[1], Robert Klanner[1], and Jörn Schwandt[1] — [1]Institut für Experimentalphysik, Universität Hamburg, Germany — [2]CERN, Geneva, Switzerland

Silicon photomultipliers (SiPMs) have become popular as photon detectors in high-energy physics and many other fields due to their excellent performance. One major limitation, especially for the use in colliders, is the radiation damage by hadrons. In this talk, SiPMs with 3484 pixels of 15x15 μm^2 produced by the company KETEK have been irradiated with reactor neutrons to different fluences up to 10^{12} n_{eq}/cm^2 (1 MeV equivalent neutrons). Current-voltage measurements have been performed at different temperatures between -30°C and +30°C. To better understand the generation of the dark current, parameters like the breakdown voltage and the activation energy given by the Arrhenius model have been investigated. A parameterization, which describes the temperature and dose dependence of the current-voltage results within 5%, is presented.

HK 36.7 Mi 18:15 F 234

Study of GEM ageing effects for the ALICE TPC Upgrade — •Michael Jung[1], Harald Appelshäuser[1], Chilo Garabados[2], and Renato Negrao de Oliveira[3] for the ALICE-Collaboration — [1]IKF - Goethe-Universistät Frankfurt — [2]GSI - Helmholtzzentrum für Schwerionenforschung — [3]Universidade de Sao Paulo

Long-term measurements with a quadruple stack of Gas Electron Multipliers (GEMs) at relatively high gain (about 15,000) were performed to invesitgate the ageing effects of GEMs in Ar-CO_2 (70-30). The GEM stack was irradiated with a high-rate ^{55}Fe source to simulate the dose of the upgraded ALICE Time Projection Chamber (TPC) at the LHC during RUN3 with a Pb–Pb interaction rate of about 50 kHz. Also the outgassing effects of different materials, such as Vetronite, Araldite 2011 and Polyamide on the energy resolution and the gain were studied. During all measurements the temperature and the ambient pressure were measured to discriminate between a change of the environment conditions and a degradation of the detector properties. One phenomenon observed was that the kapton in the GEM holes was etched, so that the double conical shape of the holes got lost.

HK 36.8 Mi 18:30 F 234

Radiation Tolerance of a Fully Depleted CMOS Monolithic Active Pixel Sensor — •Tobias Bus, Michael Deveaux, and Benjamin Linnik for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

CMOS Monolithic Active Pixel Sensors (MAPS) are considered as the technology of choice for the micro vertex detector (MVD) of the CBM experiment. We aim to adapt the radiation tolerance of the technology to the needs of CBM.

The tolerance of MAPS to non-ionizing radiation damage can be improved by means of depleting the active volume of the sensors. This technologically difficult approach could be realized with a novel sensor prototype named Pipper-2. The tolerance of this prototype to non-ionizing radiation hardness of the sensors was tested for doses of up to $5 \cdot 10^{14} \frac{n_{eq}}{cm^2}$. First results of the test will be shown and discussed.

*This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 36.9 Mi 18:45 F 234

Einsatzmöglichkeiten von synthetischem Graphit in zukünftigen Spurdetektoren — Tobias Barvich, Conny Beskidt, Wim de Boer, Alexander Dierlamm und •Stefan Maier — Institut für Experimentelle Kernphysik (IEKP), KIT

Die Anforderungen an die verwendeten Materialien in zukünftige Spurdetektoren wie dem des CMS Phase-II-Upgrades sind sehr hoch. Die Verwendung von synthetischem Graphit in Form von Klebefolien hätten in solchen Experimenten viele Vorteile. Es ermöglicht einen präzisen und leichten Bau während es gleichzeitig mit seiner hohen Wärmeleitfähigkeit für die Kühlung der Komponenten sorgt. Mit einer PET Schutzschicht ist es zusätzlich als elektrische Isolation zwischen Hochspannungspotentialen geeignet. Am Karlsruher Institut für Technologie werden die Eigenschaften und Einsatzmöglichkeiten des Materials untersucht. Der Vortrag gibt Einblicke in Simulationen und Tests mit synthetischem Graphit.

HK 37: Hauptvorträge II

Zeit: Donnerstag 8:30–10:30 Raum: F 1

Hauptvortrag HK 37.1 Do 8:30 F 1

Direct Neutrino Mass Measurements — •Susanne Mertens for the KATRIN-Collaboration — Max Planck Institute for Physics Föhringer Ring 6, 80805 München — Technical University Munich, James Frank Straße, 85748 Garching.

With a mass at least six orders of magnitudes smaller than the mass of an electron – but non-zero – neutrinos are a clear misfit in the Standard Model of Particle Physics. On the one hand, its tiny mass makes the neutrino one of the most interesting particles, one that might hold the key to physics beyond the Standard Model. On the other hand this minute mass leads to great challenges in its experimental determination. Three approaches are currently pursued: An indirect neutrino mass determination via cosmological observables, the search for neutrinoless double β-decay, and a direct measurement based on the kinematics of single β-decay. In this talk the latter will be discussed in detail and the status and scientific reach of the current and near-future experiments will be presented.

Hauptvortrag HK 37.2 Do 9:10 F 1

Precision Nuclear Mass Measurements for Neutrino Physics Studies — •Sergey Eliseev — MPIK, Heidelberg, Germany

This contribution will give a brief overview of the extended and diverse experimental campaign carried out with the Penning-trap mass spectrometer SHIPTRAP for neutrino physics and present a physical program for the next generation Penning-trap mass spectrometer PENTATRAP. The contribution is structured as follows: First, the results of our search for the nuclide with the largest probability for neutrinoless double-electron capture are summarized. The Q-values of a large number of potentially suitable nuclides have been determined with SHIPTRAP, which has resulted in the discovering of two resonantly enhanced transitions in 152Gd and 156Dy. Second, the Q-values of the beta decay in 187Re and electron capture in 163Ho - ones of the most suitable processes for the determination of the neutrino mass - have been determined with an uncertainty of about 30 eV, which is a significant contribution to the development of the ECHo project. Finally, the novel Penning trap mass spectrometer PENTATRAP is introduced and a future measurement program is presented.

Hauptvortrag HK 37.3 Do 9:50 F 1

Few-neutron resonances and their impact on neutron-rich nuclei — •Joel Lynn — Institut für Kernphysik, Technische Universität Darmstadt, Germany — ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

The possibility of few-neutron structures has long intrigued the theoretical and experimental nuclear physics community. In addition to the inherent interest in the existence of such systems, reproducing them theoretically will likely impose strong constraints on the $T = 3/2$ component of three-nucleon interactions, which in turn are critical to the description of neutron-rich nuclei. Thus, the existence of few-neutron resonances will have an important impact on neutron-rich nuclei. In this talk, I describe the historical situation up until now before turning to our recent quantum Monte Carlo calculations of few-neutron systems confined in external potentials based on local chiral interactions at next-to-next-to-leading order in chiral effective field theory. These systems are calculated in different external Woods-Saxon potentials and we assume that their extrapolation to zero external-potential depth provides a quantitative estimate of three- and four-neutron resonances. The validity of this assumption is demonstrated by benchmarking with an exact diagonalization in the two-body case. We find that the extrapolated trineutron resonance is lower than the tetraneutron resonance energy. This suggests that a three-neutron resonance exists below a four-neutron resonance in nature and is potentially measurable. We confirm that the relative ordering of the resonances is not an artifact of the external confinement, by demonstrating that the odd-even staggering in the helium isotopic chain is reproduced within this approach.

* This work is supported by the ERC Grant No. 307986 STRONGINT.

HK 38: Hadron Structure and Spectroscopy V

Zeit: Donnerstag 14:00–16:15 Raum: F 5

Gruppenbericht HK 38.1 Do 14:00 F 5

Recent results of polarization observables in π^0- and η-photoproduction off the proton — •Farah Afzal for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

A comparison of experimentally observed excited nucleon states to phenomenological quark model predictions or lattice QCD calculations reveal large differences, especially concerning the number of excited states. An important tool to probe the nucleon excitation spectrum is the study of meson photoproduction reactions. In order to extract the contributing resonances from the experimental data partial wave analyses need to be performed. For an unambiguous solution the measurement of single and double polarization observables is essential. Several experimental facilities have dedicated programs to measure polarization observables in different photoproduction reactions using a polarized photon beam and a polarized target, e.g. the CBELSA/TAPS experiment located at the electron stretcher accelerator ELSA in Bonn or the Crystal Ball experiment located at the accelerator facility MAMI in Mainz.

This talk will present recent results concerning the polarization observables Σ and E in the $\gamma p \to p\pi^0$ and $\gamma p \to p\eta$ reactions measured at the CBELSA/TAPS and the Crystal Ball experiment and their impact on the nucleon excitation spectrum. This work is supported by the Deutsche Forschungsgemeinschaft (SFB/TR16 and SFB1044) and Schweizerischer Nationalfonds.

HK 38.2 Do 14:30 F 5

Measurement of the double polarization observable G in the reactions $\gamma p \to p\pi^0/n\pi^+$ — •Karsten Spieker for the A2-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The nucleon excitation spectrum consists of many overlapping resonances. To obtain information about the contributing resonances, several well chosen single and double polarization observables have to be measured for different final states. These observables are providing the necessary data base for a unique Partial Wave Analyses (PWA) to identify the resonances and determine their properties.

The new polarization observable data reported in this talk were measured with the Crystal Ball experiment at MAMI in Mainz, using polarized photons and polarized nucleons. The setup covers nearly 4π of the solid angle and has a high detection efficiency for neutral and charged final states. The preliminary results of the double polarization observable G in the reactions $\gamma p \to p\pi^0$ and $\gamma p \to n\pi^+$ are presented. They have been determined in an energy range E_γ = 266–860 MeV, using a linearly polarized photon beam in combination with a longitudinally polarized butanol target.

Supported by the Deutsche Forschungsgemeinschaft (SFB1044, SFB/TR16) and Schweizerischer Nationalfonds.

HK 38.3 Do 14:45 F 5

Measurement of $\pi^0\pi^\pm$ Photoproduction off the Deuteron with the A2 Experiment — •Sebastian Lutterer for the A2-Collaboration — Departement Physik, Universität Basel

Photoproduction of pion pairs off (quasi-) free nucleons is important to investigate the excitation spectrum of the nucleon for low energy QCD, in particular for excited states which decay predominantly via intermediate excited states to the ground state. Quasi-free production of such pairs off heavier nuclei also figures prominently in the study of the in-medium properties of nucleon resonances. Double meson production channels make the largest contribution to the second resonance bump of the nucleon which disappears for photoproduction off nucleons bound in nuclei. The special interest in the mixed charged channels $\pi^0\pi^\pm$ is related to the contribution of the ρ-meson. This decay is forbidden for the $\pi^0\pi^0$ final state due to isospin conservation. The coupling to a ρ could induce substantial in-medium effects when the ρ spectral function itself is modified in the medium. In the present work production of $\pi^0\pi^\pm$ pairs off liquid deuterium is analysed using data taken at MAMI with the A2 experiment as a starting point for a detailed investigation of this channel for nuclear targets. Data for a ^{4}He target have also already been taken.

HK 38.4 Do 15:00 F 5

Photoproduction of $\pi^0\pi^+$ Pairs off the free Proton — •Samuel Abt for the A2-Collaboration — Departement Physik, Universität Basel

Photoproduction of mesons has been intensively studied during the last decade in view of the nucleon resonance spectrum. Beside single meson production reactions, final states with meson pairs have gained a lot of interest. For free nucleons, such final states can be used to study sequential decays of nucleon resonances via intermediate excited states and determine their branching ratios. Especially for channels with $\pi^+\pi^0$ and $\pi^+\pi^-$ pairs, also resonance decays by emission of the ρ- meson can be studied. The presented work investigates in detail the total cross section, invariant mass distributions, and angular distributions of the $\gamma p \to \pi^0\pi^+ n$ reaction up to incident photon energies of 1.5 GeV. The experiment was carried out at the tagged photon beam of the Mainz MAMI accelerator. The bremsstrahlung photon beam was impinging on a liquid hydrogen target and the pions and the recoil neutron were detected with the combined electromagnetic calorimeters Crystal Ball and TAPS detectors. The most striking finding is a strong contribution of the $D_{13}\,(1520) \to N\rho$ branch (comparably large as $D_{13}\,(1520) \to \Delta\pi$). The data will provide a precise branching ratio for this reaction. Preliminary results will be discussed.

HK 38.5 Do 15:15 F 5

Studies on η production in pd fusion to ^{3}Heη with WASA-at-COSY* — •Nils Hüsken, Florian Bergmann, Kay Demmich, and Alfons Khoukaz for the WASA-at-COSY-Collaboration — Westfälische Wilhelms-Universität Münster, Münster, Germany

The production of η mesons in proton-deuteron fusion to ^{3}Heη has been studied for a long time. As the attractive s-wave ηN potential causes a strong final state interaction between the ^{3}He-nucleus and the η-meson, the near threshold region has received considerable attention already and is still subject to active research. Away from threshold, the available database is more sparse with detailed comparisons being hindered by systematics between the different experiments. Various theoretical models have tried to describe both the total as well as the differential cross section observed by different experiments, with none of them being regarded as the generally accepted model for η production away from threshold. Our new measurement performed with the WASA-at-COSY experiment covers 15 excess energies in the region between $Q \approx 13$ MeV and $Q \approx 81$ MeV, allowing a detailed study of the development of differential distributions with rising excess energy with minimal systematics, therefore acting as a valuable benchmark to existing and future theoretical models. The current status of the ongoing analysis will be presented along with future possibilities the dataset presents.
*Supported by FFE program of the Forschungszentrum Jülich, the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n 283286 and the Deutsche Forschungsgemeinschaft (DFG) through the Research Training Group GRK2149.

HK 38.6 Do 15:30 F 5

Determination of the η'-nucleus potential at low momenta* — Mariana Nanova and •Volker Metag for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The real part of the η'-nucleus potential has been determined at low momenta by analyzing the η' kinetic energy distribution and the excitation function in photoproduction of of η' mesons off C in coincidence with forward going protons. The forward going protons take over most of the momentum of the incoming photon beam and thus allow a study of the η'-nucleus interaction at very low energies. This experimental approach was previously used in the determination of the ω -nucleus potential at low momenta [1]. The present measurement extends earlier determinations of the η' -nucleus potential at higher average momenta [2,3] towards the production threshold. A comparison of the data with calculations by E. Paryev [4] indicates that also at low momenta deep η' - nucleus potentials of ≥ 100 MeV, predicted in [5], can be excluded, in agreeement with [6].

[1] S. Friedrich et al., *Phys. Lett. B* **87** (2013) 045201
[2] M. Nanova et al., *Phys. Lett. B* **727** (2013) 417
[3] M. Nanova et al., *Phys. Rev. C* **94** (2016) 025205
[4] E. Paryev, *J. Phys. G* **43** (2016) 015106
[5] H. Nagahiro et al., *Phys. Rev. C* **74** (2006) 045203
[6] Y. Tanaka et al., *Phys. Rev. Lett.* **117** (2016) 202501
*Supported by DFG through SFB/TR16.

HK 38.7 Do 15:45 F 5

Determination of the 3 π^0 photoproduction cross-section for $E_\gamma \in [1.42, 1.58]$ GeV — •Martin Wolfes and Wolfgang Gradl for the A2-Collaboration — Institut für Kernphysik, JGU Mainz, Germany

The A2 Collaboration uses an electron beam provided by the MAMI accelerator in Mainz to produce an energy tagged photon beam. Photon induced reactions are studied with the Crystal Ball/TAPS 4π calorimeter, which is optimized for neutral final states. Identification of charged particles is accomplished by an inner detector system.

In the course of the year 2014 this experimental setup was used to gather a large data sample of photon-proton reactions. Eg. the production of π^0, ω, η or η' mesons. This presentation will show the status of the ongoing analysis to determine cross-sections for triple π^0 production. We will show how to get a precise value for the luminosity and how to identify the main background channels, namely the kinematically identical process of the η decaying to three π^0 and the reaction $\gamma p \ \to \Sigma^+ \ k^0$ with the k^0 decaying to two neutral pions.

HK 38.8 Do 16:00 F 5

Photoproduction of neutral pion pairs and triplets of deuteron — •Michael Sven Günther for the A2-Collaboration — Departement Physik, Universität Basel, Basel, Schweiz

Photoproduction of multiple-meson final states is an efficient tool for the study of sequential decays of nucleon resonances, i.e. decays involving intermediate excited states. When pions are involved in the decay the isospin degree of freedom is important. Apart from quasi-free production reactions off neutrons bound in light nuclei, such as the deuteron, coherent production mechanisms off light nuclei may serve as an isospin filter. So far, such reactions have almost not been explored due to the small production cross sections and the background from quasi-free processes. Here we summarize preliminary results for the coherent photoproduction of Pi0 pairs and Pi0 triples off deuterium nuclei. Coherent photoproduction of Pi0 pairs has gained a lot of interest because this is a possible production channel for the much discussed d*(2380) di-baryon resonance. Coherent photoproduction of Pi0 triples offers an elegant way to study three-pion production processes in an energy range where in free and quasi-free processes this final state is completely dominated by the 3-Pi0 decay of the eta meson. The experiments were done at the tagged photon beam of the Mainz MAMI accelerator using a liquid deuterium target and the combined Crystal Ball/TAPS electromagnetic calorimeter.

HK 39: Heavy Ion Collisions and QCD Phases VIII

Zeit: Donnerstag 14:00–16:15 Raum: F 1

Gruppenbericht HK 39.1 Do 14:00 F 1

Recent ALICE measurements on open heavy-flavour hadron production in pp, p–Pb, and Pb–Pb collisions at the LHC — •Andrea Dubla for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Physikalisches Institut, University of Heidelberg, Heidelberg, Germany

In heavy-ion collisions at ultra-relativistic energies a de-confined state of quarks and gluons, the Quark-Gluon Plasma (QGP), is expected to be formed. Produced in hard-scattering processes in the initial stage of the collision, heavy quarks are a powerful tool to probe the partonic interactions ongoing in the medium. The analysis of the transverse momentum spectra and of the azimuthal anisotropy of heavy-flavour particles in Pb–Pb collisions provides crucial information on the mechanisms of parton energy loss, hadronisation and thermalization in the hot and dense state of matter. Heavy-flavour measurements in pp collisions provide a baseline for the results from Pb–Pb data, and an important test of perturbative QCD. In heavy-ion collisions, the nuclear nature of the incoming projectiles also give rise to cold nuclear matter effects such as modification of parton densities in nuclei, momentum broadening and shadowing. These effects have to be disentangled from those due to the hot QGP phase. This can be studied with p–Pb collisions. The most recent results obtained in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV and 5.02 TeV will be discussed, together with the results measured in smaller collision systems.

HK 39.2 Do 14:30 F 1

Charm quark diffusion coefficients in the quark-gluon plasma — •Johannes Misch, Moritz Greif, Hendrik van Hees, and Carsten Greiner — Institut fuer Theoretische Physik/ITP, Johann Wolfgang Goethe-Universitaet, Frankfurt am Main

The diffusion of heavy quarks, e.g., charm quarks in a thermal medium can be described by the Fokker-Planck equation. Heavy quarks are important probes of the quark-gluon plasma, and the understanding of their diffusion properties is necessary to explain experimental data. We use the BAMPS (Boltzmann Approach to Multi-Parton Scatterings) simulation framework to determine the drag and diffusion constants. BAMPS uses pQCD matrix elements for binary and inelastic scattering. We study the dependence of the charm quark diffusion on multiple scales of the system, such as charm mass, temperature and ingoing charm momentum.

HK 39.3 Do 14:45 F 1

Measurement of the production cross-section of electrons from heavy-flavour hadron decays in pp collisions at $\sqrt{s}$ = 2.76 TeV with ALICE — •Sebastian Hornung for the ALICE-Collaboration — GSI, Darmstadt, Germany — Heidelberg University, Germany

Measurements of heavy-flavour hadrons produced in proton-proton collisions are important to test perturbative Quantum ChromoDynamics and as a reference for measurements in heavy-ion collisions. Electrons from semileptonic decay of heavy-flavour hadrons are obtained subtracting the background from non-heavy-flavour sources from the inclusive electron spectra. Traditionally, this is done with the so-called cocktail-subtraction method based on a Monte Carlo simulation of electrons from various sources. This approach is affected by large systematic uncertainties, especially at low transverse momenta, where the main source of background are photon conversions and Dalitz decays of light neutral mesons. A data-driven method to subtract these electrons was developed in the last years, which turned out to be less affected by systematic uncertainties. Background electrons are reconstructed by pairing electrons (positrons) with tracks identified as positron (electron). The electron candidates belonging to low mass pairs are subtracted from the inclusive electron yield. The production cross-section of electrons from heavy-flavour hadron decays was measured in pp collisions at $\sqrt{s}$ = 2.76 TeV applying the pair-finding method. With the resulting cross-section the precision of the measurement of the nuclear modification factor at low transverse momenta was improved.

HK 39.4 Do 15:00 F 1

NLO + Parton Shower Calculation of Heavy Flavour Electrons with Nuclear PDFs — •Florian Herrmann — Westfälische Wilhelms-Universität, Münster, Germany

Heavy flavour (beauty and charm) quarks are of special interest for the study of the Quark-Gluon Plasma as they are predominantly produced in the initial hard-scattering process and participate in the entire evolution of the system created in heavy-ion collisions. Thus, heavy flavours are an excellent probe to study in-medium energy loss (mechanisms) in nuclear collisions by calculating the nuclear modification factor R_{AA} or the azimuthal anisotropy and especially the elliptic flow v_2 of heavy-flavour particles. Experimentally, heavy flavours are often investigated using measurements of electrons from heavy-flavour hadron decays. These electrons can be separated statistically from the background originating from light flavours and gluons and provide insight into the colour charge and mass dependence of parton energy loss. We present the relative contribution of electrons from beauty hadron decays to the yield of electrons from heavy-flavour hadron decays estimated with Monte Carlo simulations based on POWHEG. The calculations are performed for p–p and Pb–Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. Nuclear effects are taken into account using the nuclear parton distribution functions EPS09 and nCTEQ15. These calculations serve as an essential ingredient to separate the contributions of charm and beauty quarks in the measurements of the p_T-differential invariant cross section and elliptic flow of electrons from heavy-flavour hadron decays. – Supported by DFG GRK2149

HK 39.5 Do 15:15 F 1

Prospects for extended heavy flavour investigations in ALICE using new vertexing methods — •Lukas Layer for the ALICE-Collaboration — University Heidelberg — GSI Darmstadt

A Large Ion Collider Experiment (ALICE) is a dedicated heavy-ion experiment at the LHC that focuses on the study of the hot and dense strongly interacting medium created in Pb-Pb collisions, the so-called Quark-Gluon Plasma (QGP). Heavy quarks (charm and beauty), that are only produced in the initial hard scattering processes, constitute an important way to probe features of the QGP. Due to the typically short decay length for charmed hadrons ($c_\tau \approx 150\mu m$) and beauty hadrons ($c_\tau \approx 500\mu m$) powerful vertexing algorithms are needed in order to reach the precision required to measure these decays and to distinguish the contributions from charm and beauty. For this a new vertexing package "KFParticle", that is based on Kalman Filter mathematics, is tested and the prospects for new heavy flavour measurements are investigated.

HK 39.6 Do 15:30 F 1

J/ψ measurements pp collisions at 13 TeV using EMCal-triggered events with ALICE at LHC — •Cristiane Jahnke for the ALICE-Collaboration — Excellence Cluster *Universe*, Garching, Germany

The study of the J/ψ production in pp collisions provides important information on perturbative and non-perturbative quantum chromodynamics. The production of the heavy-quark pairs can be described perturbatively while its hadronisation into quarkonium state is a non-perturbative process. These processes are not fully understood and additional experimental data are necessary to further constraints the theoretical production models. In this work we report studies of J/ψ production in pp collisions at a centre-of-mass energy of $\sqrt{s}$ = 13 TeV with ALICE. The J/ψ were reconstructed via their dielectron decay channel in events where at least one of the decay electrons was triggered on by the Electromagnetic Calorimeter (EMCal). The availability of a high-p_{T} electron trigger enhanced the sampled luminosity significantly relative to the available minimum bias triggered data set and extended the p_{T} reach for the J/ψ measurement. Additionally, the usage of EMCal for particle identification in high p_{T} ranges provides a very good electron/hadron separation. Using this data, the J/ψ was measured in the transverse momentum interval of $5 < p_{\mathrm{T}} < 20$ GeV/c.

This work is supported by BMBF and the Excellence Cluster Universe.

HK 39.7 Do 15:45 F 1

Charmonium production in heavy-ion collisions at LHC energies with the statistical hadronisation model — Anton Andronic[1], Peter Braun-Munzinger[1], •Markus K. Köhler[2], and Johanna Stachel[2] — [1]Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany

Charmonia are an important tool to investigate the fundamental properties of the early phases of a heavy-ion collision (HIC). Due to their high mass, charm quarks are not produced thermally, but only in initial hard scatterings. Matsui and Satz [1] showed, if a deconfined medium is formed, a Debye-like colour screening prevents the formation of J/ψ and a suppression with respect to the expectation from binary collision scaling should be observed. It was predicted within the statistical hadronisation model [2] that, since the charm cross section increases significantly as a function of collision energy, an enhanced charmonium production is expected for LHC energies in comparison to lower energies.

In this contribution, we compare the production of J/ψ calculated within the statistical hadronisation model with available J/ψ yields measured at the LHC. The centrality as well as the rapidity dependence will be investigated.

[1] T. Matsui and H. Satz, Phys. Lett. B 178 (1986) 178
[2] P. Braun-Munzinger and J. Stachel, Phys. Lett. B 490 (2000) 196

HK 39.8 Do 16:00 F 1

Measurement of the J/ψ elliptic flow at mid-rapidity in

Pb−Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV. — •Pascal Dillenseger for the ALICE-Collaboration — Goethe Universität

J/ψ measurements at $\sqrt{s_{NN}} = 2.76$ TeV Pb−Pb collisions clearly show a smaller suppression than the one expected from color screening, when compared to binary-scaled pp collisions. An answer to this behavior is presented by models containing a regeneration component. In these models a possible (re)combination of (un)correlated $c\bar{c}$-quarks enhances the J/ψ production. Since those $c\bar{c}$-quarks interact with the bulk medium before forming a J/ψ, they should be coupled to the medium flow. Hence the measurement of the elliptic flow (v_2) for J/ψ imposes strong constraints on the J/ψ production models in high energy Pb−Pb collisions.
The ALICE experiment at the Large Hadron Collider (LHC) is a unique tool to study J/ψ. It is able to measure the J/$\psi \to e^+e^-$ decay channel at mid-rapidity ($|y| < 0.9$) and down to $p_T = 0$. New preliminary results on the v_2 of J/ψ measured in the e^+e^- decay channel with ALICE in Pb−Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV will be presented.

HK 40: Heavy Ion Collisions and QCD Phases IX

Zeit: Donnerstag 14:00–16:15 Raum: F 3

HK 40.1 Do 14:00 F 3

Dielectron Production in Pb–Pb Collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE — •Carsten Klein for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Electron-positron pairs (dielectron) are an excellent experimental probe to investigate the properties of the quark-gluon plasma which is formed during ultrarelativistic heavy-ion collions. Because they do not interact strongly their spectra reflect the entire space-time-evolution of the collision. The created medium can lead to a modification of the dielectron production with respect to the vacuum rate.
In the ALICE apparatus at the LHC electrons and positrons are identified by their specific energy loss in the Inner Tracking System (ITS) and in the Time Projection Chamber (TPC) combined with the time-of-flight information from TOF.
In this contribution, we give a status report on the recent dielectron measurements in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV in the central barrel of ALICE. For the first time, we show invariant mass and pair transverse momentum spectra for this collision system at this energy.
Supported by BMBF and the Helmholtz Association.

HK 40.2 Do 14:15 F 3

Separating prompt and non-prompt contributions in the dielectron mass spectrum in pp collisions at $\sqrt{s}$ = 7 TeV with ALICE — •Sebastian Scheid for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

Dileptons are a prime probe of the deconfined state of strongly interacting matter, the Quark Gluon Plasma (QGP), produced in high energy heavy ion collisions, as they are not affected by secondary hard interactions. A measurement of the thermal radiation from the QGP in the dielectron intermediate mass region allows to estimate the medium temperature. In this region the main component of the dielectron continuum is due to correlated semi-leptonic decays of B- and D-mesons. The proper decay length for B-mesons is $c\tau \approx 500\ \mu m$ and for D-mesons it is 100-300 μm, hence the reconstructed decay electrons do not point to the primary vertex of the collision.

Combining the measured distance of closest approach (DCA) of each single electron into a pair variable DCA_{ee} gives the possibility to separate prompt and non-prompt dielectron pairs.

The analysis in pp collisions allows to study the feasability of extracting the heavy-quark production with the current Inner Tracking System detector of ALICE and provides a reference for Pb–Pb collisions. In this talk, preliminary results on the DCA_{ee} spectra in pp collisions at $\sqrt{s} = 7$ TeV will be shown and compared to reference distributions from MC simulations.

HK 40.3 Do 14:30 F 3

Low mass dielectrons from Au+Au Collisions at 1.23A GeV with HADES — •Patrick Sellheim — Goethe-Universität Frankfurt

Dielectrons are well suited to access the hot and dense stage of heavy-ion collisions and to identify hadron modifications induced by the medium. In the past years, various experiments measured dileptons and observed in the low mass region an excess over the so-called hadronic cocktail. In continuation of these studies, HADES measured e^+e^- production in Au+Au collisions at 1.23A GeV.

In this contribution, the reconstructed e^+e^- pair spectra will be presented. The multi-differential analysis allows to extract properties of strongly interacting matter at low collision energies. Moreover, the reconstructed pair spectra will be compared to microscopic transport model calculations, but also to the coarse-graining approaches.

This work has been supported by BMBF (05P15RFFCA), GSI, HIC for FAIR, HGS-HIRe and H-QM.

HK 40.4 Do 14:45 F 3

In-Medium Spectral Functions of Vector- and Axial-Vector Mesons from the Functional Renormalization Group — •Christopher Jung[1,2], Fabian Rennecke[1,3], Ralf-Arno Tripolt[4], Lorenz von Smekal[1], and Jochen Wambach[2,4] — [1]Justus-Liebig-Universitaet Giessen, Germany — [2]TU Darmstadt, Germany — [3]Ruprecht-Karls-Universitaet Heidelberg, Germany — [4]ECT*, Italy

We present first results on vector and axial-vector meson spectral functions as obtained by applying the non-perturbative functional renormalization group approach to an effective low- energy theory motivated by the gauged linear sigma model. By using a recently proposed analytic continuation method, we study the in-medium behavior of the spectral functions of the ρ and a_1 mesons in different regimes of the phase diagram. In particular, we demonstrate explicitly how these spectral functions degenerate at high temperatures as well as at large chemical potentials, as a consequence of the restoration of chiral symmetry. (arXiv:1610.08754)

HK 40.5 Do 15:00 F 3

Thermal dilepton emission as a fireball probe — •Florian Seck[1], Tetyana Galatyuk[1,2], Ralf Rapp[3], and Joachim Stroth[4,2] — [1]TU Darmstadt — [2]GSI, Darmstadt — [3]Texas A&M Univ., College Station, USA — [4]Goethe-Universiät Frankfurt

Collisions of heavy ions at (ultra-)relativistic energies offer the opportunity to explore strongly interacting matter across the QCD phase diagram. Electromagnetic probes are an excellent tool for these investigations as they are emitted during the whole evolution of the collision and decouple from the interaction zone once they are produced. They carry information about the properties of matter created inside the hot and dense fireball to the detector which is irretrievable from the spectra of final-state hadrons due to rescattering. In particular, the yield of thermal low-mass dileptons is sensitive to the fireball lifetime, while the slope in the intermediate-mass region of the dilepton invariant-mass spectrum can serve as a true thermometer of the medium.

Realistic thermal dilepton emission rates and a coarse-graining method for the fireball's space-time evolution are utilized to properly describe the contribution of in-medium signals to the dilepton invariant-mass spectrum. The obtained results will be compared to the excitation function of the lifetime and temperatures of the fireball established at higher energies. The results can serve as a baseline for future explorations by the HADES and CBM experiments at FAIR as well as the RHIC beam energy scan phase II.

This work has been supported by: VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 40.6 Do 15:15 F 3

Machine learning for the analysis of low-mass dielectrons on Run II data with ALICE — •Alex Chauvin for the ALICE-Collaboration — Excellence Cluster, Garching, Germany

Dielectron pairs are an experimental tool to investigate the Quark Gluon Plasma (QGP), which is expected to be created during ultra-relativistic heavy-ion collision. The measured electron-positron pairs are created at different stages of the evolution of the hot and dense medium and do not interact strongly with the latter. Hence, dielectron pairs can carry information to describe the space-time evolution of the system, thereby allowing us to investigate the predicted restoration of chiral symmetry.

However, photon conversions contribute largely to the background of the dielectron signal we are after. Whereas dielectron pairs at very low mass (< 100MeV) are created, photon conversion rejection leads to systematic uncertainty in the crucial mass range used for normalisation and extraction of virtual photons. The Toolkit for Multi-Variable Analysis allows us to consider several variables with different classification methods, such as Boosted Decision Trees, while obtaining a higher signal efficiency.

In this talk we will present the advantages of using machine learning for background rejection and how this method preserves signal efficiency. To illustrate it, we will further apply the method on the Run II data recorded by the ALICE experiment.

This work is supported by BMBF-FSP 202 and the Excellence Cluster Universe.

HK 40.7 Do 15:30 F 3

Neutral meson and direct photon measurements using conversions in proton-proton collisions at $\sqrt{s} = 7$ TeV in ALICE
— Nicolas Schmidt and •Lucas Altenkämper for the ALICE-Collaboration — Physikalisches Institut, Heidelberg University

The ALICE detector is dedicated to study the properties of the Quark-Gluon-Plasma, which is created in Pb-Pb collisions at high energies. The spectra in pp collisions are used to obtain a baseline of hadron production for heavy-ion collisions and can provide additional information to understand pQCD predictions at LHC energies. This work focuses on the measurement of neutral mesons via their two photon decay channel as well as the direct photon measurement using conversions in the detector material. For this, the ALICE Inner Tracking System (ITS) and the Time Projection Chamber (TPC) are mainly used. The status of the analysis in pp collisions at $\sqrt{s} = 7$ TeV will be presented. Step by step, the signal extraction and applied efficiency correction will be explained. Final results are discussed and put into context with measurements at other LHC energies.

HK 40.8 Do 15:45 F 3

Photon Production in a Hadronic Transport Approach
— •Anna Schäfer[1,2], Niklas Ehlert[2], Juan M. Torres-Rincon[1], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced Studies, D-60438 Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Goethe-Universität, D-60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany

Photons play an important role in the investigation and understanding of the QGP. Unlike hadrons, which are likely to interact with the medium before detection, photons only interact electromagnetically, their mean free path is much larger than the size of the system. They are direct probes of the observed medium and offer unique insights into the fireball and the hadronic phase. Additionally, measurements at RHIC and LHC show unexpectedly large momentum anisotropies for photons presumably produced in the hadronic phase of heavy ion collisions. Further investigation of photons in a strongly-interacting medium is hence necessary to solve the *direct photon flow puzzle*.
To improve the theoretical understanding of photons at low energies in heavy ion reactions, scattering processes involving photons have been implemented into a hadronic transport approach (SMASH), which simulates hot and dense strongly-interacting nuclear matter. Comparisons of the obtained thermal rates in infinite matter calculations to the ones used in hydrodynamic calculations will be shown. The plan for the future is to apply this hadronic transport approach within a hybrid approach to RHIC/LHC energies.

HK 40.9 Do 16:00 F 3

Direct Photon Simulations with POWHEG BOX
— •Hendrik Poppenborg — Institut für Kernphysik, Münster

Direct photons provide particular insight into nuclear collisions. Since they give immediate access to the energy scale of a hard scattering, direct photons allow further constraints of (nuclear) parton distribution functions, especially on the poorly known distribution of initial state gluons.

We present the POWHEG BOX implementation of the dominant direct photon production processes $qg \to q\gamma$ and $q\bar{q} \to g\gamma$ at Next-to-Leading Order, interfaced with the PYTHIA8 parton shower. We aim for a robust description of direct photons and investigate therefore various simulation parameters of both the hard scattering kernel and the shower Monte Carlo. We present comparisons to direct/isolated photon measurements from ATLAS, CMS and ALICE and evaluate the improvement with respect to the PYTHIA8 standalone description. In preparation of the differential direct photons measurements to come, we will in addition provide a study about gamma-hadron and gamma-jet correlations including isolation criteria.

This work has been supported by the DFG (GRK 2149).

HK 41: Structure and Dynamics of Nuclei VI

Zeit: Donnerstag 14:00–16:15 Raum: F 2

Gruppenbericht HK 41.1 Do 14:00 F 2

Recent Results From the FRS Ion Catcher
— •Samuel Ayet San Andrés for the FRS Ion Catcher-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Justus Liebig Universität, Gießen, Germany

At the Super-FRS, exotic nuclei far from stability will be produced and separated in-flight at relativistic energies. At the Low-Energy-Branch (LEB) of the Super-FRS, the ions will be slowed down, thermalized in a cryogenic stopping cell (CSC), extracted and transferred to the experiments MATS and LASPEC where high precision mass measurement of short-lived nuclei and laser spectroscopy will be performed.

The prototype of the CSC and a multiple-reflection time-of-flight mass spectrometer have been developed and commissioned recently as part of the FRS Ion Catcher experiment with fragments of ^{238}U and ^{124}Xe beams. The masses of more than 30 nuclides have been measured with accuracies down to the low 10^{-7} level, 7 of them directly measured for the first time. More than 15 isomers were observed with excitation energies down to few hundreds of keV. An overview of the latest developments, results and an outlook on the near future of the FRS Ion Catcher will be given.

HK 41.2 Do 14:30 F 2

Recent technical developments and mass measurements above the potentially doubly-magic nuclide ^{78}Ni at ISOLTRAP
— •Andree Welker[1] and ISOLTRAP Kollaboration[2] — [1]TU-Dresden, Dresden, Deutschland — [2]CERN, TU-Dresden, MPIK Heidelberg, Universität Greifswald,

ISOLTRAP [1] mass measurements of neutron rich copper isotopes are presented. ^{79}Cu could be addressed by the first time using a Multi-Reflection Time-of-Flight Mass Spectrometer (MR-ToF MS) [2]. With only one proton above the Z = 28 core, the binding energies of the copper isotopes are sensitive to the evolution of nuclear shell structure close to the doubly-magic ^{78}Ni isotope. Preliminary results in combination with a shell-model theory will be shown. To reach even more exotic nuclides and to improve ISOLTRAP's mass precision limit, a position-sensitive ion detector was installed upstream the precision Penning-trap. It will allow the application of the Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) detection method developed at SHIPTRAP/GSI [3]. This new method offers compared to the presently used Time-Of-Flight Ion-Cyclotron-Resonance detection technique higher precision and resolution in shorter measurement time, and thus the ability to resolve low-lying isomers. The current status, first measurements, and an outlook on the implementation of the PI-ICR technique at ISOLTRAP will be presented. [1] S. Kreim et al. Nucl. Instrum. Methods B 317, 492-500 (2013). [2] R.N. Wolf et al. Int. J. Mass Spectrom. 349-350, 123-133 (2013). [3] S. Eliseev et al. Appl. Phys. B 114, 107-128 (2014).

HK 41.3 Do 14:45 F 2

Measurements of isomers at the FRS Ion Catcher
— •Christine Hornung for the FRS Ion Catcher-Collaboration — Justus-Liebig Universität Gießen, Germany

Projectile fragmentation and fission reactions at in-flight facilities are important production mechanisms to access short-lived exotic nuclei. It is a challenge to describe the angular momentum distribution after the collision of relativistic nuclei. This can be experimentally accessed by measuring the population of isomeric states.

The relative population of the isomer and ground states and excitation energies of short-lived exotic nuclei can be determined via high resolution mass spectrometry at the FRS Ion Catcher at GSI. Here, projectile and fission fragments are produced at relativistic energies and separated in-flight. Ions are transported to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), where masses of the ground and isomeric states can be measured in a broad mass range simultaneously. This method gives access to long-lived isomers ($\geq$1 ms) directly ideally complementing gamma-ray spectroscopy. The MR-TOF-MS can also be used to spatially separate the ions in order to provide isomerically clean ion beams.

Results of isomeric ratios and excitation energies of uranium projectile and fission fragments measured with the MR-TOF-MS with a mass resolving power in excess of 400,000 will be presented. Furthermore ratios and excitation energies of isomers of xenon fragments were measured during a recent experiment.

HK 41.4 Do 15:00 F 2

High-resolution laser spectroscopy on neutron-rich nickel isotopes — •Simon Kaufmann for the COLLAPS-IS568-Collaboration — Institut für Kernphysik, TU Darmstadt, D-64289 Darmstadt, Germany

Laser spectroscopy of nickel isotopes was so far only performed for the stable isotopes ^{58,60,61,62,64}Ni. Studies of the nuclear charge radii and nuclear moments in the neighboring isotopic chains of Cu (Z=29) and Ga (Z=31) showed a weak effect of a possible $N = 40$ sub-shell closure in copper but nothing convincing in the Ga isotopes [1, 2]. The aim of this experiment was to complement the picture by studying the neutron-rich Ni isotopes with the magic proton number $Z = 28$ in order to understand the Z dependency of this behavior. The experiment on the isotopes $^{58-68,70}$Ni was carried out at the collinear laser spectroscopy (CLS) beamline COLLAPS at ISOLDE/CERN probing the $3d^9 4s\,^3\mathrm{D}_3 \rightarrow 3d^9 4p\,^3\mathrm{P}_2$ transition at 352.454 nm in atomic Ni. We used a bunched beam structure with bunch lenghts in the order of some μs produced by the radio frequency quadrupole cooler and buncher ISCOOL. During this measurement campaign a new time-resolved data acquisition system was successfully tested in parallel to the conventional data acquisition system. The time-resolved measurement allowed us to detect irregularities within the energy structure of the ion bunches and minimize those effects by optimizing ISCOOL.

[1] T. J. Procter et al., Phys. Rev. C 6, 034329 (2012)
[2] M. L. Bissell et al., Phys. Rev. C 93, 064318 (2016)

HK 41.5 Do 15:15 F 2

Nuclear charge radii and quadrupole moments of neutron-rich tin isotopes — •Christian Gorges for the COLLAPS-IS573-Collaboration — Institut für Kernphysik, TU Darmstadt, D-64289 Darmstadt, Germany

The tin isotopes have a magic proton number (Z=50) and the most stable isotopes of all elements. Therefore tin has always been a key element in the understanding of nuclear theory. Laser spectroscopy measurements have been performed previously with low resolution up to the doubly magic nucleus ^{132}Sn [1]. To extract magnetic dipole and electric quadrupole moments, these measurements have now been repeated using high-resolution laser spectroscopy at the COLLAPS beam line at ISOLDE, CERN. Furthermore, isomers along the chain from $^{113m-131m}$Sn have been investigated and the data is extended up to ^{134}Sn allowing the investigation of the strength of the characteristic kink at $N = 82$. In the elements above tin a clear change in the slope is observed in the mean square charge radius when crossing the magic neutron number $N = 82$. It is, however, weaker for tellurium ($Z = 52$) than in xenon ($Z = 54$). Hartree-Fock-Bogoliubov calculations have recently been performed confirming this behaviour and predicting such a kink in the nuclear charge radii also for the tin isotopes [1,2]. The nuclear charge radii as well as the isomer shifts will be presented.

[1] F. Le Blanc et al., Phys Rev C **72**, 034305 (2005)
[2] N. Schunck et al., Comput. Phys. Commun. **183**, 166 (2012)
[3] M. Kortelainen et al., Phys. Rev. C **85**, 024304 (2012)

HK 41.6 Do 15:30 F 2

Lifetime measurement of the internal conversion decay channel of ^{229m}Th — •Benedict Seiferle, Lars v.d. Wense, and Peter G. Thirolf — Ludwig-Maximilians-Universität München, Am Coulombwall 1, 85748 Garching b. München, Germany

Among all so far known excited nuclear states, the first isomeric state of ^{229}Th exhibits the lowest excitation energy, which has been reported to be 7.8±0.5 eV. This energy range is accessible with today's laser technology and could allow for a direct nuclear laser excitation. However, at present, the knowledge of the spectroscopic properties of the isomer are not sufficient to allow for the latter. The isomer decays to its ground-state via three decay channels: (i) internal conversion (IC), (ii) γ emission and (iii) bound internal conversion (BIC). The strength of the decay channels and thus the lifetime of the isomer depends strongly on its charge state. For neutral ^{229m}Th the dominant decay channel is IC. In this talk, lifetime measurements of the internal conversion decay channel are presented. A half-life of 7±1 μs has been measured for neutral ^{229m}Th which is well in agreement with theoretical predictions.

This work was supported by DFG grant (Th956/3-1) and by the EU Horizon 2020 grant agreement No. 664732 "nuClock".

HK 41.7 Do 15:45 F 2

A new nuclear laser excitation scheme for $^{229\mathrm{m}}$Th — •Lars von der Wense[1], Benedict Seiferle[1], Adriana Pálffy[2], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität München, 85748 Garching, Germany — [2]Max-Planck-Institut für Kernphysik, 69117 Heidelberg, Germany

The measurement of time has always been an important tool in science and society. $^{229\mathrm{m}}$Th offers the potential for the development of an ultra-precise nuclear clock that may outperform existing atomic clock technology. However, despite 40 years of past research, no direct decay detection of this nuclear state was achieved. Only recently, measurements were performed that have led to the direct detection of the ground-state decay of $^{229\mathrm{m}}$Th [1] and a first characterization of the isomeric decay parameters [2]. Based on this information, a new nuclear laser excitation scheme for $^{229\mathrm{m}}$Th is proposed. This excitation scheme circumvents the general assumed requirement of a better knowledge of the isomeric energy value, thereby paving the way for nuclear laser spectroscopy of $^{229\mathrm{m}}$Th.

[1] L. v.d.Wense et al., Nature 533 (2016) 47-51.
[2] B. Seiferle et al., submitted for publication.

Supported by DFG grant TH956/3-1 and Horizon 2020 research and innovation programme under grant agreement 664732 "nuClock".

HK 41.8 Do 16:00 F 2

Laser-nucleus reactions in coherent gamma-ray fields — Adriana Pálffy[1], •Hans A. Weidenmüller[1], and Paul G. Reinhard[2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg — [2]Universität Erlangen

Doppler backscattering of optical laser photons on a "flying mirror" of relativistic electrons promises to yield coherent photons with MeV-range energies. We compare the nuclear interaction of such a laser pulse with the standard atom-laser interaction. The mean-field description of atoms must be replaced by a rate equation and the classical field strength, far too faint in nuclei, by the dipole transition rate. Significant nuclear excitation occurs for photon numbers much smaller than typical for atoms. That drastically reduces the requirements on the experimental realization of a "flying mirror".

HK 42: Nuclear Astrophysics III

Zeit: Donnerstag 14:00–16:00 Raum: F 33

Gruppenbericht HK 42.1 Do 14:00 F 33

Felsenkeller 5 MV underground ion accelerator: muon, neutron, and γ background and project status — •Daniel Bemmerer[1], Francesca Cavanna[1], Thomas E. Cowan[1,2], Marcel Grieger[1,2], Thomas Hensel[1,2], Arnd R. Junghans[1], Felix Ludwig[1,2], Stefan E. Müller[1], Bernd Rimarzig[1], Stefan Reinicke[1,2], Stefan Schulz[1,2], Ronald Schwengner[1], Klaus Stöckel[1,2], Tamás Szücs[1,3], Marcell P. Takács[1,2], Andreas Wagner[1], Louis Wagner[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]TU

Dresden, Germany — [3]MTA ATOMKI, Debrecen, Hungary

Motivated by the success of the world's only underground ion accelerator, LUNA 0.4 MV in Italy, a project for a higher-energy underground accelerator is underway in Dresden. A 5 MV Pelletron accelerator with double charging chains and provision for intensive $^1H^+$, $^4He^+$, and $^{12}C^+$ beams based on external and internal ion sources is currently being installed in the Felsenkeller underground site in Dresden. Civil construction work in Felsenkeller will be completed in August 2017. The nine Felsenkeller tunnels are shielded from cosmic rays by 45 m rock overburden, attenuating the background in radiation detectors. New data on the muon, neutron, and γ background in Felsenkeller will be shown, and used for a discussion on the feasibility of low-background experiments there. The new accelerator will be open for outside users, and its most important experimental capabilities will be summarized.

HK 42.2 Do 14:30 F 33

Bestimmung des ^{10}Be(n,γ)-Wirkungsquerschnitts — •Daniel Veltum[1], Klaus Eberhardt[2], Stephan Heinitz[3], Arndt Junghans[4], René Reifarth[1], Benedikt Thomas[1], Meiko Volknandt[1], Mario Weigand[1], Norbert Wiehl[2] und Clemens Wolf[1] — [1]Goethe Universität, Frankfurt, Deutschland — [2]Johannes Gutenberg Universität, Mainz, Deutschland — [3]Paul Scherrer Institut, Villigan, Schweiz — [4]Helmholtz Zentrum Dresden-Rossendorf, Deutschland

Zu den grundlegenden Aufgabe der experimentellen nuklearen Astrophysik zählt der Versuch die primordiale und stellare Nukleosynthese besser zu verstehen und die beobachtete solare Häufigkeitsverteilung der Elemente zu erklären. Hierzu ist die Untersuchung von Kernreaktionen unter stellaren Bedingungen unerlässlich. Im September 2016 erfolgte eine Aktivierung von ^{10}Be mit Neutronen am Forschungsreaktor TRIGA in Mainz, um den Neutroneneinfangsquerschnitt genauer zu bestimmen. Mit Hilfe zweier $LaBr_3$ Szintiallationsdetektoren wurde die Aktivität der erzeugten ^{11}Be-Kerne gemessen. Es wurden der thermische und der epithermische Wirkungsquerschnitt von ^{10}Be(n,γ) bestimmt.

HK 42.3 Do 14:45 F 33

Untersuchung der ^{135}I(n,γ) - Reaktion — •Meiko Volknandt[1], René Reifarth[1], Michael Heil[2] und Alexander Koloczek[1] für die R3B-Kollaboration — [1]Goethe Universität, Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Um die beobachtete solare Elementhäufigkeitsverteilung mit theoretischen Modellen rekonstruieren zu können, ist eine genaue Kenntnis der Reaktionsraten der einzelnen Nuklide notwendig.

Für das Verständnis der neutroneninduzierten Nukleosynthese sind Einfangswirkungsquerschnitte von instablien Isotopen unabdinglich.

Der kürzlich postulierte i-Prozess, ein Neutroneneinfangsprozess, der zwischen dem r- und dem s-Prozess angesiedelt ist, ist sehr stark von der ^{135}I(n,γ) - Rate abhängig.

Am R3B-Aufbau ist im Rahmen FAIR Projekts ein Coulomb-Aufbruch-Experiment an ^{136}I geplant. Mit Hilfe der Theorie der virtuellen Photonen kann daraus auf die Reaktion ^{136}I(γ,n) geschlossen werden, was wiederum wertvolle Informationen zur gesuchten, zeitumgekehrten Reaktion ^{135}I(n,γ) liefert.

HK 42.4 Do 15:00 F 33

Screening effects for nuclear reactions of astrophysical interest in laser-generated plasmas — •Yuanbin Wu and Adriana Pálffy — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany

Due to screening effects, nuclear reactions in astrophysical plasmas may behave differently than in the laboratory. At the upcoming ELI-NP facility with 10 PW lasers, an experimental setup where two laser beams generate two colliding plasmas is envisaged [1]. In this experimental setup, a laser pulse interacting on a solid target produces a plasma through the Target Normal Sheath Acceleration scheme, and then this rapidly streaming plasma (ion flow) interacts on a secondary plasma created by the interaction of a second laser pulse on a gas jet target. We model here this scenario and calculate the reaction events for the reaction ^{13}C(^{4}He,n)^{16}O which is one of the main neutron sources for the s-process. We find that, with this experimental setup, it is possible to determine the plasma screening enhancement factor for fusion reactions, by detecting the difference of the reaction events between the two scenarios of ion flow interacting with the plasma target and the gas target. This will provide a tool to explore the nuclear reactions in stellar environments which could strongly contribute to the field of nuclear astrophysics.

[1] M. Roth et al. (eds.), Laser driven nuclear physics at ELI-NP – technical design report, 2015.

HK 42.5 Do 15:15 F 33

Implementation of isomeric states into stellar nucleosynthesis codes — •Deniz Kurtulgil, Kathrin Göbel, René Reifarth, and Benedikt Thomas — Goethe University Frankfurt

The existence of indirect transitions between ground and long-lived isomeric states through thermal excitation into higher lying states was implemented into a stellar nucleosynthesis code.

Gaining information about the inner workings of stellar burning and thermonuclear explosion phases through direct observation is difficult. Therefore, nuclear astrophysics has to rely on stellar modelling and nucleosynthesis codes to produce those results, which can then be compared to the observable data, like elemental abundances from astronomical spectroscopy or isotopic ratios in presolar grains. One process of interest is the effect that high temperatures have on the lifetime of long-lived isomeric states (e.g. ^{26}Al, ^{85}Kr), where thermal excitations and subsequent decay processes into different states can significantly alter the abundance distribution and availability for further nucleosynthesis reactions of the isotope.

This talk will outline the implementation of isomeric states, first tests on well-studied cases like ^{26}Al and its application to the s-process branchpoint ^{85}Kr.

HK 42.6 Do 15:30 F 33

Determination of the ^{129}I Half-Life Using Research Reactors — •Kafa Khasawneh[1], Lukas Bott[1], Alexander Domula[2], Klaus Eberhardt[3], Jan Glorius[4], Kathrin Göbel[1], Tanja Heftrich[1], René Reifarth[1], Stefan Schmidt[1], Kerstin Sonnabend[1], Mario Weigand[1], Norbert Wiehl[3], Mathilde Ziegler-Himmelreich[1], Stephan Zauner[3], and Kai Zuber[2] — [1]Goethe University Frankfurt — [2]Technical University Dresden — [3]Johannes Gutenberg University Mainz — [4]GSI-Helmholtzzentrum für Schwerionenforschung

A new methodology was adopted in order to determine the half-life of ^{129}I. Half-life measurements in the range of a few million years rely on the determination of the number of radioactive atoms and the activity. In this work the number of atoms was determined from the activity of the short-lived isotope ^{129}Te, which decays into the desired isotope. ^{129}Te was produced at TRIGA MARK II Reactor irradiating ^{128}Te. The long-lived activity was investigated above and under ground at the Felsenkeller Dresden. We will present the method, the current status of analysis as well as future options.

HK 42.7 Do 15:45 F 33

The Measurement of Long Lived Alpha Decay for Cosmochronometry — •Heinrich Wilsenach[1], Kai Zuber[1], Réne Heller[2], Volker Neu[3], Yordan Georgiev[4], and Tommy Schönherr[4] — [1]IKTP TU-Dresden, Dresden, Germany — [2]Institute of Ion Beam Physics and Materials Research, Dresden-Rossendorf, Germany — [3]Institute for Metallic Materials, Dresden, Germany — [4]Transport Phenomena in Nanostructures, Dresden-Rossendorf, Germany

Long lived alpha decaying isotopes (about $T_{1/2} = 10^{8-10}$ a) can be used as a powerful tool to date the formation of astronomical objects in the Solar System. This is due to their extremely long half-lives. This technique is however very vulnerable to the accuracy of the half-life. This means that improved half-life measurements are important, though they pose a significant technical obstacle.

To measure the half-lives of this magnitude special care needs to be taken with background and signal efficiency. To overcome these obstacles the design of the twin Frisch-Grid ionisation chamber was chosen. This design combines excellent energy resolution with a high detector efficiency to measure decay rates in the region of a few counts per day. Pulse shape analysis was used to improved signal to background discrimination.

This presentation will give an overview of the detection aspects of the twin Frisch-Grid ionisation chamber, as well as new measurements of the half-lives of ^{147}Sm and ^{190}Pt.

HK 43: Astroparticle Physics II

Zeit: Donnerstag 14:00–16:15 Raum: F 073

Gruppenbericht HK 43.1 Do 14:00 F 073

The Jiangmen Underground Neutrino Observatory — •Paul Christian Hackspacher for the JUNO-Collaboration — Johannes Gutenberg-Universität Mainz & Excellence Cluster PRISMA

The Jiangmen Underground Neutrino Observatory (JUNO) is a reactor neutrino experiment currently being built near the town of Kaiping in the Guangdong province in southern China. From 2020 onwards, the 20 kt liquid scintillator detector under 1900 mwe overburden is going to measure low-energy electron antineutrinos from two nuclear power plants, each with an oscillation baseline of 53 km to the experimental hall. By probing the flux spectrum with an energy resolution of 3% @ 1 MeV, the experiment is set out to determine the neutrino mass hierarchy with at least $3\,\sigma$ significance. Further goals are improving the precision of solar oscillation parameters to below 1%, examining geoneutrinos and supernova neutrinos as well as the search for dark matter, sterile neutrinos and non-standard interactions. This will be an overview talk, presenting the current design, status and physics potential of the JUNO experiment.

Gruppenbericht HK 43.2 Do 14:30 F 073

Status and commissioning of the KATRIN experiment — •Philipp Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The goal of the **KA**rlsruhe **TRI**tium **N**eutrino experiment (KATRIN) is to investigate the neutrino mass with a sensitivity of $0.2\,\mathrm{eV/c^2}$ by a high-resolution and high-statistics measurement of the end-point region of the ^{3}H β-spectrum. For this task it uses an experimental setup made of two main parts, firstly a source and transport section including a windowless gaseous tritium source, a differential and a cryogenic pumping section. This system provides a clean current of ^{3}H β-electrons that are analyzed and detected in the second part, namely the spectrometer and detector section. The latter section consists of two electrostatic spectrometers based on the MAC-E filter technique and a multi-pixel silicon semiconductor detector.

At the experimental site at the Karlsruhe Institute of Technology (KIT), all major components have arrived in summer 2015 and the complete beam line has been assembled. The inauguration of the full beam line, the “First Light”, took place in October 2016 and was followed by a “First Light Plus” commissioning campaign, that finished in December 2016.

This talk gives an overview of the current status of the KATRIN experiment, focusing on the recent “First Light Plus” campaign and the upcoming steps towards the first tritium measurements.

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

HK 43.3 Do 15:00 F 073

Search for Invisible Dark Photon Decays — •Martin Ripka and Achim Denig for the BESIII-Collaboration — KPH JGU Mainz

The direct detection of dark matter is still an open topic of highest interest in particle- and astrophysics. While the experimental search is ongoing, more and more parts of the parameter-space of many intuitive extensions to the Standard Model like super-symmetry are ruled out. Newer state of the art theories attempt to describe the dark sector more generally. A kinetic mixing of the Standard Model photon with a proposed dark photon opens the so called vector-portal to the dark sector. The dark photon may be heavier than other dark matter particles, such that it would predominantly decay invisibly. We report a search for invisible decays of dark photons with the BESIII detector at the BEPCII storage ring in Beijing, China. The dark photons are produced in the Initial State Radiation (ISR) method. Since the dark photon decays into light dark matter particles that cannot be detected, we look for narrow structures in the recoil mass spectrum of the ISR photon. The available data allow for a search of the dark photon with masses between 0-3 GeV. We can set an upper limit at the 90% confidence level on the mixing parameter of the dark photon, which completely excludes an invisibly decaying dark photon as an explanation of the Muon g-2 puzzle.

Supported by DFG under contract No SFB 1044

HK 43.4 Do 15:15 F 073

Internal backgrounds in the XENON100 experiment — •Dominick Cichon and Sebastian Lindemann for the XENON-Collaboration — Max-Planck-Institut für Kernphysik (MPIK), Heidelberg, Germany

Astrophysical observations hint towards the existence of a non-baryonic component in the universe's total mass content, called dark matter. In the search of weakly interacting massive particles (WIMPs), which are postulated to explain dark matter, several liquid xenon (LXe) dual-phase time projection chambers (TPCs), like XENON100, have already been employed to provide limits on possible WIMP interactions. XENON100's successor experiment, XENON1T, has recently been commissioned and aims to be sensitive to spin-independent WIMP-nucleon cross-sections down to $\sigma \sim 1.6 \cdot 10^{-47}\mathrm{cm}^2$ at a WIMP mass of 50 $\mathrm{GeV/c^2}$.

To achieve this goal, great care has to be taken to understand potential background sources and to limit them. Of all relevant sources, ^{222}Rn and ^{85}Kr belong to the largest contributors. One of the reasons for this is, that they dissolve in the LXe target medium. As a consequence, they cause background events which cannot be rejected using position reconstruction techniques. This talk outlines methods for identifying decays of ^{85}Kr and those from the ^{222}Rn chain in XENON100 data to estimate the expected amount of background events from both. In addition, the relevance of the techniques presented herein to the estimation of background in XENON1T is illustrated, as ^{222}Rn and ^{85}Kr belong to the most relevant sources for both experiments.

HK 43.5 Do 15:30 F 073

Prospects on radon mitigation using surface treatment techniques — •Florian Jörg, Hardy Simgen, and Guillaume Eurin — Max-Planck-Institut für Kernphysik (MPIK), Heidelberg, Germany

For experiments dedicated to the search for rare events, background control and its reduction are of crucial concern. Examples for these experiments are liquid xenon detectors searching for dark matter such as XENON1T. One of the biggest contributions to its background is due to ^{222}Rn emanated from detector materials. Besides radon removal using liquid xenon distillation and selection of materials that emanate as little radon as possible, surface treatment can provide further improvement.

It has proven that the application of a coating of several hundreds of nm on the material surface can reduce the amount of radon emanation. Several coating techniques, such as plasma deposition and sputtering were considered in partnership with German companies. In addition, surface cleaning by enhanced electropolishing of several tens of μm has been investigated. In order to determine the reduction factor on radon emanation, relative measurements before and after the application of surface treatment techniques are performed. Due to the very low expected activities, highly sensitive proportional counters and radon monitors were employed. In this talk, first promising results and prospects on radon mitigation will be presented.

HK 43.6 Do 15:45 F 073

Das Minidex-Experiment zur Vermessung Myonen-induzierter Neutronen — •Raphael Kneissl[1], Iris Abt[1], Allen Caldwell[1], Christopher Gooch[1], Xiang Liu[1], Béla Majorovits[1], Matteo Palermo[2], Qiang Du[1], Oliver Schulz[1] und Laura Vanhoefer[1] — [1]Max-Planck-Institut für Physik, München, Deutschland — [2]University of Hawaii, US

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. Die Neutronenproduktionsraten durch Myonen in verschiedenen Materialien sind nicht genau vermessen. Um genauere Vorhersagen darüber machen zu können, welcher Untergrundbeitrag in zukünftigen Experimenten erwartet wird, wurde der Minidex (Muon induced neutrons indirect detection experiment) Aufbau im Tübinger Untergrundlabor errichtet. Mit diesem Aufbau können Neutronen, die im untersuchten Material durch Myonen induziert wurden, nachgewiesen werden. Dies geschieht mit HPGe Detektoren, die den thermischen Einfang von Neutronen an Wasserstoffatomen nachweisen. Es sollen Neutronenproduktionsraten in verschiedenen Abschirmmaterialien untersucht werden. Im Vortrag werden der Aufbau, die Datenanalyse sowie die Resultate des Minidex-Experiments vorgestellt.

HK 43.7 Do 16:00 F 073

Fast neutron detector data analysis, MC simulation and preliminary result in the context of Minidex — Iris Abt[1], Allen Caldwell[1], •Qiang Du[1], Christopher Gooch[1], Raphael Kneissl[1], Xiang Liu[1], Béla Majorovits[1], Matteo Palerno[2], Oliver Schulz[1], and Laura Vanhoefer[1] — [1]Max-Planck-Institut für Physik, Deutschland — [2]University of Hawaii, US

Muon-induced neutrons are a background in current and future low-background experiments. A Gd doped liquid scintillator detector has been operated in Munich and Tübingen to measure neutrons induced by muons in lead in parallel to the Minidex (Muon-induced neturons indirect detection experiment) setup. The neutron detector data will give a crosscheck to the results of Minidex. Neutrons are captured by gadolinium after thermalization in the scintillator resulting in neutron capture gamma-rays with about 8 MeV total energy. This leads to the possibilty of applying a time coincident cut which reduces the background significantly. The data analysis of the fast neutron detector will be introduced, including calibration with thorium 228, cobalt 60 and AmBe neutron sources. Also, the data to Monte Carlo comparison will be shown. Furthermore, some preliminary result on the investigation of muon-induced neutrons will be discussed.

HK 44: Instrumentation IX

Zeit: Donnerstag 14:00–16:00 Raum: F 102

Gruppenbericht HK 44.1 Do 14:00 F 102

Status of the Barrel- and the Disc DIRC detectors at PANDA — •Marvin Krebs for the PANDA-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — Goethe-Universität Frankfurt

The PANDA experiment at the future FAIR facility will use antiproton annihilations to investigate open questions in hadron physics in the momentum range of 1.5-15 GeV/c. Two DIRC detectors will be built for the PANDA target spectrometer in order to achieve excellent charged particle identification (PID), which is needed to cleanly separate $\pi/K/p$. The Barrel DIRC will surround the interaction point and perform π/K separation for polar angles between 22° and 140° and momenta between 0.5 GeV/c and 3.5 GeV/c. It is based on the successful BaBar DIRC detector, but with several key improvements to perform a better-than 3σ π/k separation between 0.5 GeV/c and 3.5 GeV/c. In the (forward) endcap region, the Disc DIRC will be placed to cover the angular range from 5° to 22° to cleanly separate π from K for momenta up to 4 GeV/c. Both DIRC counters will use enhanced-lifetime MCP-PMTs for photon detection in combination with fast readout electronics. The radiators are made from highly polished synthetic fused silica to ensure that photons, propagating through the radiators by total internal reflection, conserve the Cherenkov angle and reach the photon detection plane without angular distortions. Geant4 simulations and tests with several prototypes at various test beam facilities have been used to evaluate the designs and validate the expected PID performance of both PANDA DIRC counters.

HK 44.2 Do 14:30 F 102

The DIRC Upgrade for the GlueX Experiment — Ahmed Ali[1,2], •Roman Dzhygadlo[1], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the GlueX-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

The GlueX experiment will provide the data necessary to perform quantitative tests of non-perturbative QCD by studying the spectrum of light-quark mesons and baryons. The addition of a Cherenkov-based particle identification (PID) system will significantly enhance the GlueX physics program by allowing the study of hybrid mesons decaying into kaon final states with significantly higher efficiency and purity.

The Detector of Internally Reflected Cherenkov light (DIRC) will be a compact and robust PID system utilizing optical components from the decommissioned BaBar DIRC detector. It will provide clean π/K separation for forward angles (θ<11°) and momenta up to 4 GeV/c.

Geant4 simulation are used to optimize the design configuration of the focusing photon camera. Two reconstruction algorithms were developed to provide the best PID.

We will discuss the status of the DIRC detector and the latest achievements in the reconstruction.

HK 44.3 Do 14:45 F 102

DIRC-based PID for the EIC Central Detector — •Roman Dzhygadlo[1], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the DIRC-at-EIC-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

One of the key requirements for the central detector of a future Electron-Ion Collider (EIC) is to provide charged Particle Identification (PID) (e/π, π/K, K/p) over a wide momentum range. It is expected that the PID system will need to include one or more Cherenkov counters to achieve this goal. With a radial size of only a few cm, a DIRC counter (Detector of Internally Reflected Cherenkov light) is an attractive option.

The ongoing R&D investigates ways to extend the momentum coverage of a DIRC counter for the EIC detector by up to 50% beyond the current state of the art. Possible design improvements include a complex focusing system in a form of multi-component lenses, multi-anode sensors with smaller pixels, providing fast single-photon timing in high magnetic fields, a time-based PID algorithm, and chromatic dispersion mitigation.

We will discuss the current status of the design studies with Geant simulations, improvements to the time-based imaging reconstruction, and the results of prototype tests with particle beams.

This work was supported in part by BNL under eRD4 and eRD14.

HK 44.4 Do 15:00 F 102

Testbeam with the latest Disc DIRC prototype — •Julian Rieke, Simon Bodenschatz, Erik Etzelmüller, Michael Düren, Klaus Föhl, Avetik Hayrapetyan, Kristof Kreutzfeldt, and Mustafa Schmidt for the PANDA-Collaboration — II. Physikalisches Institut, Justus Liebig-University of Giessen, Giessen, Germany

The PANDA experiment at the future FAIR facility needs excellent particle identification to do precision studies of antiproton-proton reactions in the 1.5-15 GeV/c momentum range. To fulfill this need, two Cherenkov detectors will be installed in the PANDA target spectrometer, both based on the DIRC concept that uses internally reflected Cherenkov light to perform particle identification, with a focus on the separation of pions and kaons. The Disc-DIRC is designed to cap the forward region of theta angles between 5 and 22 degrees. It will be the first time that a Disc-DIRC is used for PID in a real physics experiment beyond prototyping. A new prototyping Disc-DIRC apparatus has been constructed at the JLU Giessen. It features a radiator and focusing elements made out of fused silica and close to final readout electronics. The entire prototype was tested with an electron beam of several GeV/c at DESY in Hamburg. The components, their setup and a first analysis of the recorded data will be presented.

HK 44.5 Do 15:15 F 102

The Technical Design of the PANDA Barrel DIRC — Ahmed Ali[1,2], Anastasios Belias[1], Roman Dzhygadlo[1], Andreas Gerhardt[1], Klaus Goetzen[1], Marvin Krebs[1,2], Dorothee Lehmann[1], Frank Nerling[1], Klaus Peters[1,2], •Georg Schepers[1], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

Excellent hadronic Particle Identification (PID) is needed to meet the objectives of the rich physics program of the PANDA experiment at FAIR, which includes charmonium physics, exotics, hadron spectroscopy, nucleon structure, and hypernuclei. The Barrel DIRC (Detection of Internally Reflected Cherenkov light) of the PANDA Target Spectrometer will provide a π/K separation of better than 3 standard deviations for particle momenta up to 3.5 GeV/c and polar angles between 22° and 140°. Several key aspects of the design, which was inspired by the successful BaBar DIRC, were improved. The Cherenkov photons produced in narrow radiator bars are focused by a three-component compound lens. The compact expansion volume consists of individual solid prisms made from synthetic fused silica. The photon patterns are detected by an array of lifetime-enhanced microchannel-plate photomultiplier tubes, which are read out by fast electronics with a time precision of about 100 ps. A second, cost-saving design uses wide radiator plates and a time-based reconstruction for the analysis of the resulting Cherenkov patterns. The two designs, and beam test results comparing their PID performance will be discussed.

HK 44.6 Do 15:30 F 102

PID with the Disc DIRC in PANDA at FAIR — •Mustafa Schmidt, Simon Bodenschatz, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, Kristof Kreutzfeldt, and Julian Rieke — JLU Gießen, Gießen, Deutschland

The PANDA detector at the future FAIR facility at GSI is planed as a fixed-target experiment for proton-antiproton collisions at momenta between 1.5 and 15 GeV/c. This talk will mainly cover the Disc DIRC detector, which is placed at the forward endcap of the PANDA target spectrometer and is going to provide a 4σ separation of pions and kaons up to a momentum of 4 GeV/c for θ angles from 5°/10° and 22°.

This new detector concept requires the development of dedicated reconstruction and PID algorithms, which permit an efficient analysis of the measured time-correlated photon patterns. The online reconstruction is planed to be performed with a single FPGA card calculating the Cherenkov angle from the measured hit pattern and related tracking information for each event with a rate of more than 20 MHz.

Time and event based Monte-Carlo simulations within the PandaROOT framework have been used to analyse the evaluate the PID performance for high momentum particles. In order to determine the overall performance near to real PANDA conditions, the benchmark channel $p\bar{p} \to f_0\pi^0 \to K^+K^-$ with stuitable background events has been studied by taking all additional tracking information into account. Results from various testbeams during the last years were used to validate the PID performance for the desired momentum range.

HK 44.7 Do 15:45 F 102

Simulation results for the upgraded RICH detector in the HADES experiment.† — •Semen Lebedev[1,3], Jürgen Friese[2], Claudia Höhne[1], and Tobias Kunz[2] for the HADES-Collaboration — [1]Justus Liebig Universität Giessen, II. Physikalisches Institut — [2]Technische Universität München, Physik Department E62 — [3]LIT JINR, Dubna, Russia

A Ring Imaging Cherenkov (RICH) detector is used to identify electron-positron pairs in the HADES experiment. In cooperation with the CBM-RICH collaboration the existing gaseous photon detector based on a MWPC with CsI cathode will be replaced by multianode photomultipliers (MAPMT). The detector geometry of the upgraded RICH has been implemented in the HADES analysis package HYDRA. The upgraded detector simulation includes the versatile and optimized ring reconstruction algorithm developed for the CBM RICH and realistic photo tube readout response. Simulations show that the detection efficiency for electron-positron pairs increases significantly, in particular for pairs with very small opening angles.

We will present the expected detector performance and compare it to results obtained in a previous HADES experiment for the system p+Nb at $E_{kin} = 3.5$ GeV.

† *Supported by BMBF (05P15RGFCA, 05P12WOGHH) and the Excellence Cluster Universe*

HK 45: Instrumentation X

Zeit: Donnerstag 14:00–15:45 Raum: F 072

HK 45.1 Do 14:00 F 072

Unified Communication Framework (UCF) — •Dominic Gaisbauer, Igor Konorov, Dymtro Levit, and Stephan Paul — TUM Institute for Hadronic Structure and Fundamental Symmetries, Garching, Germany

UCF is a unified network protocol and FPGA firmware for high speed serial interfaces employed in Data Acquisition systems. It provides up to 64 different communication channels via a single serial link. One channel is reserved for timing and trigger information whereas the other channels can be used for slow control interfaces and data transmission. All channels are bidirectional and share network bandwidth according to assigned priority. The timing channel distributes messages with fixed and deterministic latency in one direction. From this point of view the protocol implementation is asymmetrical. The precision of the timing channel is defined by the jitter of the recovered clock and is typically in the order of 10-20 ps RMS. The timing channel has highest priority and a slow control interface should use the second highest priority channel in order to avoid long delays due to high traffic on other channels. The framework supports point-to-point connections and star-like 1:n topologies but only for optical networks with passive splitter. It always employs one of the connection parties as a master and the others as slaves. The star-like topology can be used for front-ends with low data rates or pure time distribution systems. In this case the master broadcasts information according to assigned priority whereas the slaves communicate in a time sharing manner to the master.

HK 45.2 Do 14:15 F 072

An FPGA based Pre-Processor for the ALICE TPC Readout Upgrade — •Sebastian Klewin for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

After the major upgrade of ALICE for Run 3 of the Large Hadron Collider at CERN, the new frontend electronics of the Time Projection Chamber (TPC) will generate around 4 TB/s of raw data. This enormous amount of information can not be written and stored on disc and thus has to be processed and reduced online.

As the first processing step, a cluster finding will be performed on the data directly in the readout electronics. Looking for charge clusters already at this early stage of the readout provides the opportunity to use non zero-suppressed data which increases the sensitivity and resolution especially for small clusters. For this purpose, a 2D cluster finder is developed for and implemented in an FPGA. The high number of channels which have to be processed within a single FPGA makes this development challenging. The conceptual layout of such a cluster finder algorithm will be presented as well as first simulation results.

HK 45.3 Do 14:30 F 072

Feature extraction of the electromagnetic calorimeter preamplifier (APFEL ASIC) for the $\bar{\text{P}}$ANDA experiment at FAIR — S. Ahmed[1,2], A. Aycock[1,2], L. Capozza[1], A. Dbeyssi[1], B. Fröhlich[1,2], P. Grasemann[1,2], S. Haasler[1,2], D. Izard[1], D. Khaneft[1,2], J. Köhler[1,2], F. Maas[1,2,3], M. Carmen Mora Espí[1], •O. Noll[1,2], D. Rodríguez Piñeíro[1], J. Jorge Rico[1], S. Wolff[1,2], M. Zambrana[1,2], and I. Zimmermann[1,2] — [1]Helmholtz-Institut Mainz — [2]Institute of Nuclear Physics, Mainz — [3]PRISMA Cluster of Excellence, Mainz

The $\bar{\text{P}}$ANDA experiment at the upcoming FAIR accelerator facility will study antiproton annihilation reactions at antiproton beam momenta from 1.5 GeV/c up to 15 GeV/c. With its modular multi purpose detector system it will be able to observe a variety of physical channels. The electromagnetic process group (EMP) in Mainz is developing the backward end-cap of the electromagnetic calorimeter. Within this activity a method for the real time extraction of specific signal features using the APFEL ASIC preamplifier will be developed for the whole $\bar{\text{P}}$ANDA calorimeter. The feature extraction has to cope a multitude of requirements. It has to be high sensitive to the pulse shape. Furthermore the single channel threshold has to be lower than 3 MeV to be capable of doing the $\bar{\text{P}}$ANDA physics. Due to the high event rate of $\bar{\text{P}}$ANDA a short dead time is needed. The extraction procedure has to be efficient to achieve a short calculation time. In my talk I will point out the latest developments of the feature extraction by presenting promising candidates for the on-line extraction routine.

HK 45.4 Do 14:45 F 072

Status update of the Feature Extraction Framework for CBM-TRD — •Cruz de Jesus Garcia Chavez and Udo Kebschull for the CBM-Collaboration — Infrastructure and Computer

Systems in Data Processing (IRI), Goethe University, Frankfurt am Main, Germany

The feature extraction framework is a software suite developed for FPGA firmware generation. It uses a Domain-Specific Language (DSL) description, specifically designed for the framework, which provides a fast prototyping platform for multiple levels of feature extraction algorithms. The feature extraction framework has been primary used at the CBM-TRD experiment at FAIR for which an intermediate online pre-processing stage in the readout architecture is necessary to deliver an event-filtered and bandwidth reduced data stream to the First Level Event Selection (FLES). The status update focuses on the integration of High-Level Synthesis (HLS) tools inside the framework, design space exploration and finally the application and results for the Data Acquisition Chain of the TRD experiment.

HK 45.5 Do 15:00 F 072

The quality assurance scheme of GEM foils for the ALICE TPC upgrade — •Markus Ball, Viktor Ratza, Bernhard Ketzer, and Steffen Urban for the ALICE-Collaboration — Helmholtz Institut für Strahlen- und Kernphysik, Universität Bonn

With the planned upgrade of the ALICE (A Large Ion Collider Experiment at CERN) Time Projection Chamber the current readout technology will be replaced by a Gas Electron Multiplier (GEM) - based readout technology. This allows a continuous operation at high interaction rates up to 50kHz in Pb-Pb collisions. A stack of four GEM stages with specific field field configuration was chosen to achieve a suppression of the ion backflow below 1%, while maintaining a sufficient energy resolution below $\sigma/E = 12\%$ for ^{55}Fe. The discharge probability was shown to be comparable to standard triple GEM detectors in low discharge settings.
To upgrade all the Inner and Outer Readout Chambers of ALICE, 576 GEM foils will be needed. However, taking into account a limited production yield, as well as, certain amounts of spare GEM foils, between 720 and 864 GEM foils will be produced and tested. Only GEM foils that fulfill the highest quality criteria can be used. Therefore, a stringent quality assurance (QA) scheme has been developed. The scheme includes leakage current measurements, high definition scanning of foil defects and gain uniformity measurements. A thourough documentation in a database allows to follow the QA history of each individual foil. This work is supported by BMBF.

HK 45.6 Do 15:15 F 072

Untersuchung von Silizium-Streifen-Detektoren mit einem ortsaufgelösten Infrarot-Laser-Teststand* — •Martin Kesselkaul, Kai-Thomas Brinkmann, Tommaso Quagli, Robert Schnell und Hans-Georg Zaunick für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gießen

Am zukünftigen Beschleunigerzentrum FAIR sollen mit dem PANDA-Experiment Vernichtungsreaktionen des Antiprotonenstrahls mit Protonen des stationären Targets (Wasserstoff und schwere Kerne) untersucht werden. Als Teil des Trackingdetektors soll der Mikrovertex-Detektor hoch aufgelöste Spurrekonstruktion und das Erkennen sekundärer Vertizes ermöglichen.

Zur Charakterisierung und Qualitätskontrolle der doppelseitigen Silizium-Streifen-Detektoren für den PANDA MVD wurde ein Laserteststand entwickelt, der die automatisierte Messung diverser für das Tracking relevanter Parameter ortsaufgelöst erlaubt. Mittels eines hochpräzisen xy-Tisches wird die Sub-Mikrometer genaue Positionierung des Lasers realisiert. Dieser Beitrag behandelt die Analyse der aufgenommenen Daten und geht auf die Ladungssammlungs-Charakteristik der einzelnen Streifen ein.

*Gefördert durch BMBF und HIC for FAIR.

HK 45.7 Do 15:30 F 072

The quality assurance database for the CBM Silicon Tracking System — •Anton Lymanets for the CBM-Collaboration — GSI, Darmstadt, Germany

For the construction of the silicon tracking detector in the CBM experiment, more than 1000 microstrip sensors including spares will be produced and integrated into detector modules at several assembly laboratories. Quality assurance of the sensors will be done both by the vendors and at the receiving institutes. In order to keep track of the final inspection data and the component flow, a database tool has been developed with the specific functionality needed in the CBM silicon tracker project. The software has been implemented using the FairDB interface that provides connectivity to the most common database engines. The C++ based library is compatible with the ROOT framework. Both graphical/web and script based interfaces are available to input, update and query the data from different locations.

In the presentation, I will summarize the database architecture, the data structure, and will give examples of particular use cases of the tool under test for the production readiness.

HK 46: Hadron Structure and Spectroscopy VI

Zeit: Donnerstag 16:45–19:00 Raum: F 5

Gruppenbericht HK 46.1 Do 16:45 F 5

The *t*-dependence of the pure DVCS cross-section at COMPASS — Horst Fischer, Simon Gerstner, Matthias Gorzellik, Pirmin Hofmeier, •Philipp Jörg, Christopher Regali, and Tobias Szameitat — Albert-Ludwigs-Universität Freiburg

A major part of the COMPASS-II program will be dedicated to the investigation of **G**eneralized **P**arton **D**istributions (GPDs), which aim for the most complete description of the partonic structure of the nucleon. GPDs are experimentally accessible via lepton-induced exclusive reactions, in particular the **D**eeply **V**irtual **C**ompton **S**cattering (DVCS) and **D**eeply **V**irtual **M**eson **P**roduction (DVMP). At COMPASS, those processes are investigated using a high intensity muon beam with a momentum of 160 GeV/c and a 2.5 m-long liquid hydrogen target. In order to optimize the selection of exclusive reactions at those energies, the target is surrounded by a new barrel-shaped time-of-flight system to detect the recoiling particles.

COMPASS-II covers the up to now unexplored x_{Bj} domain ranging from 0.01 to 0.15. From the sum of cross-sections measured with positive and negative beam polarities, the pure DVCS cross-section and its t-dependence can be extracted. Pilot measurements for the COMPASS II program allow for an extraction of the t-dependence in a single x_{Bj} bin, thus providing first information on the nucleon transverse size in an up to now uncharted x_{Bj} regime.
* Supported by BMBF and the DFG Research Training Group Programme 2044.

Gruppenbericht HK 46.2 Do 17:15 F 5

Measurement of the exclusive π^0 muoproduction cross section at COMPASS — Horst Fischer, Simon Gerstner, •Matthias Gorzellik, Pirmin Hofmeier, Philipp Jörg, Christopher Regali, and Tobias Szameitat — Albert-Ludwigs-Universität Freiburg

At COMPASS Deeply Virutal Compton Scattering and **D**eeply **V**irtual **M**eson **P**roduction (DVMP) processes are studied in order to probe the partonic structure of the nucleon by constraining **G**eneralized **P**arton **D**istribution (GPD) models. Extending beyond semi-inclusive deep inelastic scattering, the measurement of lepton-induced exclusive reactions enables the study of GPDs, which ultimately reveal the three dimensional picture of the nucleon and the decomposition of its total angular momentum.
The COMPASS experiment at CERN uses a high intensity tertiary muon beam with a momentum of 160 GeV/c impinging on a 2.5 m-long unpolarized liquid hydrogen target. To ensure the exclusivity and precision of the measurement, the wide angle electromagnetic calorimetry together with the two-stage magnetic spectrometer is complemented with a new barrel-shaped time-of-flight system surrounding the target. Exploiting the flavour filtering character of DVMP measurements, the COMPASS experiment is able to access different combinations of quark and gluon GPDs by determining the cross sections for various mesons. We report on the first extraction of the exclusive π^0 cross section in the intermediate x_{Bj} domain ranging from 0.01 to 0.15.
*Supported by BMBF and the DFG Research Training Group Programme 2044.

HK 46.3 Do 17:45 F 5

Meson-baryon scattering to one-loop order in heavy baryon chiral perturbation theory — •Bolin Huang[1,2] and Norbert

Kaiser[1] — [1]Physik Department, Technische Universität München, D-85747 Garching, Germany — [2]Department of Physics, Yunnan University, Kunming 650091, China

We calculate the T matrices of pseudoscalar meson octet-baryon scattering to one-loop order in SU(3) heavy baryon chiral perturbation theory (HBχPT). The low-energy constants (LECs) and their combinations are then determined by fitting the phase shifts of πN and KN scattering and the corresponding data. By using these LECs, we predict the other channels and obtain reasonable results. The issues like convergence are discussed in detail.

HK 46.4 Do 18:00 F 5

Proton Time-Like Electromagnetic Form Factor Measurement with the Scan Method at BESIII — •Yadi Wang[1], Samer Ali Nasher Ahmed[1], Alaa Dbeyssi[1], Paul Larin[1], Dexu Lin[1], Frank Maas[1,2,3], Cristina Morales[1], Christoph Rosner[1], and Bo Zheng[1,4] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany — [4]University of South China, 421001 Hengyang China

Electromagnetic form factors (FF) provide valuable insight to the internal structure and dynamics of the proton. While they are well known in the space-like region through electron scattering experiments, the time-like region, typically accessed by annihilation experiments, is known with much less precision. Specifically the separation of the electric and magnetic FF has only been possible with low accuracy due to the low luminosity of previous data.

This contribution reports on the analysis based on 651 pb^{-1} scan data taken at 22 energy points between 2.0 and 3.08 GeV with the Beijing Spectrometer III (BESIII) at the Beijing Electron Positron Collider II (BEPCII). The efforts to extract both the cross section of $p\bar{p}$ as well as the individual electric and magnetic FF are presented.

HK 46.5 Do 18:15 F 5

High precision studies on angular asymmetries of the differential cross sections in the $d + p \to {}^3\mathrm{He} + \eta$ reaction — •Christopher Fritzsch, Alfons Khoukaz, and Daniel Schröer for the ANKE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Deutschland

Investigations on the total and differential cross sections of the reaction $d + p \to {}^3\mathrm{He} + \eta$ are of special interest since they differ strongly from a pure phase space behavior near threshold. Furthermore, analyses of the asymmetry factor α of the differential cross sections show a distinct effect of s- and p-wave interference, which can be explained by a rapid variation of the relative phase. These effects are an indication for an unexpected strong final state interaction (FSI) between η mesons and ^{3}He nuclei which could lead to a quasi bound state of the ^{3}Heη-system. Current investigations on high precision data at the internal fixed target experiment ANKE of the storage ring COSY enable the extraction of additional total and differential cross sections for the η production up to an excess energy of $Q = 15\,\mathrm{MeV}$. These cross sections will significantly improve the accuracy, which will allow to study the behavior of the asymmetry factor α with high resolution. Recent results will be presented and discussed.

*This work has been supported by the COSY-FFE program of the Forschungszentrum Jülich and the Deutsche Forschungsgemeinschaft (DFG) through the Research Training Group "GRK 2149: Strong and Weak Interactions - from Hadrons to Dark Matter".

HK 46.6 Do 18:30 F 5

Upper limit of the η-decay $\eta \to \pi^0 + e^+ + e^-$ with WASA-at-COSY* — •Florian Bergmann, Kay Demmich, Nils Hüsken, and Alfons Khoukaz for the WASA-at-COSY-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

Investigations on symmetries and symmetry breaking allow for a better understanding of the physics within the standard model. The study of rare meson decays is an elegant way to search for violation of conservation laws, and hence symmetry breaking effects. An extensive physics program on η-meson decays has been performed as part of the WASA-at-COSY experiment. Due to the high statistics of the measurements new limits on e.g., the C, P and T symmetry breaking or combinations thereof can be determined.

This contribution will present recent results of the analysis of the C-violating η-decay $\eta \to \pi^0 + e^+ + e^-$ using the high statistics $p+d \to {}^3He+\eta$ data obtained with WASA-at-COSY. In a further contribution by the WASA-at-COSY collaboration insights on the analysis based on the $p + p \to p + p + \eta$ data, also obtained with WASA-at-COSY, will be given.

*Supported by FFE program of the Forschungszentrum Jülich.

HK 46.7 Do 18:45 F 5

Measuring the branching fraction of $\omega \to \eta\gamma$ with the Crystal Ball Experiment at MAMI — •Oliver Steffen and Wolfgang Gradl for the A2-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The Crystal Ball Collaboration uses energy tagged bremstrahlung photons produced from the MAMI electron beam to study photo-induced reactions on nucleons and nuclei. The Crystal Ball/TAPS 4π calorimeter setup is optimized for the detection of neutral final states. Charged particles are identified and measured by the inner detector system.

A large data set of photoproduced η' and ω mesons has been obtained during recent data taking periods with the End Point Tagger ($E_\gamma = 1.4$ to $1.6\,\mathrm{GeV}$) and the liquid hydrogen target.

With this dataset we want to measure the branching fraction of the $\omega \to \eta\gamma$ decay. This is useful for understanding the pseudo vector-gamma interaction within effective field theories. In this talk we will give an overview of the ongoing analysis.

HK 47: Heavy Ion Collisions and QCD Phases X

Zeit: Donnerstag 16:45–19:00 Raum: F 1

Gruppenbericht HK 47.1 Do 16:45 F 1

Recent results on (anti-)(hyper-)nuclei production with ALICE at the LHC — •Esther Bartsch for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The high collision energies reached at the LHC lead to significant production yields of light anti- and hyper-nuclei in proton-proton and, in particular, Pb-Pb collisions. The excellent particle identification capabilities of the Time Projection Chamber, using the specific energy loss (dE/dx), and the time-of-flight measurement, allow for the detection of these rarely produced particles. Furthermore the Inner Tracking System gives the possibility to separate primary nuclei from those coming from the decay of heavier systems. This altogether offers the unique opportunity to search for exotica like the bound state of a Λ and a neutron which would decay into deuteron and pion, or the bound state of two Λs, and also allows for the topological identification of the hypertriton via its mesonic decay (${}^3_\Lambda\mathrm{H} \to {}^3\mathrm{He} + \pi^-$).

In this group report we will show results for (anti-)deuterons, (anti-)tritons, (anti-)^{3}He and (anti-)^{4}He and give an overview on the ongoing searches. The results will also be compared with the expectations from thermal and coalescence models.

Supported by BMBF and the Helmholtz Association.

HK 47.2 Do 17:15 F 1

Multi-strange Hyperons and Hypernuclei reconstruction at the CBM experiment — •Iouri Vassiliev[1], Ivan Kisel[2], and Maksym Zyzak[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]FIAS Frankfurt Institute for Advanced Studies

The main goal of the CBM experiment at FAIR is to study the behavior of nuclear matter at very high baryonic density in which the transition to a deconfined and chirally restored phase is expected to happen. The promising signatures of this new state are the enhanced production of multi-strange particles, production of hypernuclei and dibaryons. Theoretical models predict that single and double hypernuclei, and heavy multi-strange short-lived objects are produced via coalescence in heavy-ion collisions with the maximum yield in the region of SIS100 energies. The discovery and investigation of new hypernuclei and of hyper-matter will shed light on the hyperon-nucleon and hyperon-hyperon interactions. Results of feasibility studies of the key

CBM oservables in the CBM experiment are discussed.

HK 47.3 Do 17:30 F 1

Mechanisms of hypernuclei formation in relativistic ion collisions — •Alexander Botvina[1], Jan Steinheimer[1], Marcus Bleicher[1], and Josef Pochodzalla[2] — [1]FIAS and ITP J.W.Goethe University, D-60438 Frankfurt am Main, Germany — [2]HIM and IKP J.Gutenberg University, D-55099 Mainz Germany

The study of hypernuclei in relativistic ion collisions open new opportunities for nuclear and particle physics. The main processes leading to the production of hypernuclei in these reactions are (1) the disintegration of large excited hyper-residues (target- and projectile-like), and (2) the coalescence of hyperons with other baryons into light clusters. We use the transport, coalescence and statistical models to describe the whole process, and demonstrate the advantages over the traditional hypernuclear methods: A broad distribution of predicted hypernuclei in masses and isospin allows for investigating properties of exotic hypernuclei, as well as the hypermatter both at high and low temperatures. We point at the abundant production of multi-strange nuclei and new bound/unbound hypernuclear states. The realistic estimates of hypernuclei yields in various collisions are presented [1]. Also the processes well known in normal reactions: evaporation, fission, multifragmentation break-up are transformed in the case of hypermatter [2]. There is a saturation of the hypernuclei production at high energies [1], therefore, the optimal way to pursue this experimental research is to use the GSI/FAIR accelerator (Darmstadt).

[1] A.S. Botvina, et al., arXiv:1608.05680, in Phys. Rev. C (2016).
[2] A.S. Botvina, et al., Phys. Rev. C94, 054615 (2016).

HK 47.4 Do 17:45 F 1

Deuteron Distributions in Au+Au Collisions at 1.23A GeV — •Max Zuschke for the HADES-Collaboration — Goethe-Universität Frankfurt

In April 2012, the HADES collaboration collected data on Au+Au collisions at 1.23*A* GeV.
As light hadrons, such as pions, kaons and protons have successfully been analyzed, ongoing studies try to extend the set of identified particles towards light nuclei in order to improve the statistical model analysis. Here we present results on the measurement of deuterons.
After particle identification, based on a mass determination via time-of-flight and on a measurement of the energy loss in the MDC drift chambers, the transverse mass spectra of the deuteron candidates are extracted. Subsequently, they are corrected for acceptance and efficiency losses, which are determined using a UrQMD simulation, containing embedded deuterons that have passed a full detector simulation, provided by the HGeant framework.
The obtained yields are then compared to blast-wave-fits, in order to extract the radial expansion velocity (β) of the system and its kinetic freeze-out temperature T_{kin}. The latter one is compared to the chemical freeze-out temperature T_{chem} as extracted from statistical model fits to hadron yields.
Supported by the German BMBF-grant 05P15RFFCA.

HK 47.5 Do 18:00 F 1

Production of deuterons in pp collisions at $\sqrt{s} = 13$ TeV with ALICE at the LHC — •Benedikt Krimphoff for the ALICE-Collaboration — Goethe-Universität, Institut für Kernphysik, Frankfurt am Main

The production of nuclei in high-energy collisions is commonly discussed within two different scenarios: the thermal-statistical model and the coalescence model. Both approaches are successful in describing the data when applied with certain parameters but they might exhibit more dependencies when used for a wider range of energies.
With the measurement of (anti-)deuterons in $\sqrt{s} = 13$ TeV pp collisions we want to shed light on the nature of light nuclei and their production mechanisms. In particular, the measurement of the production cross section at an unprecedented collision energy may reveal important constraints for the models.
In this presentation we describe the procedure to extract a deuteron spectrum and present the current status of the analysis.

HK 47.6 Do 18:15 F 1

Measurement of (anti-)hypertriton in Pb–Pb collisions with ALICE at the LHC — •Lukas Kreis for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt

The ALICE experiment at the CERN LHC is dedicated to the study of nucleus–nucleus collisions at the highest energies ever reached in the laboratory. The excellent particle identification and decay vertex reconstruction capabilities allow the study of light (anti-)hypernuclei production in heavy-ion collisions. Hypernuclei are weakly-bound unstable nuclei, which contain at least one hyperon. This makes them interesting for gaining insight into the nucleon-hyperon interaction. The lifetime of hypertriton ${}^3_\Lambda$H has gathered particular interest. Recent heavy-ion experiments indicate a deviation from the lifetime of the free Λ baryon, but higher precision measurements are required. In this talk the methodology of the measurement of hypertriton and anti-hypertriton with ALICE is explained. First results obtained in Pb–Pb collisions are presented.

HK 47.7 Do 18:30 F 1

Exit flow, enter femto — •Ante Bilandzic for the ALICE-Collaboration — Technical University of Munich, James-Franck-Str. 1, 85748 Garching, Germany

Neutron stars are the densest stars observed in the Universe. Their mass can be as large as 2 solar masses while their radius is only about 10-15 km. Recent observations of these massive neutron stars are proving to be a serious challenge for our understanding of their fundamental properties, most notably of their chemical content. A neutron star composed only of neutrons cannot match the experimental data, instead the other particle species are nowadays suggested by the theorists to model the content of a neutron star. One popular candidate are hyperons.

The onset of hyperons in the core of neutron star have dramatic effect on its equation of state. The nature of both the two-body hyperon-nucleon and the three-body hyperon-nucleon-nucleon interactions are at the moment poorly understood by the theorists mostly due to lack of experimental constraints for the parameters entering the theoretical models. It was only recently argued that a strong repulsive interaction of hyperons with nucleons via three-body force could yield to equation of state of a neutron star which is stiff enough to support the recent experimental data.

In this talk with present the status of multiparticle correlation techniques for the study of genuine three-body interactions between hyperons and nucleons, in the context of multiparticle femtoscopic techniques utilized for the analysis of elementary collisions in ALICE.

HK 47.8 Do 18:45 F 1

Online reconstruction of multi-strange hyperons with the CBM experiment — •Hamda Cherif[1,2], Alberica Toia[1,2], and Iouri Vassiliev[2] for the CBM-Collaboration — [1]Goethe Universität Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research in Darmstadt is a dedicated heavy ion experiment which will operate in fixed target mode at beam energies up to 11A GeV for ions delivered by the SIS100 accelerator. The CBM physics program is devoted to the exploration of the QCD phase diagram at high net-baryon densities. One of the main experimental challenges is the measurement of very rare probes, which requires an interaction rate of up to 10 MHz.

We study the production of multi-strange (anti)hyperons as one of the earliest proposed signatures for the formation of a Quark Gluon Plasma. The reconstruction of multi-strange hyperons in CBM is based on their weak decay topology, characterized by one or more displaced vertices, and reaches a reconstruction efficiency of about 20% for Λ, 8% for Ξ and 5% for Ω . In this presentation, we discuss the performance of the online event selection of multi-strange hyperons in Au+Au collisions at various SIS100 energies.

HK 48: Structure and Dynamics of Nuclei VII

Zeit: Donnerstag 16:45–19:00 Raum: F 2

HK 48.1 Do 16:45 F 2

Lifetime Measurements in ^{61}Zn — •M. Queiser, A. Vogt, P. Reiter, R. Altenkirch, K. Arnswald, T. Braunroth, A. Dewald, C. Fransen, B. Fu, R. Hetzenegger, R. Hirsch, V. Karayonchev, L. Kaya, L. Lewandowski, C. Müller-Gatermann, J.-M. Regis, D. Rosiak, D. Schneiders, M. Seidlitz, B. Siebeck, T. Steinbach, and K. Wolf — Institut für Kernphysik, Universität zu Köln

Lifetimes of excited states in the neutron-deficient nucleus ^{61}Zn were measured employing the Recoil-Distance Doppler-Shift (RDDS) and the Fast-Timing Method at the University of Cologne. The nucleus of interest was populated as an evaporation residue in ^{40}Ca(^{24}Mg,n2p)^{61}Zn and ^{58}Ni(α,n)^{61}Zn reactions at 67 MeV and 19 MeV, respectively. Five lifetimes are measured for the first time, including the $5/2^- \rightarrow 3/2^-$ transition depopulating the 124-keV isomer. Short lifetimes from the RDDS analysis are corrected for Doppler-Shift Attentuation (DSA) effects in the stopper foil. Ambiguous results from previous measurements were resolved. The obtained lifetimes are compared to predictions from different sets of shell-model calculations. Supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 48.2 Do 17:00 F 2

Fast-Timing Lebensdauermessung an ^{162}Er — •Lukas Knafla, Jean-Marc Régis, Vasil Karayonchev und Jan Jolie — Institut für Kernphysik, Universität zu Köln

Die Lebensdauern der Rotationsbande von ^{162}Er wurden erstmalig gemessen. Über eine, am Kölner FN-Tandembeschleuniger durchgeführten ^{154}Sm(^{12}C,4n)^{162}Er Fusions-Verdampfungsreaktion bei 62 MeV, wurden die angeregten Zustände populiert. Dabei wurde die emittierte γ-Strahlung mit dem mit 8 HPGe- und 8 LaBr$_3$-Detektoren ausgestatteten HORUS-Spektrometer detektiert. Zur Lebensdauermessung im Pikosekundenbereich hat sich die direkte Messung durch das $\gamma-\gamma$ Fast-Timing mit der Generalized-Centroid-Difference (GCD) Methode etabliert [1]. Durch die Auswertung der Messdaten konnten die Lebensdauern der angeregten 4_1^+- und 6_1^+-Zustände bestimmt werden. Im Rahmen dieses Beitrags werden die experimentell bestimmten Lebensdauern von ^{162}Er vorgestellt und daraus gewonnen B(E2)-Übergangsstärken mit den Vorhersagen des confined-β-soft (CBS) Modells verglichen. Dieses Modell dient zur Beschreibung von β-deformierten Kernen und liefert sehr gute Übereinstimmung mit den experimentellen Werten.

Gefördert unter DFG Fördernummer JO391/16-1.

[1] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. A 622.1 (2010) 83.

HK 48.3 Do 17:15 F 2

Extracting lifetimes via the Doppler-shift attenuation method using pγ coincidences in Cologne — •Sarah Prill[1], Michelle Färber[1], Pavel Petkov[1,2,3], Simon G. Pickstone[1], Mark Spieker[1], Vera Vielmetter[1], Julius Wilhelmy[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne, Cologne (Germany) — [2]INRNE, Bulgarian Academy of Sciences, Sofia (Bulgaria) — [3]National Institute for Physics and Nuclear Engineering, Bucharest (Romania)

Recently, a new technique to determine lifetimes of excited states from a few to hundreds of femtoseconds has been established in Cologne: the Doppler-shift attenuation method (DSAM) using pγ coincidences [1]. The SONIC@HORUS setup with its 14 HPGe detectors and several silicon detectors enables to extract the centroid-energy shifts from proton-gated γ-ray spectra, yielding lifetime values that are independent of feeding contributions. This contribution will introduce this (p,p′γ) DSAM technique and show the results of measurements on ^{96}Ru [1], ^{98}Ru, ^{112,114}Sn, and ^{94}Zr.

Supported by the DFG (ZI-510/7-1). S.P. and J.W. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

[1] A. Hennig *et al.*, Nucl. Instr. and Meth. A **794** (2015) 171

HK 48.4 Do 17:30 F 2

Schalenmodellanalyse von ^{98}Pd — •Guillaume Häfner, Andrey Blazhev, Christoph Fransen und Jan Jolie — Institut für Kernphysik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln

Bereits mit Hilfe der **R**ecoil-**D**istance-**D**opplershift (RDDS) Methode bestimmte Lebensdauern und Übergangsstärken in ^{98}Pd [1,2] werden mit Schalenmodellrechnungen verglichen, um die Kernstruktur zu untersuchen. Die niedrig-liegenden Yrast-Zustände weisen im Schalenmodell mit Valenzraum $\pi\,(2p_{1/2}, 1g_{9/2})$ und $\nu\,(2d_{5/2}, 3s_{1/2}, 2d_{3/2}, 1g_{7/2}, 1h_{11/2})$ keine reinen Strukturen von Wellenfunktionen auf, sondern bestehen vielmehr aus einer Superposition verschiedener Konfigurationen. Die Hauptkomponenten der niedrigsten Yrast-Zustände sind Zwei-Neutronen-Anregung in der $\nu\,d_{5/2}$-Schale, während Protonenkonfigurationen erst in Zuständen mit Spin $J^\pi \geq 6_1^+$ signifikante Anteile zu den Wellenfunktionen beitragen. Trotz des allgemein nicht-kollektiven Verhaltens von ^{98}Pd wurden isovektorielle Anteile der Wellenfunktionen im 2_2^+-Zustand im Schalenmodell gefunden.

* supported by the Bonn-Cologne Graduate School of Physics and Astronomy

[1] C. Fransen et al, AIP Conference Proceedings; Vol. 1090 Issue 1, p529 (2009)
[2] E. Ellinger, Diplomarbeit Universität zu Köln (2012)

HK 48.5 Do 17:45 F 2

Eine schalenmodellbasierte Deformationsanalyse von Cadmiumnukliden — •Tobias Schmidt[1], Kris Heyde[2], Andrey Blazhev[1] und Jan Jolie[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Department of Physics and Astronomy, Ghent University

Für die gerade-geraden Cadmiumisotope ^{98}Cd - ^{108}Cd wurden mittels des Computercodes ANTOINE [1] hochdimensionale Schalenmodellberechnungen im $\pi(2p_{1/2};\,1g_{9/2})$ $\nu(2d_{5/2};\,3s_{1/2};\,2d_{3/2};\,1g_{7/2};\,1h_{11/2})$ Modellraum ohne weitere Beschneidungen durchgeführt. Bekannte experimentelle Werte [2], wie Energieniveaus und $B(E2)$-Stärken, konnten zufriedenstellend reproduziert werden. Mit diesen Schalenmodellergebnissen als Basis wurden unter Verwendung der von K. Kumar [3] und D. Cline [4] eingeführten, modellunabhängigen Drehinvarianzen Deformationsparameter berechnet. Diese Deformationsparameter werden als Funktion der Neutronenzahl sowie des Spins präsentiert und diskutiert.

[1] E. Caurier and F. Nowacki, Act. Phys. Pol. B **30**, 705 (1999)
[2] Evaluated Nuclear Structure Data Files (ENSDF), Brookhaven National Laboratory, http://www.nndc.bnl.gov/ensdf/ (De- cember 2016)
[3] K. Kumar, Phys. Rev. Letters **28**, 249 (1972)
[4] D. Cline, Annu. Rev. Nucl. Part. Sci. **36**, 683 (1986)

HK 48.6 Do 18:00 F 2

A New Dedicated Plunger Device for the GALILEO γ-ray array — •Claus Müller-Gatermann[1], Alfred Dewald[1], Christoph Fransen[1], Marcel Bast[1], Marcel Beckers[1], Thomas Braunroth[1], Alain Goasduff[2], Alina Goldkuhle[1], Julia Litzinger[1], Daniele Mengoni[3], Franziskus Spee[1], Jose Javier Valiente-Dobón[2], and Dorothea Wölk[1] — [1]Institut für Kernphysik, Universität zu Köln, Deutschland — [2]INFN, Laboratori Nazionali di Legnaro, Legnaro (Padova), Italy — [3]Dipartimento di Fisica dell'Universitá di Padova, Italy

Different plunger devices have been developed in the last decades to be used with high efficiency γ-ray arrays and with complementary detectors such as the large acceptance spectrometers: PRISMA and VAMOS. Recently, a new plunger device for the γ-ray array GALILEO has been developed in collaboration with the INFN Legnaro and which can be used with the existing auxillary detectors e.g. EUCLIDES. We will report on the mechanical design and functionality of this plunger device, as well as on the constrains given partly by the complete spectrometer, which led to this design. We will close with the results of the commissioning run using a ^{154}Sm(^{32}S,6n)^{180}Pt reaction at a beam energy of 183 MeV. The experiment was chosen to reproduce the known lifetimes in ^{180}Pt and since it stands for a typical reaction using a plunger device coupled to GALILEO this can be seen as a proof of concept. Supported by the DFG under contract number DE 1516/3-1.

HK 48.7 Do 18:15 F 2

Bestimmung der Lebensdauern von angeregten Zuständen der Grundzustandsbande von ^{178}W — •Alina Goldkuhle, Alfred Dewald, Thomas Braunroth, Christoph Fransen und Claus Müller-Gatermann — Institut für Kernphysik, Universität zu Köln, Köln

Das Isotop ^{178}W befindet sich in der Nähe der interessanten Massenregion um $A = 180$, in der Formänderungen (Vibrator-Rotor) erwartet werden. Ziel dieser Arbeit ist die Untersuchung der kollektiven Eigenschaften von ^{178}W. Es wurde ein Recoil Distance Doppler Shift (RDDS) Experiment mit der Reaktion ^{164}Dy(^{18}O, 4n)^{178}W am Tandembeschleuniger der Universität zu Köln durchgeführt. Mit Hilfe von 12 Germanium (HPGe)-Detektoren, die in drei Ringen unter verschiedenen Winkeln zur Strahlachse angeordnet waren, wurden $\gamma\gamma$-Koinzidenzspektren gemessen, aus denen mittels der Differential Decay Curve Method (DDCM) Niveau-Lebensdauern der Grundzustandsbande von J = 4^+ bis 10^+ gewonnen werden konnten. Ziel ist es, aus den Zustandslebensdauern die elektromagnetischen Übergangsstärken zu bestimmen, um somit Rückschlüsse auf die Deformation von ^{178}W zu ziehen. Das Projekt wurde gefördert von der DFG, Fördernummer DE 1516/3-1.

HK 48.8 Do 18:30 F 2

Strukturuntersuchung von ^{178}Pt — •Franziska Mammes[1], Christoph Fransen[1], Thomas Braunroth[1], Alfred Dewald[1], Jan Jolie[1], Pete Jones[2], Julia Litzinger[1], Claus Müller-Gatermann[1], Nima Saed-Samii[1], Rick D. Smit[2], Mathis Wiedeking[2] und Karl-Oskar Zell[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]iThema LABS, Faure/Kapstadt, Südafrika

Neutronenarme Isotope um $A = 180$ stellen ein ergiebiges Testlabor dar, um die Entwicklung von Kollektivität in der Nähe des $Z = 82$ Schalenabschlusses, Formkoexistenzen von sphärischen, prolaten und schwach oblat deformierten Konfigurationen und eine mögliche Existenz von Kernen am kritischen Punkt des Formphasenübergangs sphärisch – prolat deformiert zu studieren. Im Rahmen dieser Arbeit wurde daher der Kern ^{178}Pt untersucht. Lebensdauern angeregter Zustände in der Yrast-Bande bis zum 10^+ Zustand wurden erstmals mit der Recoil-Distance Doppler-Shift (RDDS) Methode am AFRODITE Spektrometer des iThemba LABS in Faure (Südafrika) gemessen, woraus Yrast $E2$-Übergangsstärken bestimmt wurden. Die Ergebnisse erlauben es, ^{178}Pt rotorähnliche Eigenschaften zuzuweisen. Zur Auswertung der Daten war es zusätzlich erforderlich, den an unserem Institut entwickelten Sortiercode soco2 an die Datenstruktur des iThemba LABS anzupassen. Gefördert durch die DFG, Fördernummern FR 3276/1-1, DE 1516/3-1.

HK 48.9 Do 18:45 F 2

Effects of a broad velocity distribution on DDSM measurements — •David Werner, Alfred Dewald, Claus Müller-Gatermann, Christoph Fransen, Thomas Braunroth, and Alina Goldkuhle — Institut für Kernphysik, Universität zu Köln, D-50937, Germany

The Recoil Distance Doppler-Shift (RDDS) method is a well established method to measure lifetimes of excited nuclear states in the pico-second range. In an RDDS experiment, nuclei of interest, produced in a nuclear reaction, recoil out of a thin target foil and fly with a velocity distributed around a mean velocity $\frac{\bar{v}}{c}$. Usually only the mean velocity $\frac{\bar{v}}{c}$ is considered in the lifetime determination. In cases where the velocity distribution becomes broad it affects the shape and positions of the shifted components of the peaks. In this contribution we will present details on our investigation of the effects caused by broad velocity distributions and point out limits outside of which corrections for the lifetime analysis become important. Further, an estimate for the width of typical velocity distributions, observed in recent RDDS experiments with a rather low $\frac{\bar{v}}{c}$ of about 0.5%, will be shown. This work is supported by DFG under contract number DE 1516/3-1.

HK 49: Structure and Dynamics of Nuclei VIII

Zeit: Donnerstag 16:45–19:00 Raum: F 33

Gruppenbericht HK 49.1 Do 16:45 F 33

Shell model interactions from chiral effective field theory* — •Lukas Huth[1,2], Victoria Durant[1,2], Johannes Simonis[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We construct effective valence-space interactions for the use in shell model calculations, where the residual two-body interaction is based on symmetry principles and the low-momentum expansion from chiral effective field theory. In addition to the usual free-space operators we also include center-of-mass momentum operator terms that arise due to the translational and Galilean invariance breaking by in-medium effects. We fitted the low-energy constants and single particle energies to 442 ground- and excited-state energies in the *sd* shell and obtained a root mean square derivation of 442 keV. Our valence-space interactions provide uncertainty estimates and show promising predictions.
*This work is supported by the ERC Grant No. 307986 STRONGINT, the GSI-TU Darmstadt cooperation, the BMBF Grant No. 05P15RDFN1, and the DFG through Grant SFB 1245.

HK 49.2 Do 17:15 F 33

Precision calculations of M1 observables in light nuclei — •Laura Mertes, Thomas Huether, and Robert Roth — IKP, TU Darmstadt

In *ab initio* nuclear structure calculations we use nuclear interactions derived in chiral EFT, softened by a unitary transformation to accelerate the convergence of many-body calculations. One method is the Similarity Renormalization Group (SRG) transformation that decouples high- and low-energy physics through a flow evolution of the Hamiltonian and other operators, such as electromagnetic observables. Up to now, electromagnetic observables were almost always calculated with the bare, unevolved operator on evolved wave functions obtained as eigenstates from solving the many-body eigenvalue problem. The effects of a consistent SRG transformation are in the range of a few percent and thus performing a consistent SRG transformation is essential for precision calculations. We present first results for M1 observables in light nuclei obtained with a consistent SRG transformation.

Supported by DFG through SFB 1245.

HK 49.3 Do 17:30 F 33

Effective Field Theory for three-body hypernuclei — •Fabian Hildenbrand and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

We construct a short-range effective field theory with contact interactions for three-body hypernuclei in the strangeness $S = -1$ sector. An asymptotic analysis is performed in the $I = 0$ and $I = 1$ isospin channels and the corresponding effective Lagrangians are constructed. It turns out that a ΛNN three-body force is required for consistent renormalisation in both channels. We present universal correlations between observables and discuss the possibility of a Λnn bound state in this effective theory.

*This work has been supported by the BMBF under grant 05P15 RDFN1.

HK 49.4 Do 17:45 F 33

Uncertainties in constraining low-energy constants from ^{3}H β decay* — •Philipp Klos[1,2], Arianna Carbone[1,2], Kai Hebeler[1,2], Javier Menéndez[1,2,3], and Achim Schwenk[1,2,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Department of Physics, University of Tokyo — [4]Max-Planck-Institut für Kernphysik, Heidelberg

We discuss the uncertainties in constraining low-energy constants of chiral effective field theory from ^{3}H β decay. The half-life is very precisely known, so that the Gamow-Teller matrix element has been used to fit the coupling c_D of the axial-vector current to a short-range two-nucleon pair. As the same coupling also describes the leading one-pion-exchange three-nucleon force, this in principle provides a very constraining fit. However, the ^{3}H half-life fit has only been performed at a fixed cutoff value. We show that the cutoff dependence due to the regulator in the axial-vector two-body current affects significantly the

Gamow-Teller matrix element. We provide a range of c_D values that is compatible within cutoff variation with the experimental ^{3}H half-life and estimate the resulting uncertainties for many-body systems by performing calculations of symmetric nuclear matter.

⋆This work was supported by the DFG through Grant SFB 1245, the ERC Grant No. 307986 STRONGINT, and the Alexander von Humboldt Foundation through a Humboldt Research Fellowship for Postdoctoral Researchers.

HK 49.5 Do 18:00 F 33

Towards chiral three-nucleon forces in heavy nuclei* — •Victoria Durant[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We explore different approximation schemes for applying three-nucleon (3N) forces in microscopic calculations of medium-mass and heavy nuclei. To this end, we study different approaches for calculating 3N normal-ordered matrix elements that are benchmarked in calculations of medium-mass nuclei.

*This work is supported by the GSI-TU Darmstadt cooperation and the ERC Grant No. 307986 STRONGINT

HK 49.6 Do 18:15 F 33

Third-order particle-hole ring contributions from contact-interactions and chiral NN-potentials — •Norbert Kaiser — Physik Department, Technische Universität München, 85748 Garching

A missing piece in perturbative calculations of nuclear matter with chiral low-momentum interactions are the particle-hole ring contributions at third-order. We evaluate the 3rd-order particle-hole ring diagrams for a momentum-dependent NN-contact interaction of the Skyrme-type. By working with the antisymmetrized contact-interaction just one 4-loop diagram needs to be computed. The corresponding result for the 3-ring energy per particle $\bar{E}(k_f)$ is a cubic expression in the Skyrme-parameters t_i, x_i, W_0 with numerical coefficients N_j that are given by double-integrals over cubic expressions in euclidean (scalar, vector, tensor) polarizations functions $Q_j(s,\kappa)$. Dimensional regularization of these integrals is realized by subtracting power-divergences and the validity of the method is checked against analytical results at 2nd order. The 3rd-order ring-energy from 1π-exchange is calculated semi-analytically and found to be very strongly attractive, with $\bar{E}(k_{f0}) \simeq -92\,\text{MeV}$. For the N^{3}LO chiral NN-potential the 3-ring energy in symmetric nuclear matter and neutron matter is weakly attractive and it decreases for softer potentials (with lower cutoffs). The extensive computations based on partial-wave matrix elements are checked against semi-analytical treatments for model interactions.

Work supported in part by DFG and NSFC (CRC110).

HK 49.7 Do 18:30 F 33

Pairing in neutron matter: New uncertainty estimates and three-body forces — •Christian Drischler[1,2], Thomas Krüger[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We discuss BCS pairing gaps in the partial-wave channels ^{1}S$_0$ and ^{3}P$_2$-^{3}F$_2$ in neutron matter based on nucleon-nucleon (NN) and three-nucleon (3N) interactions derived within chiral effective field theory.

Applying new uncertainty estimates that rely on an order-by-order analysis in the chiral expansion, we show first results for the recent local and semilocal NN-only potentials up to next-to-next-to leading order (N^{2}LO) and N^{4}LO, respectively, with different regulator cutoffs. Our recent improved normal-ordering method allows us to investigate pairing gaps with consistent NN and 3N forces up to N^{3}LO. We show results for three more traditional chiral potentials including both leading and subleading 3N contributions.

Finally, we report on a robust method to solve the non-linear BCS gap equation which allows to assess the numerical convergence.

* This work is supported by the ERC Grant No. 307986 STRONGINT and the DFG through Grant SFB 1245.

HK 49.8 Do 18:45 F 33

Density-matrix expansion for local three-nucleon interactions — •Lars Zurek[1,2], Arianna Carbone[1,2], Eduardo Antonio Coello Pérez[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

The Negele-Vautherin density-matrix expansion is applied to the Hartree-Fock energy due to three-nucleon interactions. Using the density-matrix expansion, off-diagonal density matrices can be rewritten in terms of local densities and their derivatives. The resulting approximations for the density matrices are applied to calculate the contributions to the Hartree-Fock energy due to different local three-nucleon interactions derived from chiral effective field theory and fit in recent quantum Monte-Carlo calculations. The resulting energy-density functionals are presented and compared to other results.

* This work is supported by the DFG through Grant SFB 1245.

HK 50: Instrumentation XI

Zeit: Donnerstag 16:45–19:00 Raum: F 3

HK 50.1 Do 16:45 F 3

Improvements of the online TPC GPU tracking in the ALICE HLT in the face of continuous readout in LHC run 3 — •David Rohr for the ALICE-Collaboration — Ruth-Moufang-Str. 1, 60438 Frankfurt

ALICE is one of the four major experiments at the Large Hadron Collider (LHC) at CERN. Its main goal is the study of matter under extreme pressure and temperature as produced in heavy ion collisions at LHC. The ALICE High Level Trigger (HLT) is an online compute farm that performs a real time event reconstruction of the data delivered by the ALICE detectors. The HLT uses GPUs as hardware accelerators to perform online track reconstruction for the TPC, the main tracking detector. During the Long Shutdown 2, there will be a major upgrade of the ALICE TPC as well as the online / offline computing systems. The new GEM TPC for LHC run 3 will feature continuous readout instead of triggered read out. This poses challenges for the online track reconstruction: it is no longer possible to convert the TPC raw data including the time of the TPC hits to spatial coordinates in advance. The tracking algorithm must be adapted accordingly and needs tighter coupling with coordinate transformation and calibration. We present new features currently developed for the online tracking and first tests performed on the current HLT farm.

HK 50.2 Do 17:00 F 3

Dataflow Lattice QCD Calculations on FPGA Accelerator — •Thomas Janson and Udo Kebschull — Infrastructure and Computer Systems in Data Processing (IRI), Goethe University Frankfurt, Germany

We implement and test algorithms of lattice QCD on FPGA accelerator. To deploy complex algorithms on an FPGA it is crucial to use a high-level language other than VHDL or Verilog. Instead, we use a high-level dataflow based programming language openSPL from Maxeler. This reduces the design effort dramatically while producing more efficient hardware. The algorithm is described as a directed dataflow graph which exposes implicit its parallelism and locality.

We have proven this concept for the Wilson Dirac operator in single precision, where we have described the operator as dataflow graph that collects all nearest neighbor terms and perform all multiplications and additions parallel in one kernel tick. The so described operator fits completely on an Altera Stratix V FPGA and updates for each kernel tick one Spinor.

HK 50.3 Do 17:15 F 3

Einsatz des Optimierungsframeworks Geneva in der Wissenschaft — •Kilian Schwarz[1], Jan Knedlik[1], Matthias Lutz[1] und Rüdiger Berlich[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH,Planckstraße 1,64291 Darmstadt — [2]Gemfony scientific UG, c/o Dr. Rüdiger Berlich, Leopoldstr. 122, 76344 Eggenstein-Leopoldshafen

Die Geneva-Bibliothek ist ein Open Source - Framework zur verteilten parametrischen Optimierung technischer und wissenschaftlicher Fragestellungen auf Clustern sowie lokalen parallelen Recheneinheiten (z.B. Multi-Core, GPU). Der Vortrag stellt Geneva am Beispiel einer Anwendung aus der theoretischen Physik vor und diskutiert die gewählte Architektur zur transparenten Verteilung der aus der Optimierung resultierenden Aufgaben. Für eine Anpassung an besonders rechen- und speicherintensive wissenschaftliche Anwendungen wurden Optimierungsläufe mit bis zu 300 gleichzeitig rechnenden Clients auf dem GSI-Cluster durchgeführt. Ein Schwerpunkt war hierbei die stabile Skalierbarkeit der Client-Server-Applikation Geneva bei besonders hohen Lasten. Am Ende konnte eine Compute-Efficiency von bis zu 99% über mehrere Tage Laufzeit erreicht werden. Hierfür wurde der Software-Stack des Geneva-Frameworks an einigen Stellen entscheidend verbessert, insbesondere wurde der integrierte Broker auf die Verwendung einer minimalen Zahl an Locks hin optimiert. Ferner wurde ein Websocket-Server als Alternative zu einer reinen Boost.ASIO-basierten Lösung integriert. Neben der Verwendung im GSI-Umfeld werden auch alternative Einsatzgebiete von Geneva kurz vorgestellt.

HK 50.4 Do 17:30 F 3

Implementierung Site - spezifischer Anforderungen mit Hilfe von XrootD - Plugins — •Kilian Schwarz und Jan Knedlik — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt

XRootD hat sich als ein Standard für WAN - Zugriff auf Daten in HEP und HENP etabliert. Dabei sind Site - spezifische Anforderungen wie sie bei GSI existieren, bisher technisch schwierig umzusetzen gewesen. XRootD erlaubt die Anpassung von grundlegenden Funktionen der XRootD Server durch Plugins, seit Version 4.0 auch für die Anpassung der XRootD Clients. In diesem Beitrag zeigen wir die Möglichkeiten der XRootD Client - & Server - Plugins am Beispiel des ALICE Tier 2 Zentrums bei GSI. Dazu wurden drei generisch einsetzbare Plugins erstellt, welche dabei auch für FAIR nutzbar sind: XrdProxyPrefix zur automatischen Weiterleitung eines Clients über einen XRootD - Forward - Proxy, XrdOpenLocal für direkten Zugriff eines Clients auf ein lokal gemountetes Shared - Filesystem sowie XrdLustreOssWrapper welches für XRootD - Space - Statistics eines Servers Lustre - Quota - Statistics verwendet.

HK 50.5 Do 17:45 F 3

Weiterentwicklung des ALICE-Tier2-Zentrums bei GSI — •Sören Fleischer, Michael Bauer, Raffaele Grosso, Thorsten Kollegger, Victor Penso und Kilian Schwarz für die ALICE-Kollaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

Die GSI betreibt seit 2004 ein Tier2-Zentrum für das ALICE-Experiment. Es ist Teil des gemeinschaftlich mit GSI/FAIR genutzten Clusters im Green IT Cube. 2016 wurden 1800 TiB Speicherplatz sowie 16000 HEP-SPEC06 an Rechenleistung bereitgestellt. In diesem Beitrag werden der aktuelle Status des Zentrums sowie Weiterentwicklungen der zugrundeliegenden Infrastruktur vorgestellt.

Eine der wesentlichen Entwicklungen war die Einführung von Singularity, um die ALICE-Applikationsumgebung von der zugrundeliegenden Infrastruktur zu abstrahieren. Mit dieser Linux-Container-basierten Software ist es möglich, einem Anwendungsprogramm eine durch ein Image definierte Umgebung aus Libraries und Umgebungsvariablen zur Verfügung zu stellen. Die Installation von spezifischen, für das Anwendungsprogramm notwendigen Paketen auf dem Hostsystem ist damit nicht mehr notwendig. Mit dieser Technik können wir die für ALICE standardmäßig verwendete Scientific-Linux-Umgebung auf Debian-Hostsystemen realisieren.

HK 50.6 Do 18:00 F 3

Online data pre-processing for CBM-MVD — •Qiyan Li for the CBM-MVD-Collaboration — Goethe-University, Frankfurt,Germany

The MVD of CBM experiment is being designed to handle 10^5 Au+Au or 10^7 p+Au collisions per second. The CMOS Monlithic Active Pixel Sensors foreseen for the MVD show charge sharing. Each hit generates clusters of few fired pixels. This improves the spatial resolution of the detecor. However, the necessary cluster finding provides a significant load to the computer farm FLES. To reduce this load and to liberate ressources for the real time tracking and secondary decay vertex finding needed, we designed and implemented an online data pre-processing running on free ressources of the FPGAs of the MVD Readout system. This algorithm reduces the shape and position lossless to a signle 32-bit word. We show the implementation of the algorithms on the FPGAs and discuss the robustness and data compression ability of the algorithm based on labory and beam tests. * supported by BMBF (05P15RFFC1), HIC for FAIR, and GSI.

HK 50.7 Do 18:15 F 3

Studies of the Applicability of Key-Value Stores for the CBM First-level Event Selector — •Helvi Hartmann, Jan DeCuveland, and Volker Lindenstruth for the CBM-Collaboration — Frankfurt Institute for Advanced Studies

The Compressed Baryonic Matter (CBM) experiment is a fixed target high energy physics experiment which does not involve classical triggers. All data collected at the detectors is send free streaming to a high performance compute cluster, the First-level Event Selector (FLES). The FLES is the central event processing unit performing a full online event reconstruction. For this purpose the raw detector data is accessed in time intervals referred to as Timeslices. In the process of Timeslice building data from all input links are distributed via a high-performance Infiniband network to the compute nodes.

The Timeslice building is realized in the software framework Flesnet. Different processes are involved in Timeslice building. One process reads the incoming data from the FLES Input Boards (FLIBs). Another process distributes the data from the input nodes to the compute nodes. All processes within the Flesnet framework exchange data via shared memories. In order to set up a framework controlling these processes different key-value stores are investigated. The advantage of storing important information, which needs to be accessible to all processes, within a key-value store is that these kind of databases offer consistency and an intuitive data model for the user. In order to study the applicability of key-value store for the FLES Etcd and Consul performance benchmark were performed.

HK 50.8 Do 18:30 F 3

Datenerfassung für den PANDA Luminositätsdetektor mit Online-Spurrekonstruktion — •Stephan Maldaner, Florian Feldbauer, Roman Klasen, Heinrich Leithoff, Mathias Michel, Christof Motzko, Stefan Pflüger, Tobias Weber und Miriam Fritsch — Helmholtz-Institut Mainz

Am Beschleunigerkomplex FAIR in Darmstadt entsteht das für Hadronenspektroskopie ausgelegte Experiment PANDA. Ziele des Experiments sind neue Zustände zu entdecken und z.B. die Linienform bekannter Charmonium Zustände mit Hilfe der Energie-Scan-Methode sehr präzise zu vermessen. Um die Messpunkte untereinander zu normieren ist die genaue Kenntnis der Luminosität entscheidend.

Bei PANDA wird die Luminosität mit Hilfe der Winkelverteilung der elastischen Antiproton-Proton-Streuung gemessen. Der Luminositätsdetektor verwendet hierzu vier Lagen aus Silizium-Pixel-Sensoren (HV-MAPS), um mit ihnen die Spurverteilung der gestreuten Antiprotonen in Abhängigkeit vom Streuwinkel zu vermessen. Die von den Sensoren aufgenommen Treffer werden online auf GPUs mit Hilfe des Cellular Automaton Algorithmus zu Teilchenspuren zusammengefügt. Im Anschluss wird nur die Trefferinformation der Teilchenspuren archiviert, der Rest wird verworfen.

In diesem Beitrag wird der Status der Online-Spurrekonstruktion und der Datenerfassung des Lumininositätsdetektors erläutert.

*Vortragender gefördert durch die Johannes Hübner-Stiftung Giessen

HK 50.9 Do 18:45 F 3

A parametric response model for the self-triggered MRPC readout scheme of the CBM time-of-flight system — •Christian Simon and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, D-69120 Heidelberg

The design goal of the future Compressed Baryonic Matter (CBM) experiment is to measure rare probes of dense strongly interacting matter with an unprecedented accuracy. Target interaction rates of up to 10 MHz need to be processed by the detector. Compliant with the ambitious physics program a novel self-triggered digitization and readout scheme will be implemented for each subsystem of CBM. The time-of-flight (TOF) wall which should provide hadron identification at particle fluxes of up to a few tens of kHz/cm^2 is composed of high-resolution timing multi-gap resistive plate chambers (MRPCs). Due to the new readout paradigm, data analysis of in-beam tests of MRPC prototypes carried out with self-triggered electronics is accompanied by simulation efforts to model the detector response under these conditions. To avoid a computationally costly Monte Carlo treatment, the analog/digital response and load effects, i.e. the local breakdown and recovery of the electric field in the gas gaps, are parametrized. The model parameters are constrained by the requirement to reproduce measured quantities of the prototypes. A detailed description of the parametric response model will be given and its predictive power with respect to self-triggered detector data will be discussed. The project is partially funded by BMBF 05P2015 and by EU/FP7-HadronPhysic3/WP19.

HK 51: Instrumentation XII

Zeit: Donnerstag 16:45–19:00 Raum: F 072

HK 51.1 Do 16:45 F 072

Set up of a Condensed Krypton Source for the KATRIN experiment — •Stephan Dyba for the KATRIN-Collaboration — Institut für Kernphysik, Uni Münster

With the KATRIN (**KA**rlsruhe **TRI**tium **N**eutrino) experiment the endpoint region of the tritium beta decay will be measured to determine the electron-neutrino mass with a sensitivity of 0.2 eV/c^2 (90% C.L.). For the high precision which is needed to achieve the sub-eV range a MAC-E filter type spectrometer is used to analyze the electron energy by applying an electrostatic retardation potential in combination with a magnetic guiding field.

An important tool for the spatially resolved calibration of the transmission function of the KATRIN main spectrometer is the Condensed Krypton Source. This source uses a sub-monolayer ^{83m}Kr frost on a HOPG surface to generate monoenergetic conversion electrons which are guided along the magnetic field lines through the MAC-E filter onto the detector. To obtain a full coverage of all detector pixels the HOPG is moveable within the magnetic flux tube.

In this talk an overview of the system, its installation at KIT and first performance tests will be given.

This work is supported by BMBF under contract number 05A14PMA.

HK 51.2 Do 17:00 F 072

Developments for the Super-FRS Ion Catcher at the Low-Energy Branch at FAIR — •Ivan Miskun for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

At the Low-Energy Branch (LEB) of the Super-FRS at FAIR exotic nuclei will be produced at relativistic energies, separated in-flight, stopped and thermalized in cryogenic gas-filled stopping cell (CSC), and delivered to the high precision experiments MATS and LaSpec. The prototype of this CSC has been developed and successfully commissioned as part of the FRS Ion Catcher experiment at GSI. It provides areal densities up to ~ 6.3 mg/cm^2 with total efficiencies of ~ 30 %. Short extraction times of ~ 25 ms and high rate capabilities (10^4 ions of interest per second without efficiency losses) enable an access to very exotic and short-lived nuclei.

Furthermore, the design of a next-generation CSC for the LEB has been developed. The new design will incorporate a number of novel concepts, which will provide significant further improvement of the performance parameters (5 times faster extraction times, 5 times higher areal densities, three orders of magnitude higher rate capabilities, etc.). As part of the design studies for this new CSC the operation of stopping cell at extremely high electrical field strengths has been tested with the present prototype. Also, the use of collision-induced dissociation in the RFQ beamline for the breakup of adducts and as an additional separation method has been investigated.

HK 51.3 Do 17:15 F 072

Upgrade of the TRIGA Mainz UCN D source — •Jan Kahlenberg[1], Marcus Beck[1], Christopher Geppert[2], Werner Heil[1], Jan Karch[1], Sergei Karpuk[2], Tobias Reich[2], Kim Ross[1], Christian Siemensen[2], Yuri Sobolev[2], and Norbert Trautmann[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz

The upgrade of the ultra-cold neutron (UCN) source at beamport D of TRIGA Mainz has been successfully performed. A ^{58}NiMo-coated nose has led to an UCN yield increase of factor 3.5. Consequently, a UCN density of 8.5 UCN/cm^3 in a standardised volume of 32 l has been reached.

This talk presents the main results of the September and November 2016 beam times. The results convincingly prove the source's high performance and its suitability for UCN measurements at TRIGA Mainz. Supported by the PRISMA cluster of excellence, the neutron lifetime experiment τSPECT will profit from the increased UCN yield.

HK 51.4 Do 17:30 F 072

A Magnetically Driven Piston Pump for High-Purity Xenon Experiments — •Axel Buss, Christian Huhmann, Denny Schulte, Christian Weinheimer, Hans-Werner Ortjohann, Michael Murra, and Alexander Figuth — Institut für Kernphysik, Münster

In this talk, a new pump is presented which was designed for xenon gas recirculation in cooperation with the nEXO group at Stanford University and the nEXO/XENON group at Rensselaer Polytechnic Institute. It was built to meet the vast requirements of high-purity experiments like XENON1T, in terms of purity, performance and reliability. This is achieved by using a reciprocating compressor type with a magnetically driven piston. Even in a case of failure, the hermetically sealed design ensures cleanness of the pump medium at all times. Therefore the pump can be used for other applications where intrinsic safety and purity are necessary.

All parts have been carefully selected to minimize impurities and radioactive background, with the aim to reduce radon emanation below the level of commercially available pumps. At present the prototype in Münster is capable of pumping more than 100 slpm of argon at a differential pressure of 1 bar. Planned upgrades will enhance the performance further.

This project is supported by BMBF under contract 05A14PM1.

HK 51.5 Do 17:45 F 072

The Gas-Jet Target for MAGIX at MESA — •S. Grieser, D. Bonaventura, C. Hargens, A.-K. Hergemöller, B. Hetz, L. Lessmann, C. Westphälinger, and A. Khoukaz for the MAGIX-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The MAGIX experiment (MESA Gas Internal target eXperiment) will be located in the energy-recovering sector of the future electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) at the University of Mainz. There, energies up to 105 MeV with a beam current of 1 mA can be achieved. MAGIX is a fixed-target experiment with high luminosity of $10^{35}\,\frac{\text{cm}^2}{\text{s}}$, which will consist of a gas-jet target and a multi-purpose spectrometer. The experiment focuses on investigations to verify the Standard Model of particle physics. Thereby, the main interest is the search for dark photons and precision measurements of fundamental constants, e.g. the proton radius. The gas-jet target was designed and built up at the University of Münster. Gas targets continuously provide target material with constant density (e.g. $10^{19}\,\frac{\text{atoms}}{\text{cm}^2}$ directly behind the nozzle). This gas-jet target offers the possibility to be operated also in a cluster-jet mode. This can be realized by changing the pressure and temperature of the gas at the nozzle. Currently, first measurements for the characterization of the target are done. This includes a construction of a Mach-Zehnder interferometer, which is used to determine the thickness distribution and the shape of the gas-jet. The target design and the results on the beam properties will be presented. Supported by HGS-HIRe.

HK 51.6 Do 18:00 F 072

Commissioning of a detection system for forward emitted XUV photons at the ESR — M. Bussmann[3], A. Buss[6], C. Egelkamp[6], L. Eidam[9], V. Hannen[6], Z. Huang[10], D. Kiefer[4], S. Klammes[4], Th. Kühl[1,2,5], M. Löser[3], X. Ma[10], W. Nörtershäuser[1,5,7], H.-W. Ortjohann[6], R. Sánchez Alarcon[1], M. Siebold[3], Th. Stöhlker[1,2,8], J. Ullmann[6], J. Vollbrecht[6], Th. Walther[4], H. Wang[10], Ch. Weinheimer[6], D. Winters[1], and •D. Winzen[6] — [1]GSI, Darmstadt — [2]Helmholtz-Institut Jena — [3]Helmholtz-Zentrum Dresden-Rossendorf — [4]Institut für Angewandte Physik, TU Darmstadt — [5]Institut für Kernchemie, Uni Mainz — [6]Institut für Kernphysik, Uni Münster — [7]Institut für Kernphysik, TU Darmstadt — [8]Institut für Optik und Quantenelektronik, Uni Jena — [9]Institut für Theorie Elektromagnetischer Felder, TU Darmstadt —

[10]Institute of Modern Physics, Chinese Academy of Sciences

The Institut für Kernphysik in Münster developed an XUV-photon detection system for laser spectroscopy measurements at the ESR. In a test beam time for laser cooling with $^{12}C^{3+}$-ions at $\beta \approx 0.47$, the $^2S_{1/2} - ^2P_{1/2}$ transition was investigated to commission the system. The detector features a movable cathode plate which is brought into the vicinity of the beam to collect forward emitted Doppler shifted photons ($\lambda_{\text{lab}} \approx 93$ nm). The photons produce mostly low energetic (<3 eV) secondary electrons which are electromagnetically guided onto an MCP detector. First results of the beam time will be presented. This work is supported by BMBF under contract number 05P15PMFAA. D. Winzen thanks HGS-HIRe for FAIR for funding his scholarship.

HK 51.7 Do 18:15 F 072

First results of a high-precision high-voltage measurement based on collinear laser spectroscopy — •Kristian König[1], Christopher Geppert[2], Phillip Imgram[1], Jörg Krämer[1], Bernhard Maass[1], Ernst Otten[3], Tim Ratajczyk[1], Johannes Ullmann[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz — [3]Institut für Physik, Johannes Gutenberg-Universität Mainz

Many physics experiments depend on accurate high-voltage measurements to determine for example the exact retardation potential of an electron spectrometer as in the KATRIN experiment or the acceleration voltage of the ions at ISOL facilities. Until now only precision high-voltage dividers can be used to measure voltages up to 65 kV with an accuracy of 1 ppm. However, these dividers need frequent calibration and cross-checking and the direct traceability is not given. We will report on the status of the ALIVE experiment at the TU Darmstadt which aims to measure high voltages using collinear laser spectroscopy and which has the potential to provide a high-voltage standard and hence, a calibration source for precision high-voltage dividers on the 1 ppm level.

HK 51.8 Do 18:30 F 072

An Improved Charge Exchange Cell for Collinear Laser Spectroscopy — •Felix Sommer[1], Peter Müller[2], Jason Clark[2], Jörg Krämer[1], Bernhard Maass[1], Rodolfo Sanchez[3], Guy Savard[2], and Wilfried Nörtershäuser[1] — [1]IKP, TU Darmstadt, DE — [2]ANL, Chicago, USA — [3]GSI, Darmstadt, DE

Collinear laser spectroscopy (CLS) provides the opportunity to extract nuclear charge radii and magnetic dipole as well as electric quadrupole moments in a nuclear-model independent way. CLS utilizes the reduction of velocity spread via acceleration with a DC high-voltage potential of typically a few 10 kV. The isotopes of interest have to exhibit electronic transitions which are accessible with laser systems and sensitive to changes of nuclear charge radii. If these are not available from the ionic ground state, charge exchange can provide access to suitable atomic transitions.

We present an updated design of a charge exchange cell for CLS, that can hold acceleration potentials up to 30 kV and operate at temperatures above 430 °C to allow for charge exchange with magnesium vapor. The cell is developed in Darmstadt and will be used at Argonne National Laboratory (ANL), where the CAlifornium Rare Isotope Breeder Upgrade (CARIBU) opens up new possibilities for in-flight laser spectroscopy of short lived isotopes, especially in the region beyond the sudden deformation at N=60 and Z>38.

This work is supported by the U.S. DOE, Office of Science, Office of Nuclear Physics, under contract DE-AC02-06CH1135, and by the Deutsche Forschungsgemeinschaft through Grant SFB 1245.

HK 51.9 Do 18:45 F 072

Production of polarized molecules — •Hani M. Awwad — HHU, Düsseldorf, Deutschland

The payoff for a breakthrough in nuclear fusion energy would be massive, because it could provide an almost endless supply of clean energy. However research has proven to be incredibly complicated and expensive. One way of significantly reducing size and cost of the fusion devices could be the use of polarized fuel, which is known to increase the cross section of fusion reactions by 50%. Furthermore the plasma could be more easily controlled, as emission directions of fusion products can be manipulated.

This is just one reason for the growing interest in polarized molecules. In the discussed experiment (supported by DFG/RSF grant BU 2227) an atomic beam source produces polarized atoms, which then recombine to polarized molecules in a storage cell. Next the polarization of the molecules is measured in a Lamb-Shift polarimeter. Another interesting aspect is the temperature dependence of their rotational states. J=0 molecules can possibly be frozen out and stored for later use. One way to make use of them is to build polarized targets e.g. for storage rings or laser acceleration of polarized protons.

Generally understanding the nuclear spin can grant new insights in chemical reactions and may also find more applications in biology or medicine.

HK 52: HK+T Joint Session VII: Gas Detectors/GEM

Zeit: Donnerstag 16:45–19:00 Raum: F 102

Gruppenbericht HK 52.1 Do 16:45 F 102

Detectors and instrumentation for the fast-developing MAGIX experiment at MESA — •Sabato Stefano Caiazza for the MAGIX-Collaboration — KPH Institute, Johannes-Joachim-Becher-Weg 45, Mainz, Deutschland

Within the next decade a new experiment will be built and will start to be operated at the Institut für Kernphysik at the University of Mainz, exploiting the powerful electron beam of the new MESA accelerator. MAGIX aims to be a versatile apparatus which can be used to perform a broad set of experiments at the precision frontier including, but not limited to new measurements of the proton radius, searches for dark sector particles in the MeV range and high-precision nuclear cross-section measurements. To achieve this goal all the components of the setup have to be designed and developed to the limits of the current state-of-the-art and often beyond those. In this talk I will give you an overview of the challenges we face in the development of our experiment and on the most interesting solutions we are developing to overcome them, focusing in particular on the GEM based focal plane detectors and the open jet target.

HK 52.2 Do 17:15 F 102

ROPPERI - 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 und reichen an die Auflösungsgrenze von GEMs heran. Es werden Simulationen der Auslese vorgestellt, insbesondere in Hinblick auf Auflösung in Impuls und dE/dx in Abhängigkeit von der Padgröße. Sie werden verglichen mit Messungen eines ersten Prototypen. Eine mögliche Weiterentwicklung wird diskutiert.

HK 52.3 Do 17:30 F 102

Prototype of GEM based readout chamber for the upgrade of the Time Projection Chamber of ALICE — •Thomas Theodor Rudzki for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwe- rionenforschung, Planckstr. 1, 64291 Darmstadt — Physikalisches Institut, Universität Heidelberg, Im Neuenheimer Feld 226, 69120 Heidelberg

The Time Projection Chamber (TPC) of ALICE is its most important tracking detector. In its present implementation, it can handle a trigger rate up to 3 kHz. Starting from 2021, the ALICE experiment will record Pb-Pb collisions at 50 kHz making an upgrade of the TPC indispensable. For this purpose, the current multi-wire proportional chambers will be replaced by new ones equipped with GEM foils.

Recently, the first two Outer ReadOut Chambers (OROC) were assembled in Bucharest and at GSI, Darmstadt. Both OROCs were subject to extensive tests.

The talk will give an introduction to the new design of the OROC and its components and present results of perfomance tests. The focus lies on the results of the validation tests carried out with the first OROC assembled at GSI, in particular the gas tightness and the performance of the chamber under ionising radiation in terms of gain uniformity and stability.

In the end, a brief outlook of upcoming tests like a testbeam and the regular production of OROCs will be given.

HK 52.4 Do 17:45 F 102

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

Currently, High Pressure Time Projection Chambers (HP-TPC) are intensely discussed in the neutrino detector community. Employing operation pressures of up to 10 bar comes with new challenges for detector construction and gas quality monitoring. This necessitates new gas monitoring chambers, capable of measuring drift and gain properties in such a high pressure regime. This talk presents the design of such a system, operable at pressures between 1 bar and 10 bar.

HK 52.5 Do 18:00 F 102

Study of single-mask GEM foil performance for the upgrade of the ALICE TPC — •Hendrik Schulte, Esther Bartsch, Rainer Renfordt, and Harald Appelshäuser for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

In the LHC Run 3 period the interaction rate of Pb-Pb collisions will be increased to 50 kHz. To accomodate the higher rates the Time Projection Chamber (TPC) of ALICE has to be upgraded. In this upgrade the Multiwire Proportional Chambers of the TPC's readout system will be replaced by quadruple Gas Electron Multiplier (GEM) stacks that can be operated in continuous mode. However, to prevent space-charge distortions in the drift volume the backflow of positive ions has to be kept below 1%. At the same time a reasonable energy resolution has to be maintained to preserve the good particle identification capability of the TPC.

So far GEMs have been produced in two different ways. While the GEM foils used in previous tests were produced with the so-called double-mask technique, the GEMs for the final readout chambers will be mass-produced with the so-called single-mask technique.

A dedicated test detector for the characterization of quadruple GEM stacks was set up at the IKF in Frankfurt. The performance of single-mask GEM foils for different voltage settings, also in comparison with double-mask GEM foils, will be presented.

Supported by BMBF and the Helmholtz Association.

HK 52.6 Do 18:15 F 102

Discharge studies with single- and multi-GEM structures — •Piotr Gasik, Laura Fabbietti, and Andreas Mathis — TU München, Physik Department E62, Excellence Cluster "Universe", Garching

The demands of a new generation of experiments in hadron physics require a substantial further advancement of gaseous detectors. Novel devices must handle the high luminosities planned for future hadron and electron colliders as well as meet the requirements of large experiments such as the substantial increase in active detector area. Among the new innovative detector techniques, the Gas Electron Multiplier (GEM) has become a widely used technology for high-rate experiments and is also foreseen for future large-area detectors (e.g. ALICE, CMS, sPHENIX).

The key parameters for a long-term operation of GEM-based detectors in the harsh environment of high-rate experiments are radiation hardness, ageing resistance and stability against electrical discharges. Therefore, a comprehensive understanding of the discharge mechanism is mandatory to assure a stable operation of the detector.

We report on discharge probability studies in single- and multi-GEM structures in Ar- and Ne-based gas mixtures. Our experimental findings are compared to the outcome of the GEANT simulations.

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

HK 52.7 Do 18:30 F 102

Erweiterung des Würzburger Höhenstrahlungsmessstandes zur Messung des Effekts von Sauerstoff und Gasfeuchte auf das Verhalten von MicroMeGas-Detektoren — •Thorben Swirski, Raimund Ströhmer und Giovanni Siragusa — Universität Würzburg

Die Universität Würzburg betreibt einen Messstand zur Messung kosmischer Myonen, der im Jahr 2016 mit Elektronik zum Betrieb von MicroMeGas-Detektoren ausgestattet wurde.

Dieser Messstand soll nun dazu benutzt werden, den Einfluss von Gasunreinheiten, vor allem Sauerstoff und Gasfeuchte, auf die Detektoren systematisch und quantitativ zu vermessen. Der Vortrag stellt den momentanen Stand der Einrichtung zum Betrieb der MicroMeGas-Detektoren, sowie die bereits durchgeführten Änderungen an der Elektronik und notwendigen Änderungen und Anforderungen für Gaszufuhr und Gaskontrolle vor. Unter anderem werden Systeme zur Steuerung und Kontrolle des Sauerstoffgehaltes und des Wassergehaltes im Bereich von wenigen Promille benötigt, da ein Effekt schon bei kleinen Konzentrationen auftritt. Zusätzlich werden Simulationen mit Garfield++ und Magboltz vorgestellt, die einen Eindruck über den zu erwartenden Effekt ermöglichen.

HK 52.8 Do 18:45 F 102

Konzepte zur Umsetzung einer Druckkammer für Micromegas-Detektoren zur Messung von Gasverstärkungsprozessen bei variablem Druck — •Robin Boshuis, Raimund Ströhmer und Thorben Swirski — Universität Würzburg

Die Eigenschaften eines Micromegas-Detektors hängen von der Stärke des elektrischen Feldes, der Größe der Verstärkungsregion sowie des Gasdruckes ab. Da eine systematische Variation des Abstands schwierig ist, wird an der Universität Würzburg ein Aufbau entwickelt, in dem der Druck und das elektrische Feld variiert werden können.

In diesem Vortrag werden die Konzepte zur Anfertigung eines Druckgefäßes für einen Micromegas-Detektor vorgestellt. Zur Beschreibung des Verhaltens des Detektors werden Simulationsstudien unter Zuhilfenahme des Programms Garfield++ angefertigt, mit dem sich Halbleiter- und Gasdetektoren und die zugrunde liegenden Prozesse simulieren lassen. Die geplante Kammer soll in Zukunft sowohl mit Unter- als auch Überdruck betrieben werden können.

HK 53: HK+T Joint Session VIII: Pixel Detectors

Zeit: Donnerstag 16:45–19:00 Raum: F 073

Gruppenbericht HK 53.1 Do 16:45 F 073

The CBM-MVD: Group Report — •Michal Koziel for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Compressed Baryonic Matter Experiment (CBM) is one of the core experiments of the future FAIR facility. It will explore the phase diagram of strongly interacting matter in the regime of high net baryon densities with numerous probes, among them open charm. The Micro Vertex Detector (MVD) will contribute to the secondary vertex determination on a 10 μm scale, background rejection in dielectron spectroscopy and reconstruction of weak decays of multi-strange baryons. The detector comprises up to four stations placed next to the target in the vacuum. The stations are populated with 50 μm thin, highly-granular customized Monolithic Active Pixel Sensors, featuring a spatial resolution of <5 μm, a readout speed of less than 10 μs/frame, a radiation tolerance of $>10^{13}$ n_{eq}/cm^2 and 3 Mrad. This contribution will summarize recent activities towards constructing the MVD, that involve in particular: CMOS sensor development, characterization and read-out, integration and cooling aspects as well as MVD performance simulations.

*This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 53.2 Do 17:15 F 073

Passive CMOS pixel sensors as large area alternatives for HL-LHC trackers — •Ivan Dario Caicedo Sierra[1], Jochen Dingfelder[1], Tomasz Hemperek[1], Toko Hirono[1], Fabian Hügging[1], Jens Janssen[1], Hans Krüger[2], Anna Macchiolo[1], David-Leon Pohl[1], and Norbert Wermes[1] — [1]Physikalisches Institut der Universität Bonn — [2]Max-Planck-Institut für Physik in München

The large area and intensity requirements of the inner tracking detector for the High Luminosity upgrade of the Large Hadron Collider call for detector developments at an affordable cost for mass production. In this talk, we present a passive CMOS sensor as a suitable option for new hybrid pixel detector designs which could fulfill the aforementioned demands.

The devices under test were n-in-p backside biased sensor prototypes in 150 nm LFoundry CMOS technology with a thickness of 100 and 300 um. Each sensor has both AC- and DC- coupled pixel regions, bump bonded to the ATLAS FE-I4 chip.

Results from measurements with these sensors show noise levels, leakage current and charge collection efficiency -before and after irradiation- comparable to those of the current ATLAS-IBL planar sensors.

HK 53.3 Do 17:30 F 073

Development of radiation-hard 3D pixel sensors for the HL-LHC — •Jörn Lange, Emanuele Cavallaro, Fabian Förster, Sebastian Grinstein, Ivan Lopez Paz, Maria Manna, Stefano Terzo, and David Vazquez Furelos — IFAE Barcelona, Spain

3D silicon detectors, with cylindrical electrodes that penetrate the sensor bulk perpendicular to the surface, present a radiation-hard sensor technology. Due to a reduced electrode distance, trapping is less and the operational voltage and power dissipation after heavy irradiation is significantly lower than for planar devices. During the last years, the 3D technology has matured and 3D pixel detectors are already used in HEP detectors where superior radiation hardness is key: the ATLAS IBL and the ATLAS Forward Proton detector.

For the High-Luminosity upgrade of the Large Hadron Collider (HL-LHC), the radiation-hardness requirements are even more demanding with fluences up to 1–2×10^{16} n_{eq}/cm^2 for the innermost pixel layers of the ATLAS and CMS experiments. Moreover, for occupancy reasons, smaller pixel sizes of 50×50 or 25×100 μm^2 are planned.

In this work, the suitability of 3D pixel sensors for the HL-LHC innermost pixel layers is studied. Firstly, the radiation hardness of the already existing IBL/AFP generation is investigated up to HL-LHC fluences. Secondly, a new dedicated HL-LHC generation of 3D sensors is developed and tested, which is designed for the smaller pixel sizes and to even further improve the radiation hardness with smaller electrode distances. Laboratory and beam test results of 3D pixel detectors before and after irradiation will be presented.

HK 53.4 Do 17:45 F 073

Design studies on the MimoSIS pixel sensor for the CBM-MVD — •Philipp Sitzmann for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Compressed Baryonic Matter experiment at FAIR (CBM) is a dedicated fix-target experiment design to explore the QCD phase diagram in the region of high net-baryon density. One of the main physics goals is the reconstruction of short living Open Charm Mesons and Multi-Strange Hyperons. The Micro Vertex Detector (MVD) is designed to significantly increase the secondary vertex resolution and to boost near vertex tracking and reconstruction of low-momentum tracks. This detector will be equipped with CMOS Pixel Sensors developed at IPHC Strasbourg. A new generation of the sensor (MimoSIS) is developed with an improved readout aiming at a much faster readout speed below 10 μs/frame. The internal readout concept and its corresponding limitations to the occupancy is simulated in the CBM-Root Framework and tested assuming the expected beam intensities and fluctuations.

This work will present the newest results on required internal bandwith, limitations and resulting design guidelines for the employment of the new MimoSIS sensor in the CBM-MVD.
This work has been supported by BMBF (05P15RFFC1), GSI, HIC for FAIR and HGS-HIRe.

HK 53.5 Do 18:00 F 073

Edge effects of radiation damaged silicon pad diodes — •Benedict Tohermes, Eckhart Fretwurst, Erika Garutti, Michael Hufschmidt, Robert Klanner, and Jörn Schwandt — Institut für Experimentalphysik, Universität Hamburg

Edge effects for square p+n silicon pad diodes fabricated on high-ohmic silicon are investigated. Using capacitance-voltage measurements of two pad diodes with different areas and 320 μm thickness, the planar and the edge contributions to the diode capacitance are determined. For the non-irradiated pad diodes the doping profile is determined. The results with and without edge corrections differ significantly. Without edge correction the value of the bulk doping determined increases by up to 30 % over the depth of the diode, with edge correction it is uniform within ± 1.5 %, which agrees with expectation.
Edge corrections are determined both for non-irradiated diodes and for diodes irradiated to a fluence of $2.4 \cdot 10^{15}$n$_{\rm eq}$/cm^2 with 24 GeV/c protons. The edge correction for irradiated diodes is found to be larger than for non-irradiated ones.

HK 53.6 Do 18:15 F 073

Optimierung der Sensorparameter von Makropixelsensoren für das Phase II Upgrade des CMS-Trackers — Alexander Dierlamm, Thomas Müller, •Daniel Schell und Florian Wittig — Institut für Experimentelle Kernphysik (IEKP), KIT

Um die erhöhte Datenmenge während der Hochluminositätsphase des Large Hadron Colliders (LHC) verarbeiten zu können, werden für den Spurdetektor des CMS Experiments sogenannte „p_T-Module“ entwickelt, welche Teilchen mit hohem und geringem Transversalimpuls zuverlässig separieren können. Dadurch können Ereignisse mit niederenergetischen Teilchen verworfen und somit die effektive Datenrate reduziert werden. Eines dieser neuen Module ist das sogenannte PS-Modul welches aus einem Makro(P)ixel- und einem (S)treifensensor aufgebaut ist. Während die äußeren Dimensionen sowie die Anzahl der Pixel des Makropixelsensors durch die Moduldimension bzw. den Auslesechips bereits festgelegt sind, müssen Details wie die Peripherie weiter optimiert werden. Ein kritischer Punkt ist hierbei die sogenannte Punch-Through Struktur, welche es unter anderem erlaubt den Sensor vor dem Bump-Bonden der Auslesechips auf mögliche Defekte zu überprüfen. Gleichzeitig soll diese Struktur als Schutz des Auslechips dienen, indem sie hohe Ströme an der Front-End Elektronik des Chips vorbeileitet. Um diese und weitere Anforderungen zu erfüllen, nutzt die Outer-Tracker Sensorgruppe verschiedene Mess- und Simulationsprogramme um einen optimierten Parametersatz für den zukünftigen Makropixelsensor zu finden, welche in diesem Vortrag vorgestellt werden.

HK 53.7 Do 18:30 F 073

Finalizing the CBM-MVD Geometry: CAD and Simulation — •Philipp Klaus for the CBM-MVD-Collaboration — Goethe-Universität, Frankfurt

The Compressed Baryonic Matter experiment (CBM) at FAIR is a dedicated fix-target experiment designed to explore the QCD phase diagram in the region of high net-baryon density. The talk will review the concluding studies on the geometry of its Micro Vertex Detector (MVD) comprising up to four planar stations equipped with monolithic active pixel sensors close to the target. In order to perform optimally in different physics cases, tweaking the station positioning for each case is considered. In addition, recent updates of the sensor dimensions require small changes to the detector geometry.

In this process, it became evident that improved procedures and tools are required to keep mechanical integration models (CAD) and detector simulation models in sync. This contribution will discuss established methods and their advantages/disadvantages.

*This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 53.8 Do 18:45 F 073

Serial Powering Pixel Stave Prototype for the 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.

One of the main challenges for the ATLAS ITk Phase II Pixel upgrade is low mass efficient power distribution to power detector modules. This requires a powering scheme alternative to the parallel (direct) powering which is currently used. Serial powering scheme has been chosen as the baseline for the ITk pixel system.

The talk will focus on a serially powered pixel stave prototype which has been built with all the components that are needed for current distribution, data transmission, bypassing and redundancy in order to prove the feasibility of implementing serial powering scheme in the

ITk. Detailed investigations of the electrical performance of the detector prototype equipped with FE-I4 quad modules will be shown.

HK 54: HK+T Joint Session IX: Calorimeter

Zeit: Donnerstag 16:45–19:05 Raum: F 234

Gruppenbericht HK 54.1 Do 16:45 F 234

Final Design and Construction of the EMC for the PANDA Experiment — •Miriam Kümmel for the PANDA-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum

The PANDA experiment is a key experiment at the future accelerator facility FAIR, under construction in Darmstadt, Germany. Open questions in hadron physics will be addressed by studying collisions of an antiproton beam with a fixed target at antiproton momenta between 1.5 GeV/c and 15 GeV/c.

An electromagnetic calorimeter (EMC) is used to determine the energy of electrons, positrons and photons. This information is essential to fully reconstruct the 4-momenta of all collision products. The homogeneous calorimeter is equipped with lead tungstate scintillation crystals, which were chosen due to their fast signal decay time, compactness as well as radiation hardness. The EMC is subdivided into a barrel part and two endcaps. The forward endcap will be exposed to the highest hit rates and radiation dose which puts very high demands on the performance of this subdetector. To increase the light yield, the electromagnetic calorimeter will be operated at -25°C.

This talk will provide an overview of the final design and construction status of the EMC. The mechanical support structure, the cooling system, the assembly of calorimeter subunits, the matching of crystals, photosensors and preamplifiers to achieve a homogeneous signal yield, the signal digitization as well as environmental and optical monitoring systems will be presented.

This project is supported by the BMBF.

HK 54.2 Do 17:15 F 234

Studies on 2015 testbeam data of a highly granular hadron calorimeter prototype — •Sascha Krause for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz, Germany

An Analog Hadronic Calorimeter (AHCAL) is being developed within the CALICE collaboration for the planned International Linear Collider (ILC). To achieve the required energy resolution for jets, the Particle Flow Algorithm has been proposed for the event reconstruction. One major requirement for this algorithm is a highly granular calorimeter. Therefore, about 8 million detector units consisting of scintillator tiles and silicon photomultipliers (SiPMs) will be installed in the final HCAL design. During a CERN SPS testbeam in 2015, data with a prototype consisting of up to 11 layers of HCAL Base Units (HBU) was collected using muon, electron and pion beams. A special feature was the first automatically assembled HBU including 144 scintillator tiles and surface mounted SiPMs. After several calibration steps and event selections, the testbeam data can be compared to a MC simulation of the prototype. First results of this comparison will be presented, testing the performance of the prototype.

Gruppenbericht HK 54.3 Do 17:30 F 234

Sensors for the CMS High Granularity Calorimeter — •Andreas Maier — CERN, Genf, Schweiz

The Particle Flow Algorithm (PFA) is increasingly used in particle physics as a powerful tool to improve jet energy resolution. Recent technology advances allow to fully exploit PFA by combining precise tracking with fine-grained calorimetry. The CMS experiment is currently developing high granularity calorimeter endcaps for its HL-LHC upgrade (CMS HGCAL). The electromagnetic part, as well as the first layers of the hadronic part, foresees silicon sensors as the active material. This technology is similar to the silicon-based ECAL developed in the framework of the Linear Collider by the CALICE collaboration. In this talk the current status of the HGCAL silicon sensor development is presented. First results of single diode measurements are shown, as well as tests of full 6-inch hexagonal sensor wafers with 135 cells in the laboratory and in beam tests.

HK 54.4 Do 17:50 F 234

The CMS High-Granularity Endcap Calorimeter: Test Beam and Sensor Tests at CERN — Martin Erdmann[1], •Thorben Quast[1,2], and Eva Sicking[2] — [1]Physics Institute IIIA, RWTH Aachen, Germany — [2]CERN, Geneva, Switzerland

Fine-grained calorimetry has been explored for future e+e- experiments at ILC and CLIC for several years. CMS is developing high-granularity endcap calorimeters (HGCAL) for its HL-LHC upgrade. After a quick overview to the CMS HGCAL project, the talk summarises results from silicon sensor testing and test beam experiments carried out at CERN in 2016. In this context, an energy reconstruction approach based on convolutional deep neural networks is presented to assess the image-like character of the recorded data. Its application for the HGCAL is evaluated and compared to standard energy reconstruction algorithms.

HK 54.5 Do 18:05 F 234

The crystal Zero Degree Detector at BESIII — Achim Denig[1], Peter Drexler[1], •Brice Garillon[1], Leonard Koch[2], Wolfgang Kühn[2], Sören Lange[2], Werner Lauth[1], Yutie Liang[2], Torben Rathmann[1], and Christoph Redmer[1] for the BESIII-Collaboration — [1]Johannes Gutenberg Universität Mainz — [2]Justus-Liebig-Universität Gießen

The BESIII experiment based at the BEPCII e^+e^- collider (Beijing, China) is investigating physics in the charm-τ region. Processes in which the particles emission peaks towards small polar angles, such as photons from initial state radiation (ISR) or scattered leptons from $\gamma\gamma$ collisions, are detected with limited efficiency.

In order to improve their detections, we propose two small calorimeters placed at the very forward/backward angles. Each detector is composed of two arrays of 4x3 rectangular-shaped scintillating LYSO crystals, separated by a gap. The scintillation light will be collected by silicon photomultipliers (SiPMs) and the signals will be digitized using sampling Analog-to-Digital Converters (ADC).

In this contribution, we present a performance study of the detectors, based on a Geant4 simulation of BESIII, as well as the results from the tests of the LYSO crystals and the read-out electronics using radioactive sources and electron beams at the MAMI accelerator.

This work is supported by the DFG under contract No. CRC 1044.

HK 54.6 Do 18:20 F 234

Automatic assembly and test of CALICE second generation SMD readout boards — •Phi Chau for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz

The CALICE collaboration is developing an analog hadronic sampling calorimeter (AHCAL) for the International Linear Collider (ILC) using scintillator with silicon photomultiplier (SiPM) readout. Due to an optimization of the design for particle flow algorithm, small detection units are necessary. This leads to a high number of channels for the AHCAL (in total around 8.000.000) which represents a challenge for the construction and calibration in a suitable time window. To assure a fast assembly of the detection units the design of the readout board are optimized for an automatic assembly process. This presentation will show the automatic assembly of this optimized second generation readout boards (6 boards x 144 channels) and the very good performances of these boards measured in an integrated cosmic ray test stand. Also preparations for the 2017 assembly run of a large number of readout boards (with around 20.000 channels) are shown.

HK 54.7 Do 18:35 F 234

Response of a prototype for the PANDA barrel EMC to tagged photons in an energy range from 50 MeV to 800 MeV — •Benjamin Wohlfahrt[1], Kai-Thomas Brinkmann[1], Stefan Diehl[1], Christopher Hahn[1], Markus Moritz[1], Rainer Novotny[1], Christoph Rosenbaum[1], Andrea Wilms[2], and Hans-Georg Zaunick[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus Liebig Universität Gießen — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The PANDA experiment will investigate physics in the strongly interacting regime via antiproton - proton annihilations. The PANDA detector will comprise a target spectrometer as well as a dedicated forward spectrometer. In the target region, a barrel-shaped electromagnetic calorimeter with end-caps on both sides will be used. It will play a major role by detecting photons utilizing about 15500 PbWO4 crystals. A subsection of the barrel EMC has been implemented as a prototype, consisting of 120 crystals of which each is read out by two independent Avalanche Photo Diodes. To ensure that the Barrel-EMC fulfills all requirements, the response of this prototype has been tested with tagged photons in an energy range from 50 MeV to 800 MeV at the MAMI-facility in Mainz. This contribution will report about the energy resolution achieved with a 5x5 array of crystals within the prototype and will compare different calibration studies. In addition, the matching procedure of the two APDs for each crystal and their cross-calibration will be discussed. *The Project is supported by BMBF, GSI and HIC for FAIR

HK 54.8 Do 18:50 F 234

Megatile studies and development for the mass assembly of a highly granular hadron calorimeter — •Yong Liu for the CALICE-D-Collaboration — Institut für Physik, Johannes Gutenberg-Universät Mainz, 55099 Mainz, Germany

A large 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. We have developed a novel design of scintillator tiles directly coupled to surface-mounted SiPMs, which addresses the challenge from automated mass assembly of around 8 million channels of the final HCAL detector. This design has been realized in 7 HCAL readout boards with a total of 1008 channels have been successfully built via mass assembly, and this design has been adopted as the baseline design for the large prototype construction. To further simplify mass assembly, various designs based on large scintillator plates with embedded structures for optical segementation ("megatiles") have been developed. Simulation studies as well as prototype developments and measurements will be presented in detail.

HK 55: Hauptvorträge III

Zeit: Freitag 8:30–10:30 Raum: F 1

Hauptvortrag HK 55.1 Fr 8:30 F 1

Heavy-ion collisions at the LHC - theory overview — •Urs Achim Wiedemann — CERN TH, Geneva, Switzerland

The standard model of ultra-relativistic heavy ion collisions is based on the picture that viscous relativistic fluid dynamics can account for the time evolution of the dense QCD matter produced in the nuclear overlap area of nucleus-nucleus collisions. This transient QCD fluid attenuates the production of high momentum-transfer processes. Based on the experimental evidence supporting this picture, my talk will review the current theoretical understanding and open challenges.

Hauptvortrag HK 55.2 Fr 9:10 F 1

The BESII and PANDA experiments — •Cristina Morales — Helmholtz-Institut Mainz, Staudingerweg 18, 55128 Mainz

The Standard Model of particle physics leaves open questions related to Quantum Chromodynamics in the non-perturbative regime, like the formation of hadronic matter, the spectrum of hadronic states, etc. Low energy accelerators like the Beijing Electron Positron Collider (BEPCII) with the BESIII spectrometer and the Facility for Antiproton and Ion Research (FAIR) with the $\overline{\text{P}}$ANDA detector in Darmstadt, can address these questions. BEPCII operates at $\sqrt{s}$ between 2 to 4.6 GeV/c^2 and achieved the design luminosity of $1.0\times10^{33}\text{cm}^{-2}\text{s}^{-1}$. BESIII is a multi-purpose cylindrical detector with 93% of 4π geometrical acceptance and has collected, e.g. the largest exclusive charmonium data sets. These data allow to address a broad range of physics topics with high precision, like charmonium and charm physics, hadron studies, determination of the tau mass, R measurements, and investigations of the XYZ particles. FAIR will provide $\overline{\text{P}}$ANDA with antiproton beams of unprecedented intensity (luminosities up to $2\times10^{32}\text{cm}^{-2}\text{s}^{-1}$) and momentum resolution ($\Delta p/p = 10^{-5}$), corresponding to $\sqrt{s} = 2.25$ to 5.47 GeV/c^2. $\overline{\text{P}}$ANDA will be a state-of-the-art, fixed proton targed experiment with a detector designed for a wide physics program including spectroscopy of QCD bound states, hadron structure measurements, production of hyperons and the study of the properties of hadrons in medium. In this talk, the BESIII and $\overline{\text{P}}$ANDA experiments will be described together with aspects of their physics programs and a selection of their results and expectations.

Hauptvortrag HK 55.3 Fr 9:50 F 1

Baryons as bound states of quarks — •Gernot Eichmann — Justus-Liebig-Universität Giessen

Hadrons are bound states of the strong interaction, with mesons as quark-antiquark states and baryons made of three valence quarks. Since most of what we know about the quarks and gluons inside hadrons comes from our knowledge of the nucleon, a combined understanding of the nucleon and its resonances within Quantum Chromodynamics (QCD) is a major goal in studying the strong interaction. In the past years much progress has been made in the description of hadrons from first principles using functional methods. The basic ingredients are QCD's n-point functions which are solved self-consistently and enter in the subsequent calculation of hadron masses, form factors and scattering amplitudes. This allows for a combined description of baryons, light and heavy mesons, tetraquarks and other observables from the same underlying building blocks.

In this talk I will focus on baryons and review recent results for the light baryon spectrum, obtained from solving the genuine three-body equation as well as its quark-diquark simplification. Both approaches yield similar results, which underlines the role of diquark correlations within baryons. The resulting baryons carry a rich structure with relativistically induced orbital angular momentum that would be forbidden in the non-relativistic quark model. I will conclude with a brief survey of other recent applications, including meson and baryon form factors, the light scalar mesons as tetraquarks, and the muon anomalous magnetic moment.

HK 56: Hauptvorträge IV

Zeit: Freitag 11:00–12:20 Raum: F 1

Hauptvortrag HK 56.1 Fr 11:00 F 1

The origin of low-lying collective E1 and E2 strength in atomic nuclei — •Mark Spieker — Institute for Nuclear Physics, University of Cologne

In the atomic nucleus, global isospin symmetry between the constituent protons and neutrons has often been considered as a feature of the strong interaction [1]. However, it is a well-known fact that rather local than global isospin symmetry is realized, see, *e.g.*, [2]. Low-lying collective E1 and E2 strengths provide a powerful tool to study the mechanisms by which isospin symmetry is fully or partly broken. In this talk two generating mechanisms of electric dipole and quadrupole collectivity below the particle-emission thresholds will be discussed. First, the α-cluster dipole mode, i.e. the dipole-type oscillation of an α-particle against the remaining bulk will be introduced as a possible generator of low-lying E1 strength in medium-mass and heavy nuclei [3]. Secondly, the comprehensive experimental study of E2 strength in the Sn isotopes will be presented to highlight the quadrupole-type oscillation of the neutron skin against the isopin-saturated core as a possible generator of low-lying E2 strength [4].

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Hauptvortrag HK 56.2 Fr 11:40 F 1

Radionuclides for medical applications — •Ulli Köster — Institut Laue-Langevin, Grenoble, France

Ionizing radiation plays an important role in many medical applications. Not only the specialties radiology, radiotherapy and nuclear medicine rely on ionizing radiation, but also radioguided surgery, certain dermatology procedures, research and development of new pharmaceuticals, etc. Last but not least about half of all medical devices are sterilized by ionizing radiation before use.

The dominating radionuclides in diagnostic nuclear medicine are ^{99m}Tc for SPECT (single photon emission computed tomography) and ^{18}F for PET (positron emission tomography). These work horses are complemented by other diagnostic radionuclides with shorter or longer half-lives or different chemical properties to cover a wide range of applications. Therapeutic applications of radiopharmaceuticals were so far restricted to relatively rare diseases (e.g. thyroid cancer), but new targeted radionuclide therapies for different types of cancer and other diseases are now coming into clinical practice. The future holds great promise for *theranostics*, a type of personalized medicine where a targeted radionuclide therapy is individually optimized based on imaging with a companion diagnostic radiopharmaceutical. Such applications are ideally performed with so-called *matched pairs* of diagnostic and therapeutic radionuclides of the same chemical element.

The presentation will discuss medical applications of radionuclides and the respective production methods. A particular emphasis is made on synergies with nuclear physics research facilities.

HK 57: Hadron Structure and Spectroscopy VII

Zeit: Freitag 14:00–16:15 Raum: F 5

Gruppenbericht HK 57.1 Fr 14:00 F 5

Measurement of electromagnetic transition form factors in two-photon collisions at BESIII — •Christoph Florian Redmer, Achim Denig, Brice Garillon, and Yuping Guo for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Electromagnetic transition form factors of light pseudoscalar mesons are important inputs to the calculations of the hadronic light-by-light scattering contribution to the Standard Model prediction of the anomalous magnetic moment of the muon. Data at the relevant regions of momentum transfer are scarce. The BESIII experiment at the e^+e^- collider BEPCII has collected more than 10 fb^{-1} of data at center-of-mass energies between 2.0 and 4.6 GeV/c^2. The data sets are analyzed for two-photon collisions in events of the type $e^+e^- \to e^+e^-\mathcal{P}$, with $\mathcal{P} = \pi^0, \eta^{(\prime)}, \pi^0\pi^0$, and $\pi^+\pi^-$. The aim is to study the momentum dependence of the respective electromagnetic transition form factors in the space-like regime. In this presentation we discuss the current status and the prospects of the ongoing analyses.

Gruppenbericht HK 57.2 Fr 14:30 F 5

Studies of Meson Decays with the Crystal Ball/TAPS setup at MAMI — •Patrik Adlarson — Institut für Kernphysik, Johannes Gutenberg Universität, Mainz, Germany

Precision studies of light meson decays are used to investigate a wide range of topics related to fundamental aspects of hadron physics. Precision measurements of meson Dalitz decays give input to hadronic determinations of the light-by-light contribution to the anomalous magnetic moment of the muon. Pseudoscalar η' decays allow for studies of such diverse topics as $\pi\pi$ scattering lengths, the SU(3) singlet-octet mixing angle, effective field theory and fundamental symmetries. Recently, a large statistics sample of η' (ω) mesons have been produced and collected with the Crystal Ball/TAPS setup at MAMI. An overview of the physics motivations, the experimental setup and recent results are presented.

HK 57.3 Fr 15:00 F 5

Monte Carlo Event Generation with Radiative QED processes in Deep-Inelastic Scattering. — •Nicolas PIERRE — for the COMPASS collaboration, Institut für Kernphysik, Mainz, Germany

In order to apply QED corrections in the extraction of 1-photon cross-sections in deep-inelastic scattering, radiation of photon have to be taken into account. In the COMPASS experiment, the production of hadrons is studied by scattering 160 GeV muons on nucleons. Radiation of photons from various ranges of kinematics, which is calculated using information from the scattered muon, thus happens. To correct for this effect, this radiation has to be taken care of in the Monte Carlo simulation used to obtain the acceptance.

The DJANGOH event generator, working along with LEPTO and JETSET, is chosen as it describes well our data. The implementation into the Monte Carlo chain and the results obtained will be discussed.

HK 57.4 Fr 15:15 F 5

Analysis of 2016 COMPASS data on DVCS — •Johannes Giarra — for the COMPASS Collaboration, Institut für Kernphysik, Mainz, Germany

The COMPASS Experiment is a fixed target experiment at the M2 beamline at CERN. In 2016 deeply virtual compton scattering (DVCS) was measured by scattering a polarized positive and negative charged muon beam off a liquid hydrogen target. From these measurements the charge and spin cross section difference can be determined. This difference is related to a generalized parton distribution function, which allows to study the three dimensional structure of the proton. The talk will discuss the status of the ongoing analysis with a focus on determination of the luminosity and comparison of the data taken with the positive and negative charged muon beam.

HK 57.5 Fr 15:30 F 5

Status of the analysis of the $\eta' \to \omega\gamma$ relative branching ratio — •Andreas Neiser and Wolfgang Gradl for the A2-Collaboration — Institut für Kernphysik, Universität Mainz

The A2 collaboration at the electron accelerator MAMI in Mainz uses energy-tagged photons to produce light mesons off the nucleon. In 2014, three dedicated beamtimes for the production of η' mesons off unpolarized protons yielded a data sample of $\approx 6 \times 10^6$ η' mesons within an incident photon energy range $E_\gamma = 1.42 \ldots 1.58$ GeV.

The A2 detector system mainly consists of the 4π calorimeter Crystal Ball and the TAPS calorimeter in forward direction, which are ideally suited to detect neutral final states in the given energy range.

We present the status of the analysis for the relative branching ratio of the pseudoscalar-vector-gamma decay $\eta' \to \omega\gamma$ to the reference channel $\eta' \to 2\gamma$. We show the extraction of the value based on Monte Carlo studies and give estimates of the expected uncertainties of our measurement. The result serves as an input to effective field theories of the strong interaction, especially concerning η-η'-mixing and the consistent inclusion of vector mesons.

HK 57.6 Fr 15:45 F 5

Study of Light Mesons in Two-Photon Fusion at BESIII — •Marvin Richter for the BESIII-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum

The BESIII experiment at the symmetric electron-positron collider BEPCII in Beijing has recorded large data samples at center of mass energies up to 4.6 GeV. The data recorded above the $\psi(2S)$ resonance is well suited to study the production of light meson resonances in two-photon fusion.

From these processes the two-photon width of contributing resonances can be derived, which is an important measure to understand their nature. Various final states are studied to access resonances such as $\eta(1405)$ and $\eta(1475)$, which are discussed to be an admixture of conventional $q\bar{q}$ states and a glueball. For these efforts the two-photon event generator GamGam previously utilized by the CLEOc and BaBar collaborations has been migrated from Fortran77 to C++ and optimized. In this contribution preliminary results and the status of the event generator are presented.

This work is supported by the DFG (FOR 2359)

HK 57.7 Fr 16:00 F 5

Baryon electromagnetic transitions in pion induced reactions with HADES — •Federico Scozzi for the HADES-Collaboration — TU Darmstadt, Germany — IPN Orsay, France

Several experiments showed an enhancement in di-lepton invariant mass spectra below the vector meson pole both in proton-nucleus and in nucleus-nucleus collisions. The main interpretation of this effect is based on the strong coupling of the ρ meson to the baryonic resonances. In summer 2014 data were taken with the High Acceptance Di-Electron Spectrometer (HADES) at GSI in pion-induced reactions with the aim to study the coupling of the ρ with the baryonic resonances in the second resonance region by means of the reactions $\pi^- p \to \pi^+\pi^- n$ and $\pi^- p \to \pi^0\pi^- p$. In addition, the role of the ρ meson in electromagnetic transitions in the time-like region is investigated in the reaction $\pi^- p \to e^+e^- n$. In this contribution results of dilepton invariant mass spectra will be presented in comparison with different models. In addition, the connection with the two-pion production channels allows to investigate the validity of the Vector Dominance Model. Finally the angular distributions of the leptons, which contain additional information on the electromagnetic properties of the different contributions, will be discussed.

This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 58: Heavy Ion Collisions and QCD Phases XI

Zeit: Freitag 14:00–16:15 Raum: F 1

Gruppenbericht HK 58.1 Fr 14:00 F 1

Reconstruction of short lived mesons and baryons in HADES — •Georgy Kornakov for the HADES-Collaboration — Technische Universität Darmstadt

The measurement of hadron properties in hot and dense QCD matter is one of the important goals in nuclear physics. HADES measures rare and penetrating probes in elementary and heavy-ion collisions in the regime of 1 - 2 GeV kinetic energy per nucleon. Throughout the fireball evolution, mesons are mainly produced from the excitation and decay of baryonic resonances. Furthermore, the excited baryons make a significant contribution to the dilepton emission but also play an important role in the production of strange particles. The reconstruction of short-lived (∼1 fm/c) resonance states through their decay products is notoriously difficult. We have developed a new iterative algorithm, which can build the multi-differential background distribution from real data. This allows us to extract signals with signal-to-background ratios below 1%. In this contribution we will demonstrate the performance of the procedure studying inclusive πp and $\pi\pi$ final states in pion-induced reactions. Then, the differential spectra measured in Au+Au collisions at 1.23 AGeV will be discussed. Apparent resonances mass shifts and broadening as a function of centrality and transverse momentum will be elaborated. This work has been supported by TU Darmstadt: VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 58.2 Fr 14:30 F 1

Many-body reactions in baryon-antibaryon annihilation including strangeness — •Eduard Seifert and Wolfgang Cassing — Intitut für Theoretische Physik, JLU Gießen, Deutschland

We study the impact of baryon-antibaryon annihilation into three mesons on heavy-ion collisions. The reactions are based on the quark rearrangement model in the light and strange sector. Box simulations with periodic boundary conditions confirm that our implementation of these reactions fulfills the detailed balance relation on a channel by channel basis. We implement these reactions into the Parton Hadron String Dynamics (PHSD) transport model and investigate their importance for different bombarding energies in Pb+Pb and Au+Au collisions. We find a significant impact on antibaryons as their total abundance is low and sensitive to the introduced reactions.

HK 58.3 Fr 14:45 F 1

Reconstruction of short-lived particles with neutral daughter by the missing mass method — Ivan Kisel[1,2,3], •Pavel Kisel[1,3,4], Peter Senger[3], Iouri Vassiliev[3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Joint Institute for Nuclear Research

The main goal of modern heavy-ion experiments is a comprehensive study of the QCD phase diagram, in a region of Qaurk-Gluon Plasma (QGP) and possible phase transition to QGP phase.

One of possible signals of QGP formation is enhanced strangeness production. Reconstruction of Σ particles together with other strange particles completes the picture of strangeness production. Σ+ and Σ- have all decay modes with at least one neutral daughter, which can not be registered by the CBM detector.

For their identification the missing mass method is proposed: a) tracks of the mother (Σ-) and the charged daughter (π-) particles are reconstructed in the tracking system; b) the neutral daughter particle (n) is reconstructed from these tracks; c) a mass constraint is set on the reconstructed neutral daughter; d) the mother particle is constructed of the charged and reconstructed neutral daughter particles and the mass spectrum is obtained, by which the particle can be identified.

The method can be applied for other strange particles too. In total 18 particle decays with neutral daughter are now included into physics analysis.

HK 58.4 Fr 15:00 F 1

Nuclear Matter with Fluctuations beyond Local Potential Approximation — •Johannes Weyrich and Lorenz von Smekal — JLU Gießen

We describe the liquid-gas transition of nuclear matter together with chiral symmetry restoration in the high baryon-density phase considering a chiral baryon-meson model for nucleons and their parity partners in mirror assignment interacting with pions, sigma and omega mesons. Beyond mean-field fluctuations have been included within the functional renormalization group in the local potential approximation (LPA) and do not lead to major qualitative changes in the phase diagram of the model. A clear first-order chiral transition at low temperatures inside the high baryon-density phase appears to be robust. An extension beyond LPA including scale dependent wave function renormalization factors for baryons and mesons is an important step towards developing a quark-meson-baryon model for a more realistic description of nuclear matter and the transition to chiral quark matter.

HK 58.5 Fr 15:15 F 1

Event-by-Event Fluctuations of the Mean Transverse Momentum in pp, p–Pb and Pb–Pb Collisions with ALICE — •Stefan Heckel for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Event-by-event mean transverse momentum (p_T) fluctuations in pp and Pb–Pb collisions have been measured by ALICE at the LHC [1]. In both systems, non-statistical fluctuations relative to mean p_T are observed which decrease with increasing multiplicity following the same power-law like behaviour up to mid-central Pb–Pb collisions. In central Pb–Pb, a strong reduction of the fluctuations is observed.

In the present analysis, also p–Pb collisions are studied as a function of multiplicity, where a similar trend to that of pp and Pb–Pb collisions is observed. The results are examined in terms of a transition from small to large collision systems and compared to model calculations.

Supported by BMBF and the Helmholtz Association.

[1] ALICE Collaboration, B. Abelev et al., Eur. Phys. J. C **74** (2014) 3077. arXiv:1407.5530 [nucl-ex]

HK 58.6 Fr 15:30 F 1

Higher-Order Moments of Proton-Number Fluctuations in Au+Au Collisions at 1.23A GeV with HADES — •Melanie Szala for the HADES-Collaboration — Goethe Universität Frankfurt

Higher-order moments of conserved quantities are predicted to be sensitive to a first order phase transition and especially to a critical point of the QCD phase diagram. Strong fluctuations would indeed modify these moments.

The HADES experiment at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt measured Au+Au collisions at $\sqrt{s_{NN}} = 2.41$ GeV in 2012 and thus allows to extend the data taken in the RHIC Beam Energy Scan to lower energies.

In this talk we present investigations of the higher moments of proton and deuteron multiplicity distributions. Our results are compared with published RHIC data.

This work has been supported by BMBF (05P15RFFCA), GSI and HIC for FAIR.

HK 58.7 Fr 15:45 F 1

Centrality and pseudorapidity dependence of identified-particle ratio fluctuations in Pb–Pb collisions in ALICE — •Mesut Arslandok for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg, Germany

We report on event-by-event fluctuations of identified particles in Pb–Pb collisions at $\sqrt{s_{\rm NN}}$=2.76 TeV, recorded by the ALICE detector at the CERN LHC. The ALICE detector is well-suited for such studies due to its excellent particle identification capabilities. The first results on identified particle ratio fluctuations in Pb–Pb collisions as a function of centrality and pseudorapidity are presented. The results for the peripheral events indicate an increasing correlation between pions and protons which is not reproduced by the HIJING and AMPT models. On the other hand, for the most central events the ALICE results agree with the extrapolations based on the data at lower energies from the CERN-SPS and BNL-RHIC.

Supported by BMBF and SFB 1225 ISOQUANT.

HK 58.8 Fr 16:00 F 1

Color transparency in semiexclusive $A(\pi^-, l^+l^-)$ process — •Alexei Larionov[1], Mark Strikman[2], and Marcus Bleicher[3,4] — [1]National Research Center "Kurchatov Institute", 123182 Moscow, Russia — [2]Pennsylvania State University, University Park, PA 16802, USA — [3]Frankfurt Institute for Advanced Studies (FIAS), D-60438 Frankfurt am Main, Germany — [4]Institut für Theoretische Physik, J.W. Goethe-Universität, D-60438 Frankfurt am Main, Germany

Color transparency (CT) phenomenon is known as a suppression of the interaction of small color singlet $q\bar{q}$ or qqq configurations with nucleons. The CT is expected when the quark configuration was created in a large momentum transfer process. Apart from being of interest by itself as a genuine QCD effect, the observation of CT in the processes with nuclear targets is a necessary condition for the corresponding elementary process to be describable within the factorization technique. In this talk we consider the possible CT effect in the semiexclusive $A(\pi^-, l^+l^-)$ process at $p_{\rm lab} = 15 - 20$ GeV/c at small $|t|$ and large invariant mass of the dilepton pair l^+l^- [1]. Based on the size of the pionic $q\bar{q}$ configuration extracted from the semiexclusive $A(e, e'\pi^+)$ process measured at JLab, we predict very significant CT effects in $A(\pi^-, l^+l^-)$ reaction. The observation of these CT effects would provide an additional confidence on the possibility to extract the generalized parton distributions of the nucleon from the elementary reaction $\pi^- p \to l^+l^- n$ at similar kinematics.

[1] A.B. Larionov, M. Strikman, M. Bleicher, Phys. Rev. C **93** (2016) 034618; arXiv:1601.00189

HK 59: Heavy Ion Collisions and QCD Phases XII

Zeit: Freitag 14:00–16:15 Raum: F 3

Gruppenbericht HK 59.1 Fr 14:00 F 3

Strange News from HADES — •Manuel Lorenz for the HADES-Collaboration — Goethe-Universität Frankfurt

Strangeness production in heavy-ion collisions at energies below the free NN production threshold is an excellent tool to study medium properties of dense baryonic systems. For the first time, a nearly complete set of strange particles has been reconstructed in the 40% most central Au+Au collisions at 1.23A GeV. The multiplicities, together with those for non-strange hadrons, have been analyzed in the context of statistical hadronization models. We find a good agreement between data and model yields, if an additional parameter (R_c) handeling strangeness suppression is included. We find that about 30% of observed K^- are produced through ϕ-decay. If the observed K^- transverse momentum spectra are corrected for feed down from ϕ, we can fully explain the previously observed differences with respect to the K^+. Hence, no need for additional channels like e.g. strangeness exchange reactions are needed to explain the observed differences in inverse slope parameters of charged kaons, supporting also the assumption of a homogenous emission source for all particle types. This work has been supported by BMBF (05P15RFFCA), GSI and HIC for FAIR.

Gruppenbericht HK 59.2 Fr 14:30 F 3

Chiral symmetry restoration as seen by the K^+/π^+ ratio in heavy-ion collisions from PHSD transport approach — •Alessia Palmese[1], Wolfgang Cassing[1], Eduard Seifert[1], Thorsten Steinert[1], Pierre Moreau[2], and Elena Bratkovskaya[2,3] — [1]Institute for Theoretical Physics, University of Giessen, Giessen, Germany — [2]Institute for Theoretical Physics, Johann Wolfgang Goethe University, Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany

The Parton-Hadron-String-Dynamics (PHSD) is a microscopic off-shell transport approach, which successfully describes Heavy-Ion Collisions (HIC) in a wide range of energies from SIS to LHC energies. The PHSD includes the deconfinement phase transition as well as essential aspects of Chiral Symmetry Restoration (CSR) in the dense and hot hadronic medium, which are incorporated in the Schwinger mechanism for the hadronic particle production. We find that the CSR effects can be identified in many observables like particle ratios and rapidity spectra and provide the first microscopic explanation for the 'horn'-structure in the excitation function of the K^+/π^+ ratio. We study also the system size and centrality dependence of the strangeness production in HICs, in particular the appearance/disappearance of the 'horn'-structure of the K^+/π^+ and $(\Lambda + \Sigma^0)/\pi$ ratios in A+A and p+A collisions. The impact of CSR on the directed flow of charged hadrons is discussed in context of the data from the beam-energy-scan program at RHIC.

HK 59.3 Fr 15:00 F 3

Kaon and phi production in pion-induced reactions at 1.7 GeV/c — •Joana Wirth[1,2], Laura Fabbietti[1,2], Steffen Maurus[1,2], and Alessandro Scordo[3] for the HADES-Collaboration — [1]Physik Department, TUM, Garching, Germany — [2]Excellence Cluster "Universe", Garching, Germany — [3]LNF, INFN, Frascati, Italy

The production and properties of K^+, K^- and Φ in cold nuclear matter generated in pion-nucleon reactions ($\pi^- + A$, $A = C, W$) at $p_{\pi^-} = 1.7$ GeV/c has been investigated with the HADES detector at GSI.
Of particular interest is the K^- absorption in nuclear matter which should be apparent through strangeness exchange processes ($K^- N \to Y\pi$), contrary to the K^+ with no conventional absorption mechanism due to strangeness conservation. In this context also the Φ absorption ($\Phi \to K^+K^-$, $BR \sim 48.9\%$) is studied in light and heavy nuclei.
In this talk we are presenting the K^- absorption on the basis of the K^-/K^+ ratios in both nuclear environments and obtained cross-sections inside the HADES acceptance. In addition the Φ absorption in nuclear medium by comparing the production in carbon and tungsten is shown as well as the K^- production in terms of the Φ feed-down.

∗ supported by the DFG cluster of excellence "Origin and Structure of the Universe and SFB 1258"

HK 59.4 Fr 15:15 F 3

Strange particle production in nucleus-nucleus collisions at SIS energies — •Vinzent Steinberg[1,2], Ömür Erkiner[1,2], Dmytro Oliinychenko[1,4], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Straße 1, 60438 Frankfurt am Main, Germany — [2]Institute for Theoretical Physics, Goethe University Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [4]Bogolyubov Institute for Theoretical Physics, 14-b, Metrolohichna str., 03680 Kiev, Ukraine

SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) is a new hadronic transport model designed to describe the non-equilibrium evolution of heavy-ion collisions. We study two different strangeness production mechanisms: one based on resonances and another one using forced canonical thermalization. Both approaches are compared to HADES and KAOS measurements of particle yields, momentum spectra and flow.

HK 59.5 Fr 15:30 F 3

Measurement of light-flavour hadron production with ALICE in pp collisions at $\sqrt{s}$ = 13 TeV — •Raul Tonatiuh Jimenez Bustamante for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Physikalisches Institut, University of Heidelberg, Heidelberg, Germany

The ALICE detector has excellent Particle IDentification (PID) capabilities in the central barrel ($|\eta| < 0.9$). This allows identified hadron production to be measured over a wide transverse momentum ($p_{\rm T}$) range, using various sub-detectors and techniques: the particles' specific energy loss ($\mathrm{d}E/\mathrm{d}x$), their velocity determination via time-of-flight measurement, their Cherenkov angle or their characteristic weak decay topology are exploited. Measurements of identified light-flavour hadron production at mid-rapidity with ALICE in proton-proton collisions at $\sqrt{s}$ = 13 TeV are presented and compared with previous measurements performed at lower energies. The results cover a wide range of particle species including long-lived hadrons, resonances and multi-strange baryons over the $p_{\rm T}$ range from 150 MeV/c up to 20 GeV/c, depending on the particle species.

HK 59.6 Fr 15:45 F 3

J/ψ production as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE at the LHC — •Steffen Weber — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

The hadronic production of charmonium in proton-proton collisions is a complex and intrinsically multi-scale process. The dependence of J/ψ production on the event multiplicity is of special interest, since it relates the hard-scale charmonium production with the soft-scale physics of light-flavour particle production, and can give insight into the influence of multiple-parton interactions on the charmonium production. A previous measurement at $\sqrt{s}$ = 7 TeV showed an approximately linear increase of J/ψ yield with event multiplicity.

In this talk the measurement of J/ψ production as a function of charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 13 TeV measured with ALICE at the LHC will be presented. By using triggers selecting events with high particle multiplicity the reach of the measurement could be extended to values of the event multiplicity of 8 times the average value in minimum bias collisions, expanding the reach by about a factor 2 compared to the results obtained with data at $\sqrt{s}$ = 7 TeV.

HK 59.7 Fr 16:00 F 3

J/ψ production in Pb-Pb collisions with ALICE at the LHC — Raul Tonatiuh Jimenez Bustamante[1,2] and •Dennis Weiser[2] for the ALICE-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Physikalisches Institut, University of Heidelberg, Heidelberg

ALICE at the Large Hadron Collider provides unique capabilities to study charmonium production at low transverse momenta. In the early and hottest phase of nucleus-nucleus collisions the formation of a Quark-Gluon Plasma (QGP) is expected. Several QGP induced effects, such as the dissociation of charmonium states due to color screening and/or a (re)combination of uncorrelated charm and anti-charm quarks, can play a role. While a suppression of J/ψ with respect to pp collisions was indeed observed in heavy-ion collisions at all energies, recent measurements in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV indicate that (re)combination does seems to play an important role in the low $p_{\rm T}$ region at LHC energies.

At central rapidity (|y| < 0.9) J/ψ are reconstructed via their e^+e^- decay channel down to zero $p_{\rm T}$. The status of the measurement of inclusive J/ψ production and the nuclear modification factor at higher energies will be shown.

HK 60: Structure and Dynamics of Nuclei IX

Zeit: Freitag 14:00–16:15 Raum: F 2

Gruppenbericht

HK 60.1 Fr 14:00 F 2

Studying the γ-decay behaviour of the Pygmy Dipole Resonance — •Simon G. Pickstone, Michelle Färber, Miriam Müscher, Sarah Prill, Mark Spieker, Michael Weinert, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Low-lying electric dipole strength, often denoted by Pygmy Dipole Resonance (PDR), is still not understood in detail. One important observable which could shed light on this is the γ-decay branching ratio to excited states. However, this observable is still only known for a few cases. The SONIC@HORUS setup in Cologne allows to measure branching ratios with high sensitivity. It consists of twelve silicon detectors for particle identification and ejectile-energy determination and the 14 HPGe detector array HORUS for high-resolution γ-ray spectroscopy. Using this setup, the particle-γ coincidence method is employed at the 10 MV FN tandem accelerator. Since the silicon detectors have a good energy resolution (70 keV in-beam) and a high solid-angle coverage (9%), a narrow gate on a specific decay and reaction channel gives a straightforward, state-to-state determination of branching ratios. Branching ratios for 1^- states in ^{92,94}Mo, ^{60}Ni, and ^{120}Sn will be presented. Combining these experiments with γ-decay studies from the γ^3 setup at HIγS, it is possible to investigate the decay pattern of the PDR systematically and to gain more insight into the underlying structure of low-lying E1 strength.

Supported by DFG(ZI 510/7-1). S.P. and J.W. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 60.2 Fr 14:30 F 2

Untersuchung der niederenergetischen Dipolstärkeverteilung in ^{92,94}Zr — •Gerhart Steinhilber, Sergej Bassauer, Andreas Krugmann, Norbert Pietralla und Peter von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

Die Pygmydipolresonanz (PDR) ist ein aktuelles Thema der Kernstrukturforschung. Sie wird als eine Oszillation der Neutronenhaut gegen einen stabilen Kern mit N $\approx$ Z verstanden. Daher wird davon ausgegangen, dass die Stärke der PDR Informationen über die Neutronenhautdicke, die Zustandsgleichung von neutronenreicher Materie und die Dichteabhängigkeit der Symmetrieenergie liefert.

Am Research Center for Nuclear Physics (RCNP) in Osaka, Japan wurde ein Protonenstreuexperiment an ^{92,94}Zr zur Untersuchung der PDR durchgeführt. Das Grand-Raiden-Spektrometer ermöglichte es die gestreuten Protonen bei extremen Vorwärtswinkeln einschließlich 0° zu detektieren. Ziel des Experiments ist es, zusammen mit Daten zu ^{90}Zr [1] die Entwicklung der niederenergetischen Dipolstärkeverteilung in der Zirkonium Isotopenkette in Abhängigkeit von der Neutronenzahl zu untersuchen. Erste Ergebnisse der Analyse werden präsentiert.

[1] C. Iwamoto et al., Phys. Rev. Lett. **108**, 262501 (2012).

Gefördert durch die DFG im Rahmen des SFB 1245.

HK 60.3 Fr 14:45 F 2

Zerfallsverhalten von $J = 1$-Zuständen von ^{92}Zr und ^{94}Zr * — •Oliver Papst[1], Tobias Beck[1], Udo Gayer[1], Johann Isaak[2], Jörn Kleemann[1], Bastian Löher[1], Norbert Pietralla[1], Deniz Savran[3], Werner Tornow[4], Volker Werner[1] und Markus Zweidinger[1] — [1]IKP, TU Darmstadt — [2]RCNP, Osaka, Japan — [3]GSI, Darmstadt — [4]TUNL, Duke University, Durham, NC, USA

In einer Vielzahl von Kernen ist an der niederenergetischen Flanke der Dipol-Riesenresonanz konzentrierte elektrische Dipolstärke beobachtbar, die unter dem Begriff der Pygmy-Dipolresonanz zusammengefasst wird [1]. Bei Kernresonanzfluoreszenzexperimenten am γ^3-Messplatz [2] an der High Intensity γ-Ray Source (HIγS) in Durham, NC, USA, wurde mit einem quasimonochromatischen vollständig linear polarisierten γ-Strahl die Dipolstärke in den Kernen ^{92}Zr und ^{94}Zr unterhalb der Neutronenseparationsschwelle untersucht. Hinweise bezüglich der Zuordnung beobachteter E1-Stärke zu einer der beiden Resonanzen kann das mittlere Verzweigungsverhältnis in den Grundzustand geben, das für beide Kerne für mehrere Energiebereiche bestimmt wurde. Die aus HPGe- und $LaBr_3$-Spektren gewonnenen Daten erlauben eine Aufschlüsselung von mittleren Verzweigungsverhältnissen zu niedrigliegenden Zuständen in inklusive und exklusive Anteile. Diese mittleren Verzweigungsverhältnisse werden mit Rechnungen im statistischen Modell verglichen.

* Gefördert durch die DFG im Rahmen des SFB 634 und des SFB 1245.

[1] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70**, 210 (2013)
[2] B. Löher *et al.*, Nucl. Instr. Meth. Phys. Res. A **723**, 136 (2013)

HK 60.4 Fr 15:00 F 2

Investigation of the low-lying dipole strength in ^{142}Ce — •Miriam Müscher[1], Johann Isaak[2], Simon G. Pickstone[1], Deniz Savran[3], Mark Spieker[1], Julius Wilhelmy[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]RCNP, Osaka, Japan — [3]Research Division, GSI, Darmstadt, Germany

The low-lying dipole-strength of ^{142}Ce is investigated with the nuclear resonance fluorescence (NRF) method at the Darmstadt High Intensity Photon Setup (DHIPS) using bremsstrahlung with an endpoint energy of 7.35 MeV. Nuclei are excited by γ-rays from the ground state to predominantly $J = 1$ states and with a lower probability to $J = 2$ states. Afterwards, they decay via photonemission to another low-lying excited state or directly to the ground state. Due to the angular correlation of the incident photon beam and the emitted γ quanta, one is able to assign a certain multipolarity to each transition and the transition strength can be determined.

The dipole response of ^{142}Ce will be presented and discussed regarding its evolution near the closed $N = 82$ shell.

Supported by the DFG (ZI 510/7-1) and by the Alliance Program of the Helmholtz Association (HA216/EMMI).

HK 60.5 Fr 15:15 F 2

Pygmy Skin and Core Polarization Modes in Pb isotopes — •Nadia Tsoneva and Horst Lenske — Institut für Theoretische Physik, Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gieβen, Germany

We have analysed theoretically recent high resolution measurements of the electromagnetic dipole response of ^{206}Pb below the neutron separation energy which was performed at the HI$\vec{\gamma}$S facility of Duke University. The obtained experimentally spectral distributions and values for the total electric and magnetic dipole strength are compared to EDF+QPM calculations. The detailed theoretical study of the fragmentation pattern of low-energy electric dipole excitations allows for the first time to separate the pygmy dipole resonance from the tail of the giant dipole resonance and multi-phonon excitations showing striking difference of their decay patterns. Furthermore, based on the experiment and the comparison with EDF+QPM and relativistic RPA theories, the dipole polarizability α_D=122.18±9.72 mb/MeV and the neutron skin thickness r_{skin}= 0.151 fm in ^{206}Pb are extracted. The newly obtained experimental and theoretical information is used to predict the Maxwellian-averaged cross section of the ^{205}Pb(n,γ')^{206}Pb reaction at 30 keV. The astrophysical impact of different counterparts of the electric and magnetic dipole spectra related to the s-process of stellar nucleosynthesis is discussed.

HK 60.6 Fr 15:30 F 2

Investigation of the γ-decay behavior of ^{48,50}Ti and ^{52}Cr with the γ^3 setup at HIγS — •Julius Wilhelmy[1], P. Erbacher[2], U. Gayer[3], J. Isaak[4], B. Löher[5], M. Müscher[1], N. Pietralla[3], P. Ries[3], C. Romig[3], D. Savran[5], M. Spieker[1], S. G. Pickstone[1], W. Tornow[6], V. Werner[3], A. Zilges[1], and M. Zweidinger[3] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institute for Applied Physics, Goethe University of Frankfurt a.M. — [3]Institute for Nuclear Physics, TU Darmstadt — [4]Research Center for Nuclear Physics, Osaka, Japan — [5]University of Mainz — [6]Department of Physics, Duke University, USA

The γ-ray strength function is an important input parameter for the calculation of nucleosynthesis processes. To study the dipole response in more detail, the γ-decay behavior of the *fp* shell nuclei ^{48,50}Ti and ^{52}Cr was investigated with the high-efficiency γ^3 setup [1] at the High Intensity γ-ray Source facility (HIγS) at TUNL in Durham, USA. The quasi mono-energetic γ-ray beam allows for selective excitations in multipolarity (J=1 and J=2) and energy. The γ^3 setup is a multidetector array consisting of HPGe and $LaBr_3$ detectors with high efficiency and enables the measurement of γ-γ coincidences. Experimental results of ^{48,50}Ti and ^{52}Cr will be presented and discussed in this contribution.

Supported by the BMBF (05P2015PKEN9/ELI-NP), the Alliance Program of the Helmholtz Association (HA216/EMMI), and the BCGS.

[1] B. Löher *et al.*, Nucl. Instr. and Meth. A **723** (2013) 136

HK 60.7 Fr 15:45 F 2

Identification of the Mixed-Symmetry One-Phonon-$2^+_{1,ms}$-State of ^{202}Hg — •Ralph Kern[1], Robert Stegmann[1], Thomas Möller[1], Norbert Pietralla[1], Georgi Rainovski[2], Christian Stahl[1], Marc Lettmann[1], Robert Janssens[3], Mike Carpenter[3], and Shaofei Zhu[3] — [1]Institut für Kernphysik, TU Darmstadt — [2]Faculty of Physics, St. Kliment Ohridski University Sofia, Bulgarien — [3]Argonne National Laboratory, Argonne, IL, USA

The IBM-2 predicts excited nuclear states of anti-symmetric protonneutron character, so-called mixed-symmetry states (MSS). MSS probe the effective proton-neutron interaction and are suitable to study the two-fluid properties of atomic nuclei. The $2^+_{1,ms}$-state can be identified by its large absolute $\langle 2^+_{1,ms}||M1||2^+_1\rangle \approx 1\mu_N$. Recently low-lying one-phonon $2^+_{1,ms}$-states have been identified for the first time in ^{204}Hg and ^{212}Po, which exhibit a valence alpha (hole) particle structure with respect to the double magic ^{208}Pb. ^{202}Hg has 4 valence neutron-holes and 2 valence proton-holes, which leads to a similar boson structure like in ^{204}Hg. Therefore a projectile Coulomb-excitation experiment was performed at the Argonne National Laboratory in order to identify the $2^+_{1,ms}$-state of ^{202}Hg. The emitted gamma-rays were detected by the Gammasphere spectrometer. First results will be presented. Supported by DFG Pi 393/2-3 and BMBF 05P12RDCIB and 05P15RDCIA.

HK 60.8 Fr 16:00 F 2

Identifikation niederenergetischer isovektorieller Oktupol-Zustände in ^{144}Nd — •Michael Thürauf[1], Thorsten Kröll[1], Marcus Scheck[1,2,3] und Michael Jentschel[4] für die EXILL-Kollaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]School of Eng. and Comp., Univ. of the West of Scotland, Paisley, UK — [3]The Scottish Universities Physics Alliance, Glasgow, UK — [4]Institut Laue-Langevin, Grenoble, France

Isovektorielle Oktupolzustände, sog. „mixed-symmetry“ Zustände, werden im Rahmen des sdf-IBM-2 vorhergesagt. Die sichere Identifikation liefert einen wesentlichen Beitrag zur Dekomposition der Oktupol-Oktupol-Restwechselwirkung in einen isoskalaren und isovektoriellen Anteil. Dies trägt wesentlich zum Verständnis des Oktupolfreiheitsgrades bei.

In ^{144}Nd ist der 3^-_3 Zustand bei 2778 keV ein guter Kandidat für einen solchen „mixed-symmetry“ Oktupol-Zustand. Für den Übergang von einem „mixed-symmetry“ Oktupol-Zustand in den symmetrischen 3^-_1 Zustand erwartet man eine starke $M1$-Komponente. Um die Natur dieses Zustandes zu klären, wurde im Verlauf der (n, γ)-Kampagne mit dem EXILL-Aufbau am ILL, Grenoble, die Multipol-Mischungsverhältnisse $\delta(3^-_i \to 3^-_1)$ gemessen. In einem 2016 durchgeführten Experiment mit GAMS@ILL konnte die Lebensdauer des 3^-_3 Zustandes gemessen werden und mit den Daten beider Experimente ist es nun möglich, die Natur des 3^-_3 Zustandes festzulegen.

Gefördert durch die DFG (KR 1796/2-2), ILL und HGS-HIRe for FAIR.

HK 61: Structure and Dynamics of Nuclei X

Zeit: Freitag 14:00–16:15 Raum: F 33

HK 61.1 Fr 14:00 F 33

Laser spectroscopy of the heaviest elements at GSI — •Premaditya Chhetri for the RADRIS-Collaboration — TU Darmstadt — GSI Darmstadt

Laser spectroscopy of the heaviest elements with Z>100 allows studying the influence of relativistic and QED effects on the atomic shell structure but is hampered by the low production rates available. Applying the sensitive Radiation Detected Resonance Ionization Spectroscopy [1] technique at the SHIP velocity filter at GSI, we identified optical transitions in the element nobelium (Z=102) for the first time [2]. Besides the identification of a strong optical ground state transition, its hyperfine structure splitting in the isotope ^{253}No was measured along with the isotope shifts in $^{252-254}$No. These results will be discussed and an outlook on first attempts in extending laser spectroscopy to the next heavier element, lawrencium, will be given.

[1] H. Backe, W. Lauth, M. Block, M. Laatiaoui, Nuclear Physics A

944 (2015) 492
[2] M. Laatiaoui, W. Lauth, H. Backe, M. Block et. al. Nature **538** (2016) 495

HK 61.2 Fr 14:15 F 33

Recent developments at the SHIPTRAP setup — •Oliver Kaleja[1,2,3], Klaus Blaum[1], Michael Block[2,3,4], Stanislav Chenmarev[1,5], Premaditya Chhetri[3,6], Christian Droese[7], Sergey Eliseev[1], Pavel Filianin[1], Francesca Giacoppo[3,4], Yuri Gusev[5], Fritz-Peter Hessberger[3,4], Mustapha Laatiaoui[3,4], Steffen Lohse[2,4], Enrique Minaya Ramirez[8], Andrew Mistry[3,4], Yuri Novikov[5], Sebastian Raeder[3,4], Daniel Rodriguez[9], Lutz Schweikhard[7], and Peter Thirolf[10] — [1]MPIK Heidelberg — [2]Universität Mainz — [3]GSI Darmstadt — [4]Helmholtz-Institut Mainz — [5]PNPI KI Gatchina — [6]TU Darmstadt — [7]Universität Greifswald — [8]IPN Orsay — [9]Universidad de Granada — [10]LMU München

The Penning-trap mass spectrometer SHIPTRAP enables direct high-precision measurements of the heaviest elements produced at the velocity filter SHIP. The results allow us to probe and refine nuclear and nuclear astrophysics theories. In order to extend direct mass measurements to superheavy elements (Z $\geq$ 104) the setup was recently relocated with respect to SHIP. To this end a cryogenic buffer-gas stopping cell was implemented, which improves the efficiency in the thermalization and extraction of the produced nuclides. In addition, a second superconducting magnet was placed perpendicular to the current beam line to implement the non-destructive Fourier-Transform Ion-Cyclotron-Resonance technique. In this contribution an overview of the technical developments and the latest offline measurements will be presented.

HK 61.3 Fr 14:30 F 33

Decay Spectroscopy at SHIP in the neutron deficient neptunium region — •Andrew Mistry for the SHIP decay spectroscopy-Collaboration — Helmholtz Institute Mainz, Germany — GSI Helmholtzzentrum, Darmstadt, Germany

In the heavy element region of the nuclear landscape, a variety of theoretical models predict location of the enhanced shell stabilization region above the spherical closure at ^{208}Pb (Z=82, N=126) [1]. Whilst current understanding of the spherical shell closures up to ^{208}Pb is well established, experimental knowledge on the evolution of the shell closures towards the proton dripline remains limited due to low production cross sections and short half-lives. To this end, recent efforts have focused on the weakening effect of the N=126 shell closure in the neutron deficient region with Z>91 [2], employing increasingly advanced experimental apparatus. The focal plane detection system at SHIP [3] was employed online at GSI, Darmstadt with the two-fold purpose of performing an advanced commissioning of the setup and subsequently to produce neutron deficient neptunium isotopes (Z=93). The setup comprises a double sided silicon strip implantation detector surrounded by 4 single sided silicon strip detectors, with a Ge clover detector located downstream. Digital signal processing was employed. Results will be presented from the production of neptunium isotopes.

[1] R-D. Herzberg, P.T. Greenlees Progress in Particle and Nuclear Physics 61, 674 (2008)
[2] J. Khugyagbaatar et. al. PRL 115, 242502 (2015)
[3] A.K. Mistry, GSI Annual report 2015 p.109 (2016)

HK 61.4 Fr 14:45 F 33

Investigation of the spectral shape of the fourfold forbidden beta-decay of ^{113}Cd with the COBRA experiment — •Arne Heimbold for the COBRA-Collaboration — TU Dresden, Institut für Kern und Teilchenphysik

Recently, the scientific discussion about the so-called quenching of the axial vector coupling constant g_A has triggered some new calculations in nuclear physics. The possibility of a quenched coupling strength has been introduced to reproduce experimental data of double beta-decay studies with theoretical models. Of special interest are highly forbidden single beta-decays since the spectral shape of the electron momentum distribution strongly depends on the effective value of g_A, but in a highly non-trivial way. The COBRA experiment at the LNGS in Italy uses CdZnTe semiconductor detectors to search for the existence of neutrinoless double beta-decay. The material acts at the same time as source of the sought double beta-decay and consists of all isotopes of Cadmium, Zinc and Tellurium according to the natural isotopic composition of those elements. One of the isotopes present is ^{113}Cd with an abundance of about 12%. The ^{113}Cd nucleus undergoes a fourfold forbidden, non-unique single beta-decay with a half-life of $8{\cdot}10^{15}$ years, which is the most prominent signal for the COBRA demonstrator. In this talk, a first approach to compare the measured ^{113}Cd beta spectrum of COBRA with the spectral shapes resulting from nuclear shell model calculations for various values of g_A will be presented.

HK 61.5 Fr 15:00 F 33

Low-Level-Counting of an ^{129}I-sample with high-precission X-Ray spectroscopy — Lukas Bott[1], •Alexander Robert Domula[2], Klaus Eberhardt[3], Jan Glorius[1,4], Kathrin Göbel[1], Tanja Heftrich[1], Kafa Khasawneh[1], Rene Reifarth[1], Stefan Schmidt[1], Kerstin Sonnabend[1], Mario Weigand[1], Norbert Wiehl[3], Stephan Zauner[3], Mathilde Ziegler-Himmelreich[1], and Kai Zuber[2] — [1]Goethe University Frankfurt, Germany — [2]TU Dresden, Germany — [3]University of Mainz, Germany — [4]GSI Darmstadt, Germany

The exact half-life-determination of beta decays plays an important role in modern physics - amongst others for dating or the understanding of nucleosynthesis. The progress in instrumentation and technology during the last decade suggested a re-measurement of previously investigated nuclides with reduced systematic and statitical uncertainties. One possible access to a nuclides half-live is given by the activity of a suitable, well characterised sample. In order to determine the activity of the long-lived nuclide ^{129}I, an adequate sample was produced via neutron irradiation of ^{128}Te at the TRIGA reactor Mainz. The long-lived activity of the sample was characterised via γ- and X-Ray-spectroscopy at the "Niederniveau-Messlabor-Felsenkeller (VKTA)" in Dresden. The reduced background from cosmic-radiation, in particular muon-induced background in the underground laboratory enables the detection of very low activities. The results from ^{129}I activity measurements with a high-resolution Silicon-Drift-Detector at low-background-conditions and a corresponding half-life estimation will be presented.

HK 61.6 Fr 15:15 F 33

Determination of lifetimes of excited states in fission fragments from ^{252}Cf using LaBr$_3$(Ce) detectors — •Guillermo Fernández Martínez, Stoyanka Ilieva, and Thorsten Kröll for the FATIMA-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt

The experimental determination of transition probabilities of excited states in exotic nuclei by direct lifetimes measurements is crucial for the understanding of nuclear structure. The **FA**st-**TIM**ing **A**rray (FATIMA), that the upcoming FAIR will house, will consist of a set of LaBr$_3$(Ce) detectors, well known for their combination of good energy resolution and very fast response, and will be able to determine very short lifetimes. However, prior to the construction of FATIMA and its final placement at FAIR, some experiments have to be performed. One of these experimental campaigns was carried out at the Argonne National Laboratory, and aimed for the measurement of lifetimes of excited states in the fission products from the spontaneous fission of ^{252}Cf. The FATIMA demonstrator, made out of 25 of the aforementioned LaBr$_3$(Ce) crystals, was used in combination with an array of 55 HPGe detectors from the existing Gammasphere. For the determination of lifetimes in the region from some nanoseconds down to few tens of picoseconds, the generalised centroid difference (GCD) method, that has been already proven to provide reliable results, was used. In the present work, first preliminary results for the first excited states of neutron-rich even-even nuclei are shown.

HK 61.7 Fr 15:30 F 33

Application of Calorimetric Low Temperature Detectors for the Investigation of Z-Yield Distributions of Fission Fragments — •Santwana Dubey[1,2], Shawn Bishop[5], Aurelien Blanc[4], Johannes O. Denschlag[2], Artur Echler[1,2], Peter Egelhof[1,2], Friedrich Goennenwein[6], Jose Gomez[4], Patrick Grabitz[1,2], Ulli Koester[5], Saskia Kraft-Bermuth[3], Werner Lauterfeld[2], Manfred Mutterer[1], Pascal Scholz[3], and Stefan Stolte[2] — [1]GSI, Germany — [2]Univ. Mainz, Germany — [3]Univ. Giessen, Germany — [4]Technical Univ. Munich, Germany — [5]ILL Grenoble, France — [6]Univ. Tübingen, Germany

Precise fission fragment yield data are of great interest for a better understanding of the fission process. In a recent experiment, performed at the research reactor ILL Grenoble, Calorimetric Low Temperature Detectors (CLTDs) were applied for the first time for the investigation of Z-yield distributions of fission fragments. The concept of CLTDs, which is based on the collection of phonons, provides considerable advantage over conventional heavy ion detectors, based on charge collection, with respect to basic detector properties. Fission fragments, produced by thermal neutron induced fission of 235U, were passed through the LOHENGRIN separator to filter required mass and energy, followed by SiN degrader foils to separate elements with different Z within a mass, and were detected on an array of CLTDs. Preliminary data for the mass region 82<A<132 will be presented, which would lead to a better understanding of the fission process, as well as of reactor neutrino oscillations and the reactor neutrino anomaly.

HK 61.8 Fr 15:45 F 33

Determination of the fast neutron-induced fission cross section of ^{242}Pu at *n*ELBE — •Toni Kögler[1,2], Roland Beyer[1], Arnd R. Junghans[1], Stefan E. Müller[1], and Ralf Nolte[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf e.V. — [2]Technische Universität Dresden — [3]Physikalisch-Technische Bundesanstalt Braunschweig

Neutron induced fission cross sections of actinides like the Pu-isotopes are of relevance for the development of nuclear transmutation technologies. For ^{242}Pu current uncertainties are of around 21 %, the target uncertainties in the order of 7 %. Sensitivity studies show that the total uncertainty has to be reduced below 5 %, to allow for reliable neutron physics simulations. This challenging task was performed at the neutron time-of-flight facility *n*ELBE at HZDR, Dresden. Improved experimental conditions and beam power, paired with the right spectral shape of the *n*ELBE neutron source provided excellent conditions to achieve this aim. Within the TRAKULA project, large and homogeneous deposits of ^{235}U and ^{242}Pu have been produced successfully. Using them in two consecutively placed fission chambers allows the determination of the neutron induced fission cross section of ^{242}Pu relative to ^{235}U. Experimental results will be presented and compared to recent experiments and evaluated data. Corrections addressing the neutron scattering are discussed by using results of different neutron transport simulations (Geant 4, MCNP 6 and FLUKA). This work was supported by the EURATOM FP7 project CHANDA and by the German Federal Ministry of Education and Research (03NUK13A).

HK 61.9 Fr 16:00 F 33

Structure Studies from 16O(p, 2p)15N Reactions with the Missing Mass Spectroscopy — •Sebastian Reichert for the TUM-RIKEN-p2p-Collaboration — TU München, James Franck Str., 85748 Garching

The manifestation of the role of fission in the element synthesis appears to be of great importance in the r-process which is responsible for a big fraction of the elements heavier than iron in the Universe: Its termination point is marked by the onset of fission. The abundances of the elements are determined also by a detailed understanding of the elemental pattern of fission. A key technology is the missing mass spectroscopy of quasi-free scattering (p,2p) reactions in inverse kinematics.

Therefore a new detector setup was developed and tested at the HIMAC Accelerator Facility in Japan. Results of the reconstructed excitation energy spectrum of 15N are presented.

Providing nuclei as RI beam, this setup will give us the unique opportunity to assign the fission barrier heights for many short lived nuclei for the first time. Plus, the fission fragments can be measured in flight, thereby enabling us to determine its mass and charge distribution accurately utilizing the features of the probe in conjunction with the unique and powerful capability of RIBF.

Supported by BMBF 05P15WOFNA (Germany) and Outstanding Individual Research Grant (Japan).

HK 62: Instrumentation XIII

Zeit: Freitag 14:00–16:00 Raum: F 102

HK 62.1 Fr 14:00 F 102

Electron Identification with the ALICE TRD using the TMVA Toolkit — •Martin Kroesen for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

The ALICE Transition Radiation Detector (TRD) provides excellent electron identification via the measurement of specific energy loss and transition radiation (TR). The ALICE TRD is uniquely designed to record the time evolution of the signal, where at large drift times the TR contribution is measured. This allows a better electron/pion discrimination compared to measurements of the total integrated charge. The TMVA framework (Toolkit for Multivariate Analysis) in ROOT provides different non-linear statistical modeling tools. Neural Networks and other methods from TMVA are studied to maximize the separation power between electrons and pions taking into account the temporal evolution of the signal. These methods also consider the time-dependent correlations of the signal, which provides better electron/pion discrimination compared to standard simplified likelihood methods.

HK 62.2 Fr 14:15 F 102

Charakterisierung von GEM-Detektoren im Elektronenstrahl für das MAGIX-Experiment an MESA — •Mirco Christmann für die MAGIX-Kollaboration — Institut für Kernphysik der Universität Mainz

Am Institut für Kernphysik der Johannes Gutenberg-Universität Mainz wird in den kommenden Jahren der neue Teilchenbeschleuniger MESA in Betrieb gehen. Im energierückgewinnenden Modus (5 bis 105 MeV | 1 mA) wird das MAGIX-Experiment installiert. Dort werden Präzisions-Streuexperimente mit Hilfe eines fensterlosen Gas-Jet-Targets durchgeführt. Die Winkel und Impulse der gestreuten Elektronen können über zwei schwenkbare Magnetspektrometer bestimmt werden. In der Fokalebene der Magnete wird ein präzises Detektorsystem mit einer aktiven Fläche von $1,20$ m $\times$ $0,30$ m und einer Ortsauflösung besser als 50 μm benötigt. Geplant sind auf GEMs basierende Detektoren.

In diesem Beitrag wird zunächst die Konstruktion eines Prototyp-Detektors mit 100 cm^2 aktiver Fläche vorgestellt. Die GEM-Folien wurden thermisch gespannt und gerahmt. Die Auslese erfolgte über 512 gekreuzte Kupferstreifen mit einem SRS, wobei die Wellenform jedes Streifens aufgenommen wurde. Zur Charakterisierung des GEM-Detektors wurden Messungen im Labor und im Elektronenstrahl von MAMI durchgeführt. Mit kosmischen Myonen wurde die Homogenität des Detektors vermessen. Im Elektronenstrahl konnten die ortsabhängigen Effizienzen bei unterschiedlich hohen Elektronenraten bestimmt werden.

HK 62.3 Fr 14:30 F 102

Characterization of Ceramic GEM for The International Large Detector — •Serhat Atay, Ulrich Wertenbach, and Ivor Fleck — University of Siegen

The International Large Detector (ILD) will become one of the detectors of The International Linear Collider (ILC). A Time Projection Chamber (TPC), instrumented with Gas Electron Multipliers (GEM), will be constructed inside the ILD as the central tracking chamber. Different GEM prototypes are proposed. This talk will present result from characterization of ceramic GEMs, especially for gas gain and long term stability. They have been produced with a thickness of 120 um and a hole diameter 200 um. Gains of up to 100 have been measured in an Ar:CO2 mixture.

HK 62.4 Fr 14:45 F 102

Detector performance tests for the CBM TRD — •Martin Kohn for the CBM-Collaboration — Institut für Kernphysik, WWU Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. For the detection of the Transition Radiation a Multi-Wire Proportional Chamber (MWPC) with a 5 mm drift region is used. With the construction phase of the detector nearing, we will present results of the detector obtained with the final detector prototypes. The outer dimensions of this chambers are 95×95 cm^2. These results were achieved from data recorded at in-beam tests at CERN PS and SPS. The PS delivered a mixed pion/electron beam from 0.5 up to 3 GeV. From the SPS a Pb beam in the range from 13 *A*GeV to 150 *A*GeV was hit on a Pb target to archive environments with high interaction rate of charged particles. Particular focus was put on comparing the different prototypes from Frankfurt/Münster with rectangular readout pads on the one hand and the prototypes from Bucharest with triangular pads on the other hand. The TRD has different pad sizes for the MWPCs to handle different interaction rates depending on distance from the beam line. The large size prototypes has the largest pad size of 155×7.2 mm^2. The Bucharest prototype has a pad-size of 7.5×25 mm^2, which are split along the diagonal. For all measurements the same DAQ chain with SPADIC v1.0/1.1 front end electronic was used.

HK 62.5 Fr 15:00 F 102

Construction of large full-size MWPC prototypes for the CBM-TRD — •Susanne Gläessel and Florian Roether for the CBM-Collaboration — Institut für Kernphysik

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) will be dedicated to the exploration of the QCD phase-diagram in the region of high net-baryon densities. The Transition-Radiation Detector (TRD) has to provide efficient electron pion separation at high momenta and contribute to the identification of charged hadrons, in particular fragments, at high event rates of up to 10 MHz. Each layer of the TRD is composed of several Multi-Wire Proportional Chambers (MWPC).

The key challenge for the MWPC detector design is to deliver a fast detector response, i.e. short signal collection times, without significantly compromising on the TR-absorption capabilities. The best performance is achieved by adding a small drift region of only 5 mm thickness to the xenon gas volume.

For the first time, four large full-size prototypes for the outer detector area with dimensions of $95\times95\times4.95$ cm^3 have been built in a combined effort in Frankfurt and Münster and allow for an advanced evaluation of the detector performance including its tracking capabilities. The chamber construction and the implementation of the specific requirements of the experiment into the detector design and its mounting structure will be presented and discussed.

Supported by the German BMBF-grant 05P15RFFC1.

HK 62.6 Fr 15:15 F 102

Development of a Gas System Prototype for the CBM-TRD — •Felix Fidorra for the CBM-Collaboration — Institut für Kernphysik, WWU Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. For the detection of the Transition Radiation, a Multi-Wire Proportional Chamber (MWPC) with a 5 mm drift region is used. As these detectors are very sensitive to the operating conditions, a high quality gas supply system has been designed and built in order to supply the detectors with a gas mixture of constant composition and flow. The operation of the full detector system requires accurate monitoring and regulation. The design goal of the gas supply to the TRD chamber is a constant flow of 3 l Ar/CO_2 mixture in the ratio of 80/20 %. Of particular importance is to secure the maximum overpressure of 1 mbar to protect the sensitive Kapton entrance window of the chambers. In this talk the author will report on the requirements to the system and discuss the process of its development. Work supported by the German BMBF.

HK 62.7 Fr 15:30 F 102

An instrumented analysis and supply gas system prototype for the CBM TRD — •Philipp Munkes for the CBM-Collaboration — Institut für Kernphysik, WWU Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. For the detection of the Transition Radiation a Multi-Wire Proportional Chamber (MWPC) with a 5 mm drift region is used. As these detectors are very sensitive to the operating conditions a high quality gas supply system had to be designed and built to supply the detectors with a gas mixture of constant composition and flow. The operation of the system has to accompanied by close monitoring to fulfill the design goals. The design goal of the gas supply to the TRD chamber is a constant flow of about 3l Ar/CO_2 mixture in the ratio of 80/20%. The most important task is to secure the maximum overpressure of 1mbar to the sensitive Kapton windows of the chambers. In this talk the author will provide an overview over the architecture of the monitoring system, as well as the first analysis of all environmental data collected from the gas system for the CBM TRD during a recent in-beam test at CERN SPS. This work has been supported by BMBF.

HK 62.8 Fr 15:45 F 102

Spectra and Position Reconstruction on CBM-TRD Data from CERN-SPS Testbeam 2016 — •Philipp Kähler for the CBM-Collaboration — Institut für Kernphysik, WWU Münster, Deutschland

Real-size prototypes of the 95×95 cm^2 Transition Radiation Detector (TRD) chambers for the upcoming Compressed Baryonic Matter (CBM) experiment have been subjected to a testbeam campaign at CERN-SPS in the last quarter of 2016. Several datasets have been recorded to confirm the detector performance as well as to investigate the self-triggered, free-streaming SPADIC v1.1 DAQ chain in fixed-target Pb–Pb collisions with beam energies of 13, 30 and 150 AGeV. First results on the analysis of the testbeam data will be shown. Offline-event reconstruction enables the understanding of charge distribution on the cathode pad-plane and is resulting in an inclusive energy loss spectrum of charged particles. Different approaches for the spectrum calculation are compared. For the first time, this spectrum can be calibrated using ^{55}Fe measurements performed at SPS. DAQ-specific possibilities of event reconstruction in high-rate and high-multiplicity environments are discussed. Furthermore, steps towards 2-dimensional position reconstruction and particle tracking in the CBM-TRD setup will be shown. Work supported by BMBF.

HK 63: Instrumentation XIV

Zeit: Freitag 14:00–16:00 Raum: F 072

HK 63.1 Fr 14:00 F 072

A phoswich detector readout with GHz sampling using the FEBEX platform — Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, Patrick Remmels, •Felix Stark, and Max Winkel — Technische Universität München

The most forward part of the CALIFA Calorimeter consists of very fast LaBr3/LaCl3 scintillation crystals in a Phoswich configuration. To separate both components of the scintillation light with a spectroscopic resolution, the signals have to be sampled with rates of about 1 GSPS and 14 bits resolution at least. A new frontend electronics based on the DRS4 chip will provide buffered analogue signals. A direct connection to the CALIFA data acquisition platform FEBEX will allow for a homogeneous integration into the existing R3B-DAQ. Using two different ADC channels for each detector unit provides a straight forward use of the DRS4 in a free running self triggered system. We will present the readout concept, its implementation and a series of detailed tests of a first prototype which has been recently developed. Supported by BMBF Project 05P15WOFNA.

HK 63.2 Fr 14:15 F 072

Test of the STS-XYTER2 frontend ASIC for the CBM Silicon Tracking System — •Adrian Rodriguez Rodriguez[1,2] and Jörg Lehnert[2] for the CBM-Collaboration — [1]Goethe Universität Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung

The Silicon Tracking System (STS) is the essential tracking component of the CBM experiment. The STS-XYTER2 is the prototype ASIC dedicated for reading out the double-sided sensors of the STS. It is a low power, self-triggering ASIC which generates timing and energy information for each sensor signal. After tests of the previous prototype, the chip design was revised. The current ASIC version implements various improvements to achieve the desired noise levels, and ensure fail-safe operation. The digital backend was completely re-designed. A new readout protocol was developed and implemented for operation with the GBTx data concentrator. Several tests are carried out to check chip functionalities, performance, and system integration aspects. An overview of the experimental setup, device tests and results will be presented.

Supported by HGS-HIRe.

HK 63.3 Fr 14:30 F 072

Reliable experimental physics DCS Board program execution with COTS TMS570 MCU — •Antonio Lucio, Jano Gebelein, and Udo Kebschull — Infrastructure and Computer Systems in Data Processing, Goethe University Frankfurt, Germany

Given the necessity of a Detector Control Systems Board (DCSB), which shall provide 100 GPIOs, SPI, I2C CAN bus and other interfaces for detector parameter surveillance in experimental physics applications, a new DCSB design is being conceived. Furthermore, under the premise of using low Cost Commercial Off The Shelf (COTS) MCU's, reliable program execution from external redundancy-less memory is necessary. For that purpose the safety MCU TMS570 for automotive applications is examined. EPICS, a Commonly used SCADA for physics experiments, is ported to the MCU and specific MCU's mechanisms are used to apply redundancy to programs executing from external memories with insignificant amount of CPU overhead. Data redundancy reliability from such mechanisms is examined and results are displayed.

HK 63.4 Fr 14:45 F 072

First measurements on the new FPGA-based DIRICH MAPMT readout* — •Vivek Patel, Karl-Heinz Kampert, and Christian Pauly — Wuppertal university

The DIRICH module is the core part of a new readout chain for multianode PMTs and MCPs, being developed in a joined effort by the CBM-, HADES- and PANDA collaborations for their respective RICH detectors. The design focuses on excellent timing precision, limited by the Transit Time Spread(TTS) of the sensors (MAPMTs: ~ 300 ps, MCPs: <100 ps). Discriminination, time- and time-over-threshold measurement, as well as digital data handling, are all implemented on a single Lattice ECP5 FPGA, providing a cost-effective and highly compact solution. First prototypes of the DIRICH module are available for testing in the lab, and also using a dedicated test chamber with single photon light source, which will later allow for a complete system test of the new HADES photon detector prior its installation in the HADES RICH. In the talk we will present first tests and performance measurements on the DiRICH.

*Supported by : BMBF grant 05P15PXFCA, and GSI.

HK 63.5 Fr 15:00 F 072

DiRich - Readout Electronics for DIRC and RICH detectors at FAIR — •Jan Michel[1], Vivek Patel[2], Christian Pauly[2], Peter Skott[3], and Michael Traxler[3] for the HADES-Collaboration — [1]Goethe-Universität Frankfurt — [2]Bergische Universität Wuppertal — [3]GSI Helmholtzzentrum Darmstadt

Several experiments at FAIR will make use of Cherenkov detectors, namely the DIRC of the PANDA experiment and the RICH of HADES and CBM. All will be equipped with 64 channel PMTs. The DiRich module is a compact set of read-out electronics that includes all features required for these detectors: The front-end board houses discrete, low-power amplifiers and FPGA-based TDC. Auxiliary boards include a power supply and a data concentrator that provides the connection to the data acquisition system of the detectors using an optical link for data transport. All boards are connected via a 10 by 15 cm sized backplane that doubles as mechanical support for the PMTs and light-tight shielding. We present the electronics along with selected performance test results.

This work has been supported by BMBF grants 05P15PXFCA and 05P15RGFCA and contributions from the TRB3 collaboration.

HK 63.6 Fr 15:15 F 072

Evaluation of the CBM FLES input interface at 2016 CERN/SPS beam test — •Dirk Hutter, Jan de Cuveland, and Volker Lindenstruth for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM First-level Event Selector (FLES) is the central event selection system of the upcoming CBM experiment at FAIR. Designed as a high-performance computing cluster, its task is an online analysis of the physics data at a total data rate exceeding 1 TByte/s. All physics data input to the cluster is handled by a custom input interface. It comprises a custom PCIe FPGA board receiving data via optical links and handling DMA transfers to the PC's memory, an accompanying HDL module implementing the front-end logic interface and link protocol in the front-ends and a software stack publishing data to the subsequent FLES data transport framework in a very efficient way.

Read-out chains for several CBM subsystems have been successfully implemented using prototype components of the input interface. A larger scale evaluation of the FLES input interface and data handling framework has been performed during the 2016 CBM beam test at CERN/SPS. Up to 14 input links from two different subsystems have been synchronously read and archived. The structure of the input interface and FLES datapath matched the foreseen final CBM setup. An overview of the read-out setup and beam test results on system performance will be presented.

HK 63.7 Fr 15:30 F 072

Towards new analog read-out electronics for the HADES drift chamber system — •Michael Wiebusch for the HADES-Collaboration — Goethe-Universität, Frankfurt

Track reconstruction in HADES is realized with 24 planar, low-mass drift chambers (MDC). About 27000 drift cells provide both, precise spatial information of track hit points and energy loss information. In order to handle high rates and track densities required at the future SIS100 accellerator at FAIR, an upgrade of the MDC system is necessary. This involves new front-end electronics, as the original analog read-out ASIC (ASD8) is no longer procurable. A promising replacement read-out chip candidate is the PASTTREC ASIC (developed at Jagiellonian University, Krakow), which is currently at the focus of our investigations. This contribution will present the test procedures employed to evaluate the compatibility of the ASIC with the drift chambers w.r.t. spatial/energy resolution and detection efficiency. Also a cost-efficient and lightweight FPGA-based prototype TDC is used, which is foreseen to replace the TDC ASICs presently used. To arrive at conclusive performance results, the tests have to be conducted under realistic conditions in direct comparison to the present ASICs.
This work has been supported by BMBF (05P15RFFCA), GSI, HGS-HIRe and HIC for FAIR.

HK 63.8 Fr 15:45 F 072

A read-out system for the PANDA MVD prototypes: development and results. — •Alessandra Lai, Tobias Stockmanns, and James Ritman for the PANDA-Collaboration — Forschungszentrum Jülich, Germany

The PANDA experiment will play a key role at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt. Exploiting proton-antiproton interactions, its scientific program addresses fundamental questions of QCD. The Micro Vertex Detector (MVD) is the sub-detector system closest to the interaction point. It uses two different kinds of silicon detectors as sensitive elements: hybrid pixel detectors and double-sided strip detectors. Two different types of front-end ASICs are under development for the MVD: the Torino Pixel ASIC (ToPix) and the PANDA Strip ASIC (PASTA). Both are designed to transmit untriggered data at a rate of hundreds of Mb/s and handle the expected hit rate in hot spots of the detector. A test system capable of handling these high rates is therefore needed. It should have the flexibility to test different kinds of front-end electronics and be easy to adapt to new prototypes. Therefore, an FPGA-based system is the ideal candidate. Suitable firmware and a software framework are thus under development at the Forschungszentrum Jülich.

In this talk, the mentioned read-out system will be introduced and performance tests with the front-end electronics prototypes of the MVD will be presented.