Fachverband Physik der Hadronen und Kerne (HK)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsäle S1/01 A1-A5 und S1/01 A01-A04; Poster S1/05 22-24)

Plenarvorträge

PV I	Mo	11:45–12:30	S1/01 A1	**Neutrinos - a window to new physics** — •Christian Weinheimer
PV II	Mi	9:00– 9:45	S1/01 A1	**Nuclear Structure Studies using Coulomb Excitation at REX- ISOLDE (CERN)** — •Nigel Warr
PV III	Mi	9:45–10:30	S1/01 A1	**Production of fragile objects in high energy collisions at the LHC** — •Benjamin Dönigus
PV IV	Do	9:00– 9:45	S1/01 A1	**Status and Future of Neutrino Physics with Scintillator-Based Detectors** — •Livia Ludhova
PV V	Do	9:45–10:30	S1/01 A1	**From COSY to HESR and EDM-at-COSY** — •Mei Bai
PV VI	Do	20:00–21:00	S1/01 A1	**Fusion von Wasserstoff – Energie der Zukunft oder ewiger Traum?** — •Thomas Klinger
PV VII	Fr	9:00– 9:45	S1/01 A1	**High-precision comparison of the antiproton-to-proton charge-to-mass ratio** — •Christian Smorra
PV VIII	Fr	9:45–10:30	S1/01 A1	**Nuclear physics for tests of fundamental symmetries and searches for physics beyond the Standard Model** — •Martin Hoferichter

Hauptvorträge

HK 31.1	Mi	11:00–11:30	S1/01 A1	**Extracting two- and three-particle resonances from the lattice** — •Maxwell Hansen
HK 31.2	Mi	11:30–12:00	S1/01 A1	**Exploring the phase structure and dynamics of QCD** — •Jan M. Pawlowski
HK 31.3	Mi	12:00–12:30	S1/01 A1	**Precision mass measurements and more at ISOLTRAP** — •Frank Wienholtz
HK 46.1	Do	11:00–11:30	S1/01 A1	**Charmonium(like) Spectroscopy** — •Zhiqing Liu
HK 46.2	Do	11:30–12:00	S1/01 A1	**Ever-changing proton radius?!** — •Miha Mihovilovic
HK 46.3	Do	12:00–12:30	S1/01 A1	**Towards HISPEC@FAIR: Opportunities and first results with AGATA** — •Christian Stahl
HK 62.1	Fr	11:00–11:30	S1/01 A1	**Baryon Spectroscopy - Recent Results from the CBELSA/TAPS Experiment at ELSA** — •Jan Hartmann
HK 62.2	Fr	11:30–12:00	S1/01 A1	**Electromagnetic Probes of the Quark-Gluon Plasma** — •Torsten Dahms
HK 62.3	Fr	12:00–12:30	S1/01 A1	**Few-body universality in halo nuclei** — •Hans-Werner Hammer
HK 62.4	Fr	12:30–13:00	S1/01 A1	**Upgrade of the GSI-Unilac as a FAIR High Current Injector** — •Hendrik Hähnel

Plenarvorträge des fachübergreifenden Symposiums SYNU

Das vollständige Programm dieses Symposiums ist unter SYNU aufgeführt.

SYNU 1.1	Di	9:00– 9:45	S1/01 A1	**Few Nucleon Systems from Lattice QCD** — •Martin Savage
SYNU 1.2	Di	9:45–10:30	S1/01 A1	**Uncertainty quantification and nuclear forces** — •Richard Furnstahl

SYNU 2.1	Di	11:20–12:05	S1/01 A1	**Recent Results in Nuclear Lattice Effective Field Theory** — •Dean Lee
SYNU 2.2	Di	12:05–12:50	S1/01 A1	**Atomic nuclei from effective field theories** — •Thomas Papenbrock

Hauptvorträge des fachübergreifenden Symposiums SYER

Das vollständige Programm dieses Symposiums ist unter SYER aufgeführt.

SYER 1.1	Mi	9:00– 9:45	S1/05 122	**What Is An Energy Recovery Linac, and Why There Might Be One In Your Future*** — •Geoffrey Krafft
SYER 1.2	Mi	9:45–10:30	S1/05 122	**An FFAG-ERL at Cornell University for eRHIC Prototyping and Bright-Beam Applications** — •Georg Hoffstaetter
SYER 2.1	Mi	11:00–11:30	S1/05 122	**Physics opportunities at ERLs** — •Jan Bernauer
SYER 2.2	Mi	11:30–12:00	S1/05 122	**MESA - an ERL project for particle physics experiments*** — •Florian Hug
SYER 2.3	Mi	12:00–12:30	S1/05 122	**Development of a high brightness, high current SRF photo-electron source for ERL applications** — •Axel Neumann

Fachsitzungen

HK 1.1–1.6	Mo	14:00–15:45	S1/01 A5	**Hadron Structure and Spectroscopy I**
HK 2.1–2.7	Mo	14:00–16:00	S1/01 A01	**Heavy Ion Collision and QCD Phases I**
HK 3.1–3.7	Mo	14:00–16:00	S1/01 A4	**Heavy Ion Collision and QCD Phases II**
HK 4.1–4.5	Mo	14:00–15:30	S1/01 A02	**Nuclear Astrophysics I**
HK 5.1–5.7	Mo	14:00–16:00	S1/01 A03	**Structure and Dynamics of Nuclei I**
HK 6.1–6.6	Mo	14:00–16:00	S1/01 A04	**Structure and Dynamics of Nuclei II**
HK 7.1–7.5	Mo	14:00–15:30	S1/01 A2	**Instrumentation I**
HK 8.1–8.7	Mo	14:00–16:00	S1/01 A3	**Instrumentation II**
HK 9.1–9.7	Mo	16:30–18:30	S1/01 A5	**Hadron Structure and Spectroscopy II**
HK 10.1–10.7	Mo	16:30–18:30	S1/01 A01	**Heavy Ion Collision and QCD Phases III**
HK 11.1–11.7	Mo	16:30–18:30	S1/01 A02	**Nuclear Astrophysics II**
HK 12.1–12.6	Mo	16:30–18:15	S1/01 A03	**Structure and Dynamics of Nuclei III**
HK 13.1–13.7	Mo	16:30–18:30	S1/01 A04	**Structure and Dynamics of Nuclei IV**
HK 14.1–14.8	Mo	16:30–18:30	S1/01 A3	**Instrumentation III**
HK 15.1–15.5	Mo	16:30–18:00	S1/01 A2	**Instrumentation IV**
HK 16.1–16.7	Di	14:00–16:00	S1/01 A5	**Hadron Structure and Spectroscopy III**
HK 17.1–17.6	Di	14:00–15:45	S1/01 A01	**Heavy Ion Collision and QCD Phases IV**
HK 18.1–18.6	Di	14:00–15:30	S1/01 A4	**Heavy Ion Collision and QCD Phases V**
HK 19.1–19.7	Di	14:00–16:00	S1/01 A02	**Nuclear Astrophysics III**
HK 20.1–20.5	Di	14:00–15:30	S1/01 A03	**Structure and Dynamics of Nuclei V**
HK 21.1–21.6	Di	14:00–15:45	S1/01 A2	**Instrumentation V**
HK 22.1–22.7	Di	14:00–16:00	S1/01 A3	**Instrumentation VI**
HK 23.1–23.6	Di	16:30–18:15	S1/01 A5	**Hadron Structure and Spectroscopy IV**
HK 24.1–24.6	Di	16:30–18:00	S1/01 A01	**Heavy Ion Collision and QCD Phases VI**
HK 25.1–25.5	Di	16:30–18:00	S1/01 A4	**Heavy Ion Collision and QCD Phases VII**
HK 26.1–26.7	Di	16:30–18:30	S1/01 A02	**Fundamental Symmetries**
HK 27.1–27.5	Di	16:30–18:15	S1/01 A03	**Structure and Dynamics of Nuclei VI**
HK 28.1–28.6	Di	16:30–18:15	S1/01 A04	**Structure and Dynamics of Nuclei VII**
HK 29.1–29.7	Di	16:30–18:15	S1/01 A2	**Instrumentation VII**
HK 30.1–30.6	Di	16:30–18:15	S1/01 A3	**Instrumentation VIII**
HK 31.1–31.3	Mi	11:00–12:30	S1/01 A1	**Hauptvorträge I**
HK 32.1–32.7	Mi	14:00–16:00	S1/01 A4	**Hadron Structure and Spectroscopy V**
HK 33.1–33.6	Mi	14:00–16:00	S1/01 A5	**Hadron Structure and Spectroscopy VI**
HK 34.1–34.7	Mi	14:00–16:00	S1/01 A01	**Heavy Ion Collision and QCD Phases VIII**
HK 35.1–35.6	Mi	14:00–16:00	S1/01 A02	**Astroparticle Physics I**
HK 36.1–36.7	Mi	14:00–16:00	S1/01 A03	**Structure and Dynamics of Nuclei VIII**
HK 37.1–37.7	Mi	14:00–16:00	S1/01 A3	**Instrumentation IX**
HK 38.1–38.7	Mi	14:00–16:00	S1/01 A2	**Instrumentation X**
HK 39.1–39.7	Mi	16:30–18:30	S1/01 A5	**Hadron Structure and Spectroscopy VII**
HK 40.1–40.7	Mi	16:30–18:30	S1/01 A01	**Heavy Ion Collision and QCD Phases IX**

HK 41.1–41.5	Mi	16:30–18:15	S1/01 A02	**Astroparticle Physics II**
HK 42.1–42.8	Mi	16:30–18:30	S1/01 A03	**Structure and Dynamics of Nuclei IX**
HK 43.1–43.7	Mi	16:30–18:30	S1/01 A3	**Instrumentation XI**
HK 44.1–44.6	Mi	16:30–18:15	S1/01 A2	**Instrumentation XII**
HK 45.1–45.75	Mi	18:30–20:30	S1/05 22-24	**Postersession**
HK 46.1–46.3	Do	11:00–12:30	S1/01 A1	**Hauptvorträge II**
HK 47.1–47.7	Do	14:00–16:00	S1/01 A5	**Hadron Structure and Spectroscopy VIII**
HK 48.1–48.7	Do	14:00–16:00	S1/01 A01	**Heavy Ion Collision and QCD Phases X**
HK 49.1–49.6	Do	14:00–16:00	S1/01 A02	**Astroparticle Physics III**
HK 50.1–50.6	Do	14:00–16:00	S1/01 A04	**Nuclear Astrophysics IV**
HK 51.1–51.8	Do	14:00–16:00	S1/01 A03	**Structure and Dynamics of Nuclei X**
HK 52.1–52.8	Do	14:00–16:00	S1/01 A3	**Instrumentation XIII**
HK 53.1–53.6	Do	14:00–16:00	S1/01 A4	**Instrumentation XIV**
HK 54.1–54.7	Do	14:00–15:45	S1/01 A2	**Instrumentation XV**
HK 55.1–55.6	Do	16:30–18:15	S1/01 A5	**Hadron Structure and Spectroscopy IX**
HK 56.1–56.6	Do	16:30–18:00	S1/01 A01	**Heavy Ion Collision and QCD Phases XI**
HK 57.1–57.6	Do	16:30–18:15	S1/01 A04	**Nuclear Astrophysics V**
HK 58.1–58.6	Do	16:30–18:15	S1/01 A03	**Structure and Dynamics of Nuclei XI**
HK 59.1–59.6	Do	16:30–18:15	S1/01 A3	**Instrumentation XVI**
HK 60.1–60.8	Do	16:30–18:30	S1/01 A4	**Instrumentation XVII**
HK 61.1–61.7	Do	16:30–18:30	S1/01 A2	**Instrumentation XVIII**
HK 62.1–62.4	Fr	11:00–13:00	S1/01 A1	**Hauptvorträge III**
HK 63.1–63.6	Fr	14:00–15:45	S1/01 A4	**Hadron Structure and Spectroscopy X**
HK 64.1–64.7	Fr	14:00–16:00	S1/01 A5	**Hadron Structure and Spectroscopy XI**
HK 65.1–65.7	Fr	14:00–16:00	S1/01 A01	**Heavy Ion Collision and QCD Phases XII**
HK 66.1–66.7	Fr	14:00–16:00	S1/01 A04	**Heavy Ion Collision and QCD Phases XIII**
HK 67.1–67.6	Fr	14:00–15:45	S1/01 A02	**Nuclear Astrophysics VI**
HK 68.1–68.7	Fr	14:00–16:00	S1/01 A03	**Structure and Dynamics of Nuclei XII**
HK 69.1–69.7	Fr	14:00–16:00	S1/01 A2	**Instrumentation XIX**
HK 70.1–70.7	Fr	14:00–16:00	S1/01 A3	**Instrumentation XX**

Mitgliederversammlung Fachverband Physik der Hadronen und Kerne

Dienstags 18:45–19:30 S1/05 122

HK 1: Hadron Structure and Spectroscopy I

Zeit: Montag 14:00–15:45 Raum: S1/01 A5

Gruppenbericht HK 1.1 Mo 14:00 S1/01 A5

Proton polarizability program at CB-MAMI — •Cristina Collicott for the A2-Collaboration — Institut für Kernphysik, Mainz, Deutschland — George Washington University, Washington DC, USA

Nucleon polarizabilities are fundamental structure observables, like the nucleon mass or charge, which are sensitive to the internal quark dynamics of the nucleon. Scalar and spin polarizabilities quantify the response of the proton's structure and spin respectively when an external electromagnetic field is applied. Polarized Compton scattering off the proton, where the photon acts as an electromagnetic probe, can be used to study the polarizabilities of the proton, thus probing its internal structure. While the scalar polarizabilities have been studied previously, albeit with large uncertainties, the spin polarizability terms have yet to be determined experimentally.

This talk will discuss an ongoing experimental program at MAMI to study both the scalar and spin terms of the proton polarizabilties. This program makes use of the Crystal Ball and TAPS detector system within the A2 collaboration at MAMI. Through a series of Compton scattering experiments, this program aims to reduce the large experimental uncertainties on the proton scalar polarizabilities, as well as determine the proton spin polarizabilities experimentally for the first time. A program overview and current results will be presented. This program is supported by the DFG under contract SFB1044, along with international support from the USA and Canada.

HK 1.2 Mo 14:30 S1/01 A5

Measurement of the proton scalar polarizabilities at MAMI — •Edoardo Mornacchi for the A2-Collaboration — Institut für Kernphysik, Universität Mainz

The electric (α_{E_1}) and magnetic (β_{M_1}) scalar polarizabilities are fundamental properties related to the internal structure of the nucleon. They play a crucial role not only in our understanding of the nucleon, but also in other areas such as atomic physics, where they provide e.g. corrections to the Lamb Shift. In order to determine the scalar polarizabilities of the proton, the beam asymmetry Σ_3 was measured, for the first time for the Compton scattering, below the pion photoproduction threshold. The measurement was performed at the MAMI accelerator facility in Mainz.

The linearly polarized primary photons impinged on a liquid hydrogen target and the outgoing particles were detected in a nearly 4π detector setup, composed by Crystall Ball and TAPS calorimeters.

In this talk the results on the Compton scattering beam asymmetry Σ_3 and their influence on the extraction of α_{E_1} and β_{M_1} will be discussed.

Supported by DFG under contract SFB1044.

HK 1.3 Mo 14:45 S1/01 A5

Measurement of the Proton Electromagnetic Form Factor in Time-like Region with the ISR Method at BESIII — •Dexu Lin[1,2], Samer Ali Nasher Ahmed[1,2], Alaa Dbeyssi[1], Paul Larin[1], Frank Maas[1,2,3], Cristina Morales[1], Christoph Rosner[1,2], and Yadi Wang[1] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Johann-Joachim-Becherweg 36 — [3]PRISMA Cluster of Excellence, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germay

The structure of the proton can be understood through the study of its electromagnetic (EM) form factors. Electron scattering experiments (space-like region) have explored the proton EM form factors with a high accuracy. Only few data on the proton form factors in the time-like region, and only a very coarse determination of the individual electric and magnetic form factors (or their ratio) has been possible so far.

The BESIII (Beijing Spectrometer III) at BEPCII (Beijing Electron Positron Collider II) has collected large data samples from J/ψ-mass up to 4.60 GeV. These data can be used to measure proton EM form factors by means of Initial-State-Radiation (ISR) events with the process $e^+e^- \to p\bar{p}\gamma_{ISR}$. With 7.408 fb^{-1} total luminosity of seven data samples from 3.773 -4.600 GeV, the proton form factors and the cross section of $p\bar{p}$ have been analyzed with ISR-tagged method. In this talk, the status of this work will be reported together with a discussion of the analysis of the background.

HK 1.4 Mo 15:00 S1/01 A5

Measurements of $e^+e^- \to n\bar{n}$ cross Section from 2015 Scan Data at BESIII — •Samer Ahmed[1,2], Alaa Dbeyssi[1,2], Paul Larin[1,2], Dexu Lin[1,2], Frank Maas[1,2,3], Cristina Morales[1,2], Christoph Rosner[1,2], and Yadi Wang[1,2] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg-University of Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The neutron structure and dynamics can be understood through the study of its electromagnetic form factors (FFs). In the time-like region few experiments had been performed so far, none of them had the possibility to determinate the electric and magnetic FFs and even their ratio. Therefore, a large data sample [2.0 - 3.08 GeV] with a total luminosity of 523.5 pb^{-1} has been collected in Beijing Spectrometer III (BESIII) at the Beijing Electron Positron Collider II (BEPCII). With the collected data, it is expected to separately determine the electric and the magnetic FFs of neutron and enhance the knowledge of its structure. In this contribution, we will present the current status of $n\bar{n}$ analysis and the efforts of extracting the ratio of the neutron FFs.

HK 1.5 Mo 15:15 S1/01 A5

Bestimmung von Hadronmultiplizitäten am COMPASS Experiment — •Johannes Giarra — for the COMPASS collaboration - Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55099 Mainz

Quarks lassen sich ausserhalb des Nukleons nicht als einzelne Quarks sondern nur im Verbund von zwei oder mehr Quarks (Hadronen) beobachten. Die Hadronisierung eines Quarks wird durch Fragmentationsfunktionen (FF) beschrieben. Diese Funktionen lassen sich, durch Messung von Hadronmultiplizitäten, flavourseparіert in der semi-inklusiven tiefinelastischen Lepton-Nukleon Streuung (SIDIS) bestimmen. Als Hadronmultiplizitäten bezeichnet man die Anzahl der Hadronen pro DIS Ereignis.
2012 wurde am COMPASS Experiment (CERN) eine SIDIS-Messung mit einem Myonstrahl, der an einem Flüssigwasserstofftarget gestreut wird, durchgeführt. Zur Hadronenidentifikation wird ein ringabbildendender Cherenkov-Detektor genutzt.
Der Vortrag behandelt die Bestimmung von Detektoreffizienzen und Spektrometerakzeptanzen die zur Extraktion von Multiplizitäten benötigt werden.

HK 1.6 Mo 15:30 S1/01 A5

Kaon fragmentation functions from COMPASS 2006 kaon multiplicities* — •Daniel Hahne — Physikalisches Institut Bonn

Knowledge of unpolarized fragmentation functions (FFs) is essential for the flavor separation of spin dependent parton distribution functions (PDFs). Fragmentation functions are extracted based on hadron multiplicities in semi-inclusive deep inelastic scattering where at least one final state hadron is identified. I will present the latest results of kaon FFs extracted from COMPASS 2006 $K^{\pm}$ multiplicities on an isoscalar target.

Due to different experimental acceptances for the reconstruction of charged and neutral kaons, K^0_S multiplicities have an extended kinematic range compared to $K^{\pm}$ multiplicities. I will discuss the possible impact of additional K^0_S multiplicities on the extraction of kaon FFs.
*supported by BMBF, project 05P2 PDCCA

HK 2: Heavy Ion Collision and QCD Phases I

Zeit: Montag 14:00–16:00 Raum: S1/01 A01

Gruppenbericht HK 2.1 Mo 14:00 S1/01 A01

Dilepton reconstruction in Au+Au collisions at 1.23A GeV with HADES — •Patrick Sellheim for the HADES-Collaboration — Goethe-Universität Frankfurt

In continuation of a systematic investigation of the emissivity of strongly interacting matter, HADES has recently measured the di-electron emission in $Au + Au$ collisions at 1.23A GeV beam energy. Due to the high track density reached for this collision system, different reconstruction strategies have been pursued to achieve optimal reconstruction efficiencies and purities. Electron (positron) candidates have been identified by means of an multi-variate analysis, where the neural network has been trained alternatively based on clean signal and background tracks from data and by simulated tracks. Moreover, the electron track candidates have been matched to rings using ring parameters of found rings or, alternatively, track candidates identified by time-of-flight only have been matched to ring signatures without running the ring finder before.

This contribution will present the results of these analysis procedures and will discuss systematic uncertainties obtained. The statistics is sufficient to investigate double-differential distributions, like centrality dependence covering 45% most central events or transverse momentum distributions for different regions in invariant mass. Special emphasis will be given to the extraction of the radiation from the dense phase of the collision.

This work has been supported by BMBF(05P12RFGHJ,05P15RFFCA), GSI, HIC for FAIR, HGS-HIRe and H-QM.

HK 2.2 Mo 14:30 S1/01 A01

Studying ρ-N couplings with HADES in pion-induced reactions — •Federico Scozzi for the HADES-Collaboration — TU Darmstadt — IPN Orsay, France

It has been established that baryon-driven medium effects are the key in describing the low mass excess measured in heavy-ion collisions. Yet to understand better medium effects one needs measurement of electromagnetic transition form factors in the time-like region. The coupling of virtual photons to baryonic resonances can be experimentally probed by means of $\pi^- N \to R \to e^+e^- N$ processes for which no experimental data exist.

In summer 2014 data were taken with the High Acceptance Di-Electron Spectrometer (HADES) at GSI in pion-induced reactions using carbon and polyethylene targets. A large part of the data was taken at a pion beam momentum of 0.69 GeV/c in order to explore the sub-threshold coupling of the ρ to baryonic resonances. Combining polyethylene data with carbon data it is possible to extract pion-proton interactions. In this contribution the preliminary results of inclusive dilepton invariant mass will be presented and compared with model calculations. Finally the exclusive channel $\pi^- p \to e^+e^- n$ will be discussed in detail.

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

HK 2.3 Mo 14:45 S1/01 A01

The electromagnetic N-Δ transition form factor and its impact on dilepton spectra — •Janus Weil[1], Gilberto Ramalho[2], Teresa Pena[3], Hendrik van Hees[1], and Ulrich Mosel[4] — [1]Frankfurt Institute for Advanced Studies — [2]Federal University of Rio Grande do Norte — [3]Universidade de Lisboa — [4]Universität Giessen

The Dalitz decay of $\Delta \to N e^+e^-$ represents an important contribution to inclusive dilepton spectra. However, unlike the mesonic Dalitz decays, the transition form factor in this decay is not very well-constrained so far. There is plenty of electron-scattering data to fix the tails of the form factor in the space-like regime, but the more interesting region is certainly the time-like regime, where one expects to find one or more vector-meson poles. However, the only experimental constraints in the time-like regime come from dilepton spectra, which are not straightforward to interpret, in particular since they contain contributions from several other processes (including N^* and Δ^* decays) that need to be disentangled from each other. We discuss different models for the N-Δ transition form factor, including a simple VMD-like approach and a covariant spectator quark model, where one distinguishes contributions from a bare quark core and a meson cloud. These form-factor models are then coupled with a hadronic transport model, in order to simulate the dynamics of pp and heavy-ion collisions and compute inclusive dilepton spectra. By comparing those to data measured with the HADES detector, we obtain constraints on the N-Δ transition form factor and discuss their implications.

HK 2.4 Mo 15:00 S1/01 A01

Dileptons never die: measurement of virtual photons radiated from Au+Au collisions at $E_{\mathrm{beam}} = 1.23$ AGeV into HADES. — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

Dileptons are a unique probe to direct study properties of hot and dense medium formed in heavy-ion collisions, thanks to their mean-free path much larger than the size of the fireball. Excess of the low-mass lepton pairs has been measured in heavy-ion collisions from SIS up to top RHIC energies. Substantial medium effects on light vector-mesons originate from their coupling to baryons and anti-baryons. In baryon-rich fireballs the low-mass excess is expected to be maximum.

This is the paramount topic in the experimental program conducted at SIS18 accelerator in GSI with the help of the High Acceptance Di-Electron Spectrometer. The strong non-linear system size dependence of the yield component exceeding the NN reference has been extracted from former C+C and Ar+KCl runs.

This contribution will present results of virtual photon production from high statistics Au+Au at $E_{\mathrm{beam}} = 1.23$ AGeV data and confront them with the reference measured by HADES and with results of previous runs as well as with available model predictions. The integrated excess yield will be put in context of the dilepton excitation function measured by STAR.

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

HK 2.5 Mo 15:15 S1/01 A01

Modeling thermal dilepton radiation for SIS experiments — •Florian Seck for the HADES-Collaboration — TU Darmstadt

Dileptons are radiated during the whole time evolution of a heavy-ion collision and leave the interaction zone unaffected. Thus they carry valuable information about the hot and dense medium created in those collisions to the detector.

Realistic dilepton emission rates and an accurate description of the fireball's space-time evolution are needed to properly describe the contribution of in-medium signals to the dilepton invariant mass spectrum.

In this presentation we will demonstrate how this can be achieved at SIS collision energies. The framework is implemented into the event generator Pluto which is used by the HADES and CBM experiments to produce their hadronic freeze-out cocktails. With the help of an coarse-graining approach to model the fireball evolution and pertinent dilepton rates via a parametrization of the Rapp-Wambach in-medium ρ meson spectral function, the thermal contribution to the spectrum can be calculated. The results also enable us to get an estimate of the fireball lifetime at SIS18 energies.

We thank R. Rapp for providing a parametrization of the Rapp-Wambach spectral function and many fruitful discussions.

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

HK 2.6 Mo 15:30 S1/01 A01

Dielectron studies in Pb-Pb collisions with the ALICE experiment during the LHC Run-II — •Oton Vazquez Doce for the ALICE-Collaboration — Excellence Cluster Universe, TUM. Garching, Germany

Electromagnetic radiation is the ideal probe to study the formation of hot and dense matter in heavy ion collisions.

Real and virtual photons are produced in all the stages of the collision, allowing to study the whole system evolution. Moreover, electromagnetic radiation is transparent to the medium bringing information unaffected by final state interactions. By detecting photons and dileptons one can study the system temperature, via the extraction of thermal radiation, and the chiral symmetry restoration that is expected to happen in the deconfined phase via the modification of the spectral functions of vector mesons.

Dielectron studies in particular provide acces to the low p_T region

at colliders, allowing for a differential study in p_T and invariant mass of the electron pair. In this presentation, the status of dielectron measurements in Pb-Pb collisions at centre-of-mass energies per nucleon pair of 5 TeV, recorded at the recent data taking period in December 2015, will be presented.

A study of a further low mass and p_T acceptance increase for dielectron events in ALICE with a reduced magnetic field of 0.2T will be presented as well. Part of the future Pb-Pb run 3 data after the ALICE upgrade may be acquired with such a magnetic field configuration.

HK 2.7 Mo 15:45 S1/01 A01

Charm and beauty contributions in the dilepton invariant mass spectrum in pp collisions measured with ALICE — •Sebastian Scheid, Raphaelle Bailhache, and Harald Appelshäuser for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The main purpose of ALICE at the LHC is to investigate the properties of the deconfined state of strongly-interacting matter, the Quark Gluon Plasma (QGP), produced in high-energy heavy-ion collisions. Since leptons experience negligible final-state interactions, they are well suited to study the properties of the medium. A measurement of the thermal radiation from the QGP in the dielectron intermediate mass region will allow to estimate the medium temperature. In this region the main background is due to correlated semi-leptonic decays of B- and D-Mesons. They have the particularity to have a large decay length of about $500\mu m$ for B-Mesons and 100-$300\mu m$ for D-Mesons. Therefore the reconstructed tracks of heavy-flavour decay electrons do not point to the primary vertex of the collision. Combining the measured distance of closest approach of each single electron into a pair variable DCA_{ee} gives the possibility to separate prompt di-electron pairs from the heavy-quark background.

The analysis in pp collisions allows to study the feasability of extracting the heavy-quark production with the current ITS of ALICE and provides a reference for Pb−Pb collisions. In this presentation, first results on the DCA_{ee} spectra in pp collisions at 7 TeV will be shown and compared to reference distributions from MC simulations.

HK 3: Heavy Ion Collision and QCD Phases II

Zeit: Montag 14:00–16:00 Raum: S1/01 A4

Gruppenbericht HK 3.1 Mo 14:00 S1/01 A4

Vergleich von hydrodynamischen und mikroskopischen Rechnungen für p+A und A+A Stöße — •Kai Gallmeister, Harri Niemi, Carsten Greiner und Dirk Rischke — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

Die gute Übereinstimmung von Ergebnissen aus Rechnungen auf Grundlage dissipativer Hydrodynamik mit experimentellen Daten in p+Pb Stößen scheint auf ein stark kollektives Verhalten und eine schnelle Thermalisierung zu deuten. Allerdings sind schon in Schwerionenstößen große dissipative Korrekturen nötig. Wir untersuchen durch einen Vergleich von hydrodynamischen Rechnungen mit Rechnungen, die mit dem kinetischen Parton-Transportmodell BAMPS durchgeführt werden, ob dissipative Hydrodynamik in der Tat noch für kleine Stoßsysteme anwendbar ist.

HK 3.2 Mo 14:30 S1/01 A4

Pinning down QCD-matter shear viscosity in A+A collisions via EbyE fluctuations using pQCD + saturation + hydrodynamics — •Harri Niemi[1], Kari Eskola[2,3], Risto Paatelainen[4], and Kimmo Tuominen[3,5] — [1]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Max-von-Laue-Str. 1, D-60438 Frankfurt am Main, Germany — [2]University of Jyväskylä, Department of Physics, P.O. Box 35, FI-40014 University of Jyväskylä, Finland — [3]Helsinki Institute of Physics, P.O.Box 64, FI-00014 University of Helsinki, Finland — [4]Departamento de Fisica de Particulas, Universidade de Santiago de Compostela, E-15782 Santiago de Compostela, Galicia, Spain — [5]Department of Physics, University of Helsinki, P.O. Box 64, FI-00014 University of Helsinki, Finland

We compute the initial energy densities produced in ultrarelativistic heavy-ion collisions from NLO perturbative QCD using a saturation conjecture to control soft particle production, and describe the subsequent space-time evolution of the system with hydrodynamics, event by event. The resulting centrality dependence of the low-p_T observables from this pQCD + saturation + hydro ("EKRT") framework are then compared simultaneously to the LHC and RHIC measurements. With such an analysis we can test the initial state calculation, and constrain the temperature dependence of the shear viscosity-to-entropy ratio η/s of QCD matter. Using these constraints from the current RHIC and LHC measurements we then predict the charged hadron multiplicities and flow coefficients for the 5.023 TeV Pb+Pb collisions.

HK 3.3 Mo 14:45 S1/01 A4

Hydrodynamic bubbles in a transport approach — Dmytro Oliinychenko[1] 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, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany

Hybrid approaches are very successfully applied for the description of the dynamics of heavy ion collisions. In the high density regime one takes advantage of relativistic hydrodynamics, while at lower density non-equilibrium transport models are applied. Handling the transitions between fluid dynamics and the transport description includes uncertainties, both when generating the initial condition by turning particles into fluid and in the final stages, when particles are sampled from the fluid.

We suggest a way to avoid these uncertainties by generating hydrodynamical behaviour directly in the transport approach. In the regions of high density we perform a forced thermalization, which effctively simulates the result of N-particle collisions. The effect of these hydrodynamic bubbles on bulk observables such as elliptic flow is investigated by comparing the results to pure transport and traditional hybrid approach.

HK 3.4 Mo 15:00 S1/01 A4

The effect of longitudinal fluctuations in (3+1)D viscous hydrodynamics — •Long-Gang Pang[1], Hannah Petersen[1,2,3], Pasi Huovinen[6], Xin-Nian Wang[4,5], and Yuri Karpenko[1] — [1]FIAS, Frankfurt, Germany — [2]ITP, Goethe University, Frankfurt, Germany — [3]GSI, Darmstadt, Germany — [4]CCNU, Wuhan, China — [5]LBNL, Berkeley, USA — [6]ITP, University of Wroclaw, Poland

The energy density fluctuations of the quark gluon plasma (QGP) in the transverse plane are studied in detail and found to be important to explain the high order harmonic flow v_n at RHIC and LHC. However, the energy density fluctuations along longitudinal direction (space-time rapidity η_s) have not been fully investigated yet, even though they should exist as well. Previous studies show that the longitudinal fluctuations strongly depend on the initial entropy deposition mechanisms. In this work AMPT initial conditions are used where HIJING introduces longitudinal fluctuations originating from the asymmetry between forward and backward going participants, string length fluctuations and finite number of partons at different collision energies. The longitudinal fluctuations have been found to be responsible for the decorrelation of anisotropic flow and twist of event planes along rapidity. We study the effect of longitudinal fluctuations on the QGP expansion in both transverse and longitudinal direction within CLVisc, a (3+1)D viscous hydrodynamic code parallelized on GPU using OpenCL, to check whether the anisotropic flow is affected by longitudinal fluctuations and to determine appropriate shear viscosity over entropy density coefficients η/s in comparison with experiments at RHIC and LHC.

HK 3.5 Mo 15:15 S1/01 A4

Investigations about the effects of magnetic fields on QGP in Heavy Ion Collisions — •Inghirami Gabriele[1,2], Del Zanna Luca[3,4,5], Haddadi Mohsen[6], Bleicher Marcus[1,2], Becattini Francesco[3,5], Beraudo Andrea[7], and Rolando Valentina[8,9] — [1]FIAS, Frankfurt am Main, Germany — [2]Goethe Universität, Frankfurt am Main, Germany — [3]Universita' degli Studi di Firenze, Firenze, Italy — [4]Osservatorio Astrofisico di Arcetri - INAF, Firenze, Italy — [5]INFN, Sezione di Firenze, Italy — [6]Hakim Sabzevari University, Sabzevar, Iran — [7]INFN, Sezione di Torino, Italy — [8]Universita' degli

Studi di Ferrara, Ferrara, Italy — [9]INFN, Sezione di Ferrara, Italy

Numerical hydrodynamic simulations of heavy ion collisions are constantly refined through the addition of effects that may significantly improve the matching with experimental data, like viscosity or fluctuating initial conditions, but, so far, electromagnetic interactions have been almost completely neglected. However, recent lattice QCD computations and classical electrodynamics estimates both suggest that the magnetic fields produced immediately after the collisions between nuclei may live long enough and with a strength sufficient to produce measurable effects. We would like to present the results of some preliminary investigations about the influence on the properties of the medium due the presence of a strong magnetic field.

HK 3.6 Mo 15:30 S1/01 A4

Studies of the suppression of inclusive and b-tagged reconstructed jets within a partonic transport approach — •Florian Senzel[1], Zhe Xu[2], and Carsten Greiner[1] — [1]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität Frankfurt, Germany — [2]Department of Physics, Tsinghua University, Beijing, China

While the nuclear modification factor R_{AA} of charged hadrons measures jet quenching in terms of the suppression of single inclusive particle spectra, studies employing reconstructed jets additionally allow the investigation of medium modifications to the initial parton shower as a whole and thereby provide information about the angular dependence of jet quenching. Furthermore, due to mass effects the energy loss of jets is expected to be sensitive to the flavor of the shower-initiating parton. For investigating the medium modification of parton showers, we employ the transport approach BAMPS, which numerically solves the 3+1D Boltzmann equation for gluons, light and heavy quarks based on pQCD cross sections for both $2 \to 2$ and $2 \leftrightarrow 3$ processes. While employing an improved Gunion-Bertsch matrix element together with a running coupling, BAMPS simulations show a good agreement with data for both R_{AA} and the elliptic flow v_2. We present recent results about the R_{AA} of inclusive and b-tagged reconstructed jets and the modification of the underlying jet shapes. We show that the suppression of b-tagged jets is dominated by elastic energy loss of the bottom quark, while radiative processes of gluons and light quarks additionally broaden the distribution of momentum within the inclusive jets.

HK 3.7 Mo 15:45 S1/01 A4

Soft-Hard Event Engineering (SHEE) — •Barbara Betz — Goethe-Universität Frankfurt, Frankfurt am Main, Germany

The wide distributions of low-pT vn's measured experimentally have proven that any medium background model used must not only render the mean value of the low-pT vn's but also the correct amount of fluctuations within a centrality class. In the study presented, we investigate if the eccentricity selection of the background medium within a given centrality class influences the high-pT v2. For this, we couple the BBMG pQCD jet-energy loss model with the event-by-event, viscous hydrodynamical model v-USPhydro and determine the high-pT v2 and v3 for three different e2-eccentricity selections of the background medium. We find that the high-pT v2 is directly proportional to the low-pT v2 and that the width of the low-pT v2 distribution influences the value of the high-pT v2 while the RAA is independent of the e2-eccentricity distribution of the background medium.

HK 4: Nuclear Astrophysics I

Zeit: Montag 14:00–15:30 Raum: S1/01 A02

Gruppenbericht HK 4.1 Mo 14:00 S1/01 A02

Nucleosynthesis in Neutron Star Mergers: insights from astrophysical conditions and nuclear physics input⋆ — •Dirk Martin[1] and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Half of the elements heavier than iron are created by the rapid neutron capture process (r-process). Neutron star mergers present the most promising astrophysical site for the r-process, being both an explosive and extremely neutron-rich scenario.

We investigate the nucleosynthesis of matter ejected in different channels [1]. Furthermore, we study the impact of nuclear masses on the yields. Using masses obtained with six Skyrme energy density functionals [2], we determine systematic uncertainty bands for r-process abundances and discuss how details of the underlying microphysics can lead to abundance peaks and troughs [3].

[1] D. Martin et al., ApJ **813** (2015) 2.
[2] J. Erler et al., Nature **486** (2012) 509.
[3] D. Martin et al., submitted to PRL (2015).

⋆ Supported by the Helmholtz-University Young Investigator grant No. VH-NG-825 and by the BMBF under grant No. 05P15RDFN1. DM is a member of the HGS-HIRe graduate school.

HK 4.2 Mo 14:30 S1/01 A02

Sensitivity studies for Supernovae Type Ia — •Thien Tam Nguyen[1], Alan Calder[2,6], Kathrin Göbel[1,2], Marco Pignatari[2,3], René Reifarth[1,2], Dean Townsley[2,4], and Claudia Travaglio[2,5] — [1]Goethe University Frankfurt am Main, Germany — [2]NuGrid collaboration, http://www.nugridstars.org — [3]Konkoly Observatory of the Hungarian Academy of Sciences, Hungary — [4]The University of Alabama, USA — [5]INAF - Astrophysical Observatory Turin, Italy — [6]SUNY - Department of Physics and Astronomy New York, USA

The NuGrid research platform provides a simulation framework to study the nucleosynthesis in multi-dimensional Supernovae Type Ia models. We use a large network of over 5,000 isotopes and more than 60,000 reactions. The nucleosynthesis is investigated in post-processing simulations with temperature and density profiles, initial abundance distributions and a set of reaction rates as input. The sensitivity of the isotopic abundances to α-, proton-, and neutron-capture reaction, their inverse reactions, as well as fusion reactions were investigated. First results have been achieved for different mass coordinates of the exploding star.

This project was supported by the Helmholtz International Center for FAIR.

HK 4.3 Mo 14:45 S1/01 A02

Time-Resolved Two Million Year Old Supernova Activity Discovered in the Earth's Microfossil Record — •Shawn Bishop[1], Peter Ludwig[1], Ramon Egli[2], Valentina Chernenko[1], Boyana Deveva[1], Thomas Faestermann[1], Nicolai Famulok[1], Leticia Fimiani[1], Jose Gomez[1], Karin Hain[1], Gunther Korschinek[1], Marianne Hanzlik[3], Silke Merchel[4], and Georg Rugel[4] — [1]Physik Department, Technische Universität München, 85748 Garching, Germany — [2]Geomagnetism and Gravimetry, Central Institute for Metrology and Geodynamics, 1190 Vienna, Austria — [3]Chemie Department, FG Elektronmikroskopie, Technische Universität München, 85748 Garching, Germany — [4]Helmholtz-Zentrum Dresden-Rossendorf, Helmholtz Institute Freiburg for Resource Technology, 01328 Dresden, Germany

Using accelerator mass spectrometry, we have conducted a search for live, supernova-produced, ^{60}Fe atoms within biogenically produced magnetite (Fe_3O_4) crystals contained in two Pacific Ocean sediment cores. We have found a time-resolved ^{60}Fe signal in both sediment cores, above background, centered at approximately 2.1 Myr ago and spanning approximately 800 kyr duration (full width half maximum). The onset of this signal coincides with a known marine extinction event at the Pleiocene/Pleistocene boundary, and its shape will require eventual astrophysical interpretation to understand.

HK 4.4 Mo 15:00 S1/01 A02

Role of Nuclear Reactions for the Evolution of Degenerate ONeMg Cores — •Heiko Möller[1], Samuel Jones[2], and Gabriel Martínez-Pinedo[1] — [1]TU Darmstadt — [2]HITS Heidelberg

Degenerate electron cores composed of oxygen, neon & magnesium (ONeMg cores) appear primarily in the context of the late stellar evolution stages of super asymptotic giant branch (SAGB) stars with masses between 8 - 10 $M_\odot$. They can become white dwarfs, they can undergo gravitational collapse or they might even proceed towards explosive oxygen-burning and a subsequent thermonuclear explosion.

We show that an accurate description of nuclear reactions is crucial for the determination of the pre-supernova structure of these stars

and point out that weak rates involving sd-shell nuclei are especially important. This concerns in particular the ^{20}Ne electron capture, taking into account the 2nd forbidden transition to the ^{20}F ground state, where experimental and theoretical advances in the rate determination are currently being made. We perform stellar evolution calculations of accreting ONeMg cores to study the behavior of the core prior to the ignition of oxygen and show that the development of convection is highly sensitive to the nuclear reactions being considered. Some of our models develop an oxygen-deflagration requiring a hydrodynamic description coupled with a nuclear reaction network with ~ 200 nuclear species including all relevant electron captures and beta-decays. We present results of hydrodynamic simulations that capture the onset of the oxygen-flame ignition based on recent SAGB star models.

H.M. is supported by the Helmholtz Association through NAVI.

HK 4.5 Mo 15:15 S1/01 A02

Impact of (α, n)-reaction rate uncertainties on the nucleosynthesis in neutrino-driven winds — •Julia Bliss[1], Almudena Arcones[1,2], Fernando Montes[3,4], and Jorge Pereira[3,4] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum GmbH — [3]National Superconducting Cyclotron Laboratory, Michigan State University, USA — [4]Joint Institute for Nuclear Astrophysics

In neutrino-driven winds from nascent neutron stars, matter moves towards heavier nuclei, mainly via alpha capture reactions, especially (α, n)-reactions. In the absence of experimental information, the reaction rates are usually calculated with statistical Hauser-Feshbach models [1]. The predictive power of these models is uncertain, especially as one moves away from stability. Therefore, it is important to study the sensitivity of the nucleosynthesis to the theoretical uncertainty of those rates.
We will show that under some astrophysical conditions the reaction rate uncertainties can be critical for the nucleosynthesis.

[1] W. Hauser and H. Feshbach, Physical Review, 87: 366-373, 1952.

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

HK 5: Structure and Dynamics of Nuclei I

Zeit: Montag 14:00–16:00 Raum: S1/01 A03

Gruppenbericht HK 5.1 Mo 14:00 S1/01 A03

Quasi-free one nucleon knockout reactions on neutron-rich Oxygen Isotopes at the R3B-LAND setup — •Leyla Atar[1,2], Thomas Aumann[1,2], Carlos Bertulani[3], Stefanos Paschalis[1], and Chiara Nociforo[2] for the R3B-Collaboration — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]Texas A&M University-Commerce, Commerse, USA

Recent experiments have showed a reduction of spectroscopic strengths of about 60-70% for stable nuclei. When going to driplines this tendency is changing, loosely bound nucleons have spectroscopic strengths close unity while deeply bound nucleons have a large reduction of the strength. We aim to make a systematic study of spectroscopic factors (SF) of the Oxygen isotopes using quasi-free (p,2p) and (p,pn) knockout reactions in inverse kinematics. Quasi-free knockout reactions are a direct tool to study the occupancy and the location of valance and deeply bound single particle states. The Oxygen isotopes offer a large variation of separation energies which will allow us to obtain a qualitative and quantitative understanding of SF in a large variation of isospin asymmetry. For this we performed an experiment at the R3B-LAND setup at the GSI with a secondary beam $^{14-24}$O. The $^{16-18}$O and $^{21-23}$O isotopes have been analyzed and the preliminary results will be presented. The results include the partial cross sections, gamma ray spectra of the residual fragments in coincidence, and the SF obtained via comparison with theory. This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and the BMBF project 05P15RDFN1.

HK 5.2 Mo 14:30 S1/01 A03

Proton Knockout Reactions from Neutron-Rich N Isotopes at R^{3}B — •Ina Syndikus and Marina Petri for the R3B-Collaboration — IKP, TU Darmstadt, Germany

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 5.3 Mo 14:45 S1/01 A03

Erste SEASTAR Ergebnisse zu ^{86,88}Ge nach (p,2p) — •Marc Lettmann[1], Norbert Pietralla[1], Volker Werner[1], Pieter Doornenbal[2] und Alexandre Obertelli[3] für die SEASTAR-Kollaboration — [1]TU Darmstadt — [2]RIKEN — [3]CEA Saclay

Im Rahmen des SEASTAR Projekts wurde MINOS, ein Flüssigwasserstofftarget umschlossen von einer TPC, mit DALI2 verknüpft, um unter anderem die ersten angeregten Zustände der neutronenreichen Germaniumisotope ^{86,88}Ge zu untersuchen. Von den Zyklotrons des RIKEN-RIBF wurde ein ^{238}U Strahl mit einer Energie von 345 MeV/u und einem Strahlstrom von ungefähr 30 pnA erzeugt, der auf ein Berylliumtarget geschossen wurde. Die ausgehenden Spaltfragmente konnten mit dem BigRIPS Fragmentseparator getrennt, und die gewünschten Kerne zu MINOS weitergeleitet werden. Die im Wasserstofftarget entstehenden Reaktionsprodukte wurden mit dem ZeroDegree Spektrometer identifiziert. Die genaue Bestimmung des Ein- und Ausgangskanals der Reaktion durch BigRIPS und ZeroDegree ermöglicht eine genaue Bestimmung des Reaktionskanals. Mit Hilfe von MINOS erhält man den präzisen Reaktionsort im Wasserstofftarget und kann so eine bestmögliche Doppler-Korrektur gewährleisten. Ergebnisse zu den ersten angeregten Zuständen der Germaniumisotope ^{86,88}Ge, erzeugt durch die Reaktion ^{87,89}As(p,2p)^{86,88}Ge im Hinblick auf zukünftige Experimente an FAIR werden in diesem Vortrag präsentiert. Unterstützt vom BMBF unter der Fördernummer 05P15RDFN1.

HK 5.4 Mo 15:00 S1/01 A03

Inelastic scattering of neutron-rich ^{72,74}Ni off a proton target — •Martha Liliana Cortés for the SEASTAR-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

One of the fundamental pillars of nuclear structure is the concept of shell structure governed by a mean-field with a strong spin-orbit interaction. Nevertheless, it has been observed that shell structure changes as one moves away from the stability line. Particularly important to study shell-evolution are nuclei around doubly-closed shells, for example around ^{78}Ni. Inelastic proton scattering of ^{72,74}Ni was performed at RIKEN as part of the first SEASTAR campaign. Isotopes were produced by the in-flight fission of ^{238}U ions on a 3 mm thick Be target. After production, neutron-rich isotopes were selected and identified on an event-by-event basis using the BigRIPS separator. Selected isotopes were focused onto the MINOS liquid hydrogen target and γ-rays from (p, p') reactions were detected with the DALI2 array. Outgoing particles were identified using the ZeroDegree spectrometer. Transitions from the first 2^+ and 4^+ states in both isotopes were identified in Doppler corrected γ-ray energy spectra. Using detailed Geant4 simulations, exclusive cross sections for inelastic proton scattering were obtained and the corresponding deformation lengths were derived. The ongoing data analysis will be presented and a discussion on the implications of the measured cross sections on the independent motion of protons and neutrons on neutron-rich Ni isotopes will be shown.

HK 5.5 Mo 15:15 S1/01 A03

Observation and spectroscopy of new proton-unbound isotopes ^{30}Ar and ^{29}Cl – an interplay of prompt two-proton and sequential decay — •Ivan Mukha — Helmholzzentrum GSI, Darmstadt

Previously unknown isotopes ^{30}Ar and ^{29}Cl have been identified by measurement of the trajectories of their in-flight decay products ^{28}S+p+p and ^{28}S+p, respectively. The analysis of angular correlations of the fragments provided information on decay energies and structure of the parent states [1]. The lowest states in ^{30}Ar, ^{29}Cl point to a violation of isobaric symmetry in structure of these unbound nuclei. The two-proton decay has been identified in a transition region between simultaneous two-proton and sequential proton emissions from the ^{30}Ar ground state, which is characterized by an interplay of three-body and two-body decay mechanisms. Such a phenomenon, never observed before, may be common in 2p-unbound nuclei, and could be of interest for other disciplines dealing with few-body systems. In addition, the dramatic change of odd-even mass staggering in 2p-unbound nuclei and the fine structure in the 2p decay of the ^{30}Ar*(2.9 MeV) state were indicated. An Optical Time-Projection Chamber was used in the same experiment to observe beta decays of stopped ^{31}Ar ions, which passed the secondary target intact. With this detector, β-delayed 3p emission from ^{31}Ar was observed [2].

[1] I. Mukha, *et al.,* Phys. Rev. Lett. 115 (2015) 202501.
[2] A.A. Lis, *et al.,* Phys. Rev. C 91 (2015) 064309.

HK 5.6 Mo 15:30 S1/01 A03

Spectroscopy in neutron-rich nuclei in the vicinitiy of N=40 — •Thomas Braunroth[1], Alfred Dewald[1], Christoph Fransen[1], Hironori Iwasaki[2], Jan Jolie[1], and Julia Litzinger[1] — [1]Institut für Kernphysik, Universität zu Köln, Germany — [2]National Superconducting Cyclotron Laboratory, MSU, USA

The development of collectivity towards $N = 40$ in neutron-rich nuclei between $_{20}$Ca and $_{28}$Ni shows a distinct Z-dependence. While ^{68}Ni exhibits features of a pronounced shell-gap, the evolution of key observables, e.g. excitation energies and B($E2$) values, in even-even $_{26}$Fe and $_{24}$Cr isotopes is interpreted as a rapidly evolving quadrupole deformation when $N = 40$ is approached. However, experimental information on level energies and reduced transitions strengths are still sparse in this particular region of the nuclear landscape. To shed more light on the evolution of collectivity along even-even Cr isotopes towards $N = 40$, we performed an experiment at NSCL, MSU (USA) in which lifetimes of excited states were measured with the recoil distance Doppler-shift technique. The experiment focused on the 2_1^+ and 4_1^+ states in ^{58,60,62}Cr and corresponding results have been published recently [1]. In addition, various excited states in neighbouring nuclei with $23 \lesssim Z \lesssim 26$ close to $N = 40$ were populated and some spectroscopic information on transition energies and level lifetimes can be deduced. Some of them are determined for the first time. In this talk we will present preliminary results of such side reactions. This work is supported by the BMBF under contract number 05P12PKFNE.

[1] T. Braunroth *et al.*, Phys. Rev. C **92**, 034306 (2015)

HK 5.7 Mo 15:45 S1/01 A03

Determination of the Lifetime of the 1^+ State in ^{30}Na — •Sebastian Heil and Marina Petri for the E05122-Collaboration — TU Darmstadt, Darmstadt, Deutschland

^{30}Na is located at the "Island of Inversion" at N=20. The experiment E05122 was performed at the National Superconducting Cyclotron Laboratory and investigated the low-lying structure of the odd-odd nucleus ^{30}Na via nucleon removal reactions from ^{31}Mg, ^{30}Mg and ^{31}Na [1].

The aim of the work to be presented is the determination of the lifetime of the first excited 1^+ state in ^{30}Na. This is achieved via peak shape analysis of the obtained γ-ray spectrum. The analysis will be discussed and the results will be compared to large scale shell model calculations.

This work was supported by DOE contract No. DE-AC02-05CH11231, by the National Science Foundation under Grant PHY-1102511 and by the Helmholtz International Center for FAIR within the framework of the LOEWE program (Landesoffensive zur Entwicklung Wissenschaftlich-Ökonomischer Exzellenz) launched by the State of Hesse.

[1] M.Petri et al, Phys.Let.B **748** 173-177 (2015)

HK 6: Structure and Dynamics of Nuclei II

Zeit: Montag 14:00–16:00 Raum: S1/01 A04

Gruppenbericht HK 6.1 Mo 14:00 S1/01 A04

Beam normal single-spin asymmetry measurements at MAMI — •Michaela Thiel for the A1-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Reaching new precision frontiers in nuclear physics brings up new experimental challenges as well as the demand for more sophisticated theoretical calculations. Especially in parity violating electron scattering experiments the contribution from higher order processes, such as two-photon exchange, is comparable in size with the observed asymmetry A_{pv}. Hence, a precise knowledge of this contribution is mandatory to determine the systematic uncertainties.

The beam normal single-spin asymmetry A_n is a direct probe of the imaginary part of the two-photon exchange amplitude in the elastic scattering of transversely polarized electrons from unpolarized nucleons. Up to now, there is significant disagreement between experiment and theory for ^{208}Pb, which motivates more measurements to study the Q^2 and Z dependence. Therefore a new experimental campaign started at the Mainz Microtron (MAMI) using the spectrometer setup of the A1 collaboration. Within three weeks of beam time A_n was measured as a function of Q^2 for ^{12}C. First results for four different 4-momentum transfer values, ranging from 0.02 to 0.05 $(\mathrm{GeV}/c)^2$, will be presented in this talk.

Gruppenbericht HK 6.2 Mo 14:30 S1/01 A04

Direct detection of the thorium-229 isomer: Milestone towards a nuclear clock — •L. von der Wense[1], B. Seiferle[1], M. Laatiaoui[2,3], J.B. Neumayr[1], H.J. Maier[1], H.F. Wirth[1], C. Mokry[3,4], J. Runke[2,4], K. Eberhardt[3,4], C.E. Düllmann[2,3,4], N. Trautmann[4], and P.G. Thirolf[1] — [1]Ludwig-Maximilians-University Munich, 85748 Garching — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt — [3]Helmholtz Institute Mainz, 55099 Mainz — [4]Johannes Gutenberg University, 55099 Mainz

In the whole landscape of atomic nuclei, ^{229}Th possesses the only known transition which by today could allow for the development of a nuclear frequency standard. The corresponding isomeric state has an energy of just 7.8 eV, which is even accessible by laser and frequency-comb technology. The isomer to ground-state transition, however, could not be directly detected within the past 40 years, despite significant efforts. In the presentation the first time unambiguous direct detection of the isomeric transition is described. This detection will allow for the determination of the decay parameters and in this way pave the way for the development of a nuclear clock.[1]

This work was supported by DFG (Th956/3-1) and by EU Horizon 2020 grant agreement no 664732 "nuClock".

[1] L. v.d.Wense, B. Seiferle, M. Laatiaoui and P.G. Thirolf, Eur. Phys. J. A 51, 29 (2015).

HK 6.3 Mo 15:00 S1/01 A04

Inelastic Form Factor of the He-4 (0^+)-Resonance — •Simon Kegel — Institut für Kernphysik Universität Mainz, Deutschland

Electron scattering experiments offer a great opportunity to probe nuclear properties and to get deeper insight into nuclear dynamics, because the electromagnetic interaction is well understood.
The MAMI electron accelerator at Mainz, Germany, can reach high beam intensities with electron energies in the range up to 1.5 GeV, thus it is a powerful tool to investigate nuclear dynamics with high statistics and precision. In 2009 an electron scattering experiment was performed by the A1 collaboration at MAMI with the focus on the study of inclusive reactions of light nuclei. The goal of the experiment is to test effective field theories, including phenomenological 3- or 4-body forces in potentials for ab-initio calculations. In the talk a new analysis of the form factor for the He-4 (0^+)-resonance will be presented.

HK 6.4 Mo 15:15 S1/01 A04

Background analysis for the beta-spectrum of the isotope 113Cd in the COBRA experiment — •Stephan Platzek for the COBRA-Collaboration — Technische Universität Dresden, Deutschland

The COBRA experiment uses Cadmium-Zinc-Telluride as detector material. This semiconductor contains several isotopes that are candidates for neutrinoless double beta-decay. Due to the natural abundance of the detector material various other isotopes are present as well. One of them is ^{113}Cd with an abundance of about 12%.

The fourfold forbidden non-unique beta-decay of ^{113}Cd is a rare process with a half-life of about $8 \cdot 10^{15}$ years. The shape of the spectrum is still topic of scientific discussions because of various forecasts given by theoretical models. The signal related to this decay is by far the most prominent in the COBRA setup causing more than 98% of the total rate.

In this talk potential background components contributing to the ^{113}Cd beta-spectrum are discussed with the aim to develop a detailed background simulation with the program VENOM (based on Geant4), that includes background sources originating from cosmic activation as well as natural radioactivity and detector specific effects.

HK 6.5 Mo 15:30 S1/01 A04

Tensor Interaction Studies via High-Momentum Neutron Transfer Reaction, ^{16}O(p,d), at the FRS — •Fabio Farinon for the S436-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany

The contribution of the nuclear tensor force was investigated via the ^{16}O(p,d) reaction with the FRS at different energies from 400 MeV/u to 1200 MeV/u centered at 0 degrees. Previously, it was measured at lower energies and at angles up to 25 degrees [1]. The measured deuteron spectrum reflects the ground state and various excitation levels of ^{15}O. The required high momentum resolution was achieved by operating the FRS as a spectrometer in a complete dispersive ion-optical mode, where the resolving powers of the four dipole-magnet stages are added. The object size of the spectrometer was restricted by a stripe target of 1 mm in the dispersive direction. The measured deuteron spectra were compared with extended simulations. The results of cross-section ratios of the low-lying excited states to the ground state reflect the influence of the tensor force which cannot be explained by present mean field calculations.

[1] H.J. Ong et al. Phys. Lett. B 725 (2013) 277.

HK 6.6 Mo 15:45 S1/01 A04

Using ^{233}U-doped crystals to access the few-eV isomeric transition in ^{229}Th — •Simon Stellmer, Matthias Schreitl, Georgy A. Kazakov, Johannes H. Sterba, and Thorsten Schumm — Vienna Center for Quantum Science and Technology (VCQ) and Atominstitut, TU Wien, Vienna, Austria

The isotope ^{229}Th possesses an exceptionally low-lying isomeric state at an energy of only a few eV. While direct laser excitation of the isomer is a tantalizing future prospect, the stage is not yet set for nuclear laser spectroscopy: too little is known about the energy, lifetime, and internal conversion pathways of the isomer. Alternative routes to populate the isomer are needed for further investigations.

We use the alpha decay $^{233}\mathrm{U} \rightarrow {}^{229\mathrm{g,m}}\mathrm{Th}$ to populate the isomer with a probability of 2%. The ^{233}U is embedded into VUV-transparent crystals, as the isomer transition is expected around 160 nm. The wavelength of the gamma ray, emitted upon de-excitation of the isomer into the ground state, is measured with a spectrometer. Calculations show that the isomer emission will not be obscured by radioluminescence of the crystal.

We will report on the current status of the experiment.

HK 7: Instrumentation I

Zeit: Montag 14:00–15:30 Raum: S1/01 A2

Gruppenbericht HK 7.1 Mo 14:00 S1/01 A2

Vacuum-Compatible, Ultra-Low Material Budget MVD for the CBM Experiment. — •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. The detector comprises up to four stations placed next to the target and inside vacuum. The stations are populated with 50 μm thin, highly-granular Monolithic Active Pixel Sensors, featuring a spatial resolution of <5 μm, a readout speed of few 10 μs/frame, a radiation tolerance of $>10^{13} n_{eq}/cm^2$ and 3 Mrad. This contribution focuses on the next and the last step before a final detector production, that is the precursor of the third CBM-MVD station hosting 15 CMOS sensors. We will report on the status of the project and the first results of the MVD precursor characterization, with a emphasis on lessons learned for the assembly phase.

HK 7.2 Mo 14:30 S1/01 A2

The PASTA chip for the silicon micro strip sensor of the PANDA MVD — •Alberto Riccardi[1], Kai-Thomas Brinkmann[1], Valentino Di Pietro[1], Tommaso Quagli[1], James Ritman[2], Angelo Rivetti[3], Manuel Rolo[3], Robert Schnell[1], Tobias Stockmanns[2], André Zambanini[2], and Hans-Georg Zaunick[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut Justus-Liebig-Universität Giessen, Giessen, Germany — [2]Forschungszentrum Jülich — [3]INFN Sezione di Torino, Torino, Italy

In the Micro Vertex Detector, which is the innermost detector of PANDA, there are two different types of sensors: hybrid pixel and double sided micro strips. My work is focused on the development of the ASIC readout for the strips, which in the PANDA experiment must cope with a hit rate up to 50 kHz per channel. The energy loss measurement of the particles crossing the silicon sensor is obtained by implementing the Time over Threshold technique.

The first PASTA (PANDA Strip ASIC) prototype is based on a Time to Digital Converter with an analog clock interpolator which combines good time resolution with a low power consumption. A full size chip was developed in a $0.11\mu m$ CMOS technology and delivered in Autumn 2015. It features 64 channels with both analog and digital parts, a digital global controller, LVDS drivers and integrated bias.

In the presentation, an overview of PASTA and the results of the first tests will be presented.

Supported by BMBF, HIC for FAIR, HGS-HIRe and JCHP.

HK 7.3 Mo 14:45 S1/01 A2

On drift fields in CMOS Monolithic Active Pixel Sensors* — •Michael Deveaux for the CBM-MVD-Collaboration — Goethe-Universität, Frankfurt

CMOS Monolithic Active Pixel Sensors (MAPS) combine an excellent spatial resolution of few μm with a very low material budget of 0.05% X_0. To extend their radiation tolerance to the level needed for future experiments like e.g. CBM, it is regularly considered to deplete their active volume.

We will discuss the limits of this strategy accounting for the specific features of the sensing elements of MAPS. Moreover, we introduce an alternative approach to generate the drift fields needed to provoke a faster charge collection by means of doping gradients.

*supported by BMBF (05P12RFFC7), HIC for FAIR and GSI.

HK 7.4 Mo 15:00 S1/01 A2

Optical quality assurance procedures for the sensors of CBM STS Detector — •Evgeny Lavrik for the CBM-Collaboration — Physikalisches Institut der Universität 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 (STS) is the key detector to reconstruct charged particle tracks created in heavy-ion interactions. In order to assure the quality of about 1300 silicon sensors, highly efficient and highly automated procedures need to be developed.

In this contribution we report on a microscope camera based optical inspection system, used to scan along the individual sensors to

recognize and classify sensor defects. Examples of these defects are: photo-resist residues, top metallization layer lithography defects, surface scratches. In order to separate and classify these defects various image-processing algorithms are used, including: pattern recognition, object classification etc.

HK 7.5 Mo 15:15 S1/01 A2

Quality assurance tests of the CBM Silicon Tracking System sensors with an infrared laser — •Maksym Teklishyn for the CBM-Collaboration — FAIR GmbH, Darmstadt — KINR, Kyiv, Ukraine

Double-sided 300 μm thick silicon microstrip sensors are planned to be used in the Silicon Tracking System (STS) of the future CBM experiment. Different tools, including an infrared laser, are used to induce charge in the sensor medium to study the sensor response. We use present installation to develop a procedure for the sensor quality assurance during mass production. The precise positioning of the laser spot allows to make a clear judgment about the sensor interstrip gap response which provides information about the charge distribution inside the sensor medium. Results are compared with the model estimations. Supported by EU-Horizon 2020 CREMLIN.

HK 8: Instrumentation II

Zeit: Montag 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 8.1 Mo 14:00 S1/01 A3

Fast and Convenient Data Analysis Software at the BGO–OD Experiment — •Oliver Freyermuth for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO–OD experiment located at the ELSA accelerator in Bonn is using the electron beam with energies up to 3.2 GeV for the investigation of meson photoproduction off the nucleon. The setup combines a central highly segmented BGO crystal calorimeter with a forward magnetic spectrometer complemented by ToF walls. In total over 5000 channels of diverse detectors are connected to the readout system.

The data analysis for this complex setup is handled by a modular software derived from the ROOT-based analysis framework ExPlORA, originally developed by the CB-ELSA/TAPS collaboration in Bonn.

This framework has now been heavily extended with a set of generic tools which can be used without knowledge of its internal design or extensive programming experience, while achieving the execution speed of compiled code. The underlying concept as well as its performance will be presented.

Secondly, methods of data preprocessing will be discussed. Since the analysis chain is based on object-oriented data structures, it can be easily segmented by storing intermediate preprocessed datasets. A technique to prune lower-level information was developed.

Finally, it will be illustrated that ExPlORA is closely entangled with recent and upcoming developments on C++ and ROOT. On this basis it is equipped with tools assisting in development and testing.

This work is supported by the DFG (SFB/TR-16).

HK 8.2 Mo 14:30 S1/01 A3

Investigation of a Huffman-based compression algorithm for the ALICE TPC read-out in LHC Run 3 — •Sebastian Klewin for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

Within the scope of the ALICE upgrade towards the Run 3 of the Large Hadron Collider at CERN, starting in 2020, the ALICE Time Projection Chamber (TPC) will be reworked in order to allow for a continuous read-out. This rework includes not only a replacement of the current read-out chambers with Gas Electron Multiplier (GEM) technology, but also new front-end electronics. To be able to read out the whole data stream without loosing information, in particular without zero-suppression, a lossless compression algorithm, the Huffman encoding, was investigated and adapted to the needs of the TPC. In this talk, an algorithm, adapted for an FPGA implementation, is presented. We show its capability to reduce the data volume to less than 40% of its original size.

HK 8.3 Mo 14:45 S1/01 A3

Time-based cluster and hit finding for the STS detector in the CBM experiment at FAIR — •Grigory Kozlov[1,2,3,4] and Ivan Kisel[1,2,3] for the CBM-Collaboration — [1]Goethe University, Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]Joint Institute for Nuclear Research, Dubna, Russia

The goal of the future CBM experiment at FAIR is to explore the QCD phase diagram in the region of high baryon densities using high-energy nucleus-nucleus collisions. An important feature of the experiment is the real time reconstruction and physical analysis. It will allow select important events immediately after the collision and increase the quality of the data. In this case, the data are supplied to processing in form of time slices containing a large number of collisions. Preprocessing of the time-based results requires special algorithms that take into account not only the coordinates, but also the time of flight of each particle. Clustering algorithm for the STS detector has been designed and integrated into the CBMROOT framework. It enables data processing with high efficiency for the time slices of any length at frequencies of 107 and over collisions per second. The algorithm has a high speed and it can operate in event-based mode as well as in time-based.

HK 8.4 Mo 15:00 S1/01 A3

Offline Event-Building based on Free-Streaming CBM-TRD Prototype DAQ Systems in 2015 CERN-SPS Beamtest Data — •Philipp Kähler for the CBM-Collaboration — Institut für Kernphysik, WWU Münster, Deutschland

The detectors of the Compressed Baryonic Matter (CBM) experiment at FAIR will be operated with unprecedented particle rates of up to 100kHz/cm^2. Transition Radiation Detector (TRD) prototypes have been tested at particle rates of several kHz in Novemver 2015 at the CERN-SPS under the use of a lead target in a 30 AGev lead ion beam. The rate capabilities of the currently developed *Self-triggered Pulse Amplification and Digitization ASIC* (SPADIC) have been investigated in this beamtest. The SPADIC boards of two TRD prototypes were operated in a time-synchronised mode. This talk will focus on the time-based offline event building. Especially first time-correlation studies between two aligned detectors will be shown.

Furthermore the high voltage currents of the chamber anode wires have been monitored with a high frequency. First steps of a high voltage analysis and implications to the chamber design with respect to the field geometry will be discussed.

HK 8.5 Mo 15:15 S1/01 A3

Simulation kosmischer Höhenstrahlung in hochsegmentierten AGATA-HPGe-Detektoren — •David Schneiders, Benedikt Birkenbach, Peter Reiter und Dawid Rosiak für die AGATA-Kollaboration — IKP, Universität zu Köln

Der AGATA-HPGe-Detektor ermöglicht den Nachweis von hochenergetischen γ-Quanten und geladenen Teilchen bis zu einer Energie von 180 MeV. Durch die Segmentierung des Detektors ist es möglich, partielle Energiedepositionen ortssensitiv aufzulösen. In einer Langzeitmessung wurden Energien bis 160 MeV von hochenergetischen Teilchen aus der kosmischen Höhenstrahlung nachgewiesen. Energieverlustrechnungen sind konsistent mit dem Myonenanteil der einfallenden Höhenstrahlung. Dazu wurden die Messungen mit den Ergebnissen einer GEANT4-Simulation, die auf der CRY-Bibliothek basiert, verglichen. Die guten Übereinstimmungen zeigen, dass natürliche kosmische Höhenstrahlung zur Kalibration des Messsystems genutzt werden kann und AGATA-HPGe-Detektoren über das Energieverlustsignal in der Lage sind, Teilchenidentifikation zu erzielen.

HK 8.6 Mo 15:30 S1/01 A3

Impact of the *genfit*2 Kalman-Filter-based algorithms on physics simulations performed with PandaRoot. — •Elisabetta Prencipe and James Ritman for the PANDA-Collaboration — Forschungszentrum Jülich IKP1, Jülich (DE)

$\overline{\text{P}}$ANDA is a planned experiment at FAIR (Darmstadt) with a cooled antiproton beam in a range [1.5; 15] GeV/c, allowing a wide physics program in nuclear and particle physics. It is the only experiment worldwide, which combines a solenoid field (B=2T) and a dipole field

(B=2Tm) in an experiment with a fixed target topology, in that energy regime. The tracking system of $\overline{\text{P}}$ANDA involves the presence of a high performance silicon vertex detector, a GEM detector, a Straw-Tubes central tracker, a forward tracking system, and a luminosity monitor. The offline tracking algorithm is developed within the PandaRoot framework, which is a part of the FAIRRoot project. The algorithm here presented is based on a tool containing the Kalman Filter equations and a deterministic annealing filter (*genfit*). The Kalman-Filter-based algorithms have a wide range of applications; among those in particle physics they can perform extrapolations of track parameters and covariance matrices. The impact on physics simulations performed for the $\overline{\text{P}}$ANDA experiment is showed for the first time, with the PandaRoot framework: improvement is shown for those channels where a good low momentum tracking is required (p_T <400 MeV/c), i.e. D mesons and Λ reconstruction, of about a factor 2.

HK 8.7 Mo 15:45 S1/01 A3

An FPGA-based Sampling-ADC Readout for the Crystal Barrel Calorimeter — •Johannes Müllers[1] and Pawel Marciniewski[2] for the CBELSA/TAPS-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Angströmlaboratoriet, Uppsala, Sweden

The CBELSA/TAPS experiment at the electron accelerator ELSA (Bonn) investigates the photoproduction of mesons off protons and neutrons. The Crystal Barrel Calorimeter has been upgraded replacing its photodiode readout by APDs, which allows the integration of the calorimeter into the first level trigger. Since the possible DAQ rate is currently limited by the digitization stage (LeCroy QDC1885F) to $\approx$ 2 kHz, the implementation of a new Sampling-ADC (SADC) readout is the second important step in the upgrade of the detector system.

Based on the 64-channel PANDA-SADC, the design was modified, adapting it to the needs of the CBELSA/TAPS experiment. The CB-SADC offers 64 channels in one NIM module with up to 14 bit@125 MHz, accompanied by a modular analog input stage and power supply. Data processing and reduction are realized with Kintex7 FPGAs. Readout is possible via gigabit ethernet links. Using an FPGA provides a multitude of possibilities for online feature extraction, such as the determination of the energy deposited in the crystal, TDC capabilities and pile-up detection and recovery. The SADC development will be discussed and first measurements performed in comparison to the presently used LeCroy QDC will be presented.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 9: Hadron Structure and Spectroscopy II

Zeit: Montag 16:30–18:30 Raum: S1/01 A5

Gruppenbericht HK 9.1 Mo 16:30 S1/01 A5

Hadron phenomenology with Dyson-Schwinger and Bethe-Salpeter equations — •Gernot Eichmann — JLU Giessen, Germany

I will give an overview of recent progress on hadron phenomenology within the Dyson-Schwinger/Bethe-Salpeter equation approach. This includes studies of nucleon resonances and transition form factors from the three-quark Faddeev equation as well as its quark-diquark approximation; a calculation of nucleon Compton scattering and nucleon polarizabilities from the quark level; and an investigation of tetraquarks using the four-quark Bethe-Salpeter equation.

HK 9.2 Mo 17:00 S1/01 A5

Central Production at COMPASS — •Alexander Austregesilo — Technische Universität München

COMPASS is a fixed-target experiment at the CERN SPS that studies the spectrum of light-quark hadrons. In 2009, it collected a unique dataset using a 190 GeV/c positive hadron beam impinging on a liquid-hydrogen target in order to measure the central exclusive production of light scalar mesons. One of the goals is the search for so-called glueballs, which are hypothetical meson-like objects without valence-quark content. We study the decay of neutral resonances by selecting centrally produced hadron pairs from the COMPASS dataset. The angular distributions of these two-pseudoscalar meson final states are decomposed in terms of partial waves, where particular attention is paid to the inherent mathematical ambiguities. The large dataset permits us to perform a detailed analysis in two-dimensional bins of the two squared four-momentum transfers carried by the exchange particles in the reaction. Possible parameterisations of the mass dependence of the partial-wave amplitudes in terms of resonances are also discussed.

Supported by BMBF, MLL and the Cluster of Excellence Exc153 "Origin and Structure of the Universe"

HK 9.3 Mo 17:15 S1/01 A5

Measurement of Charged Kaon Multiplicities at COMPASS — •Nicolas du Fresne von Hohenesche — For the COMPASS collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55128 Mainz

Quark fragmentation functions (FF) $D_q^h(z, Q^2)$ describe final-state hadronisation of quarks q into hadrons h. The FFs can be extracted from hadron multiplicities produced in semi-inclusive deep inelastic scattering. The COMPASS collaboration has recently measured charged hadron multiplicities for identified pions and kaons using a 160 GeV/c muon beam impinging on an isoscalar target. The data cover a large kinematical range and provide an important input for global QCD analyses of world data at NLO, aiming at the determination of FFs in particular in the strange quark sector. The most recent results from COMPASS on kaon multiplicities will be presented.

Supported by BMBF

HK 9.4 Mo 17:30 S1/01 A5

First results on the longitudinal double spin asymmetry for identified hadrons from the 2011 COMPASS data — •Malte Wilfert — for the COMPASS collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55128 Mainz

The COMPASS experiment at the M2 beamline of the CERN SPS has taken data with a polarised muon beam scattering off a polarised NH_3 target in 2011. The beam energy has been increased to 200 GeV as compared to 160 GeV in 2007. With the increased beam energy it is possible to reach higher values of Q^2 and lower values of x compared to our first measurement in 2007. We will present our results on the longitudinal double spin asymmetry for identified hadrons ($A_{1,p}^{\pi\pm}, A_{1,p}^{K\pm}$). The results will be compared to our previous results from 2007.

Supported by BMBF and GRK Symmetry Breaking

HK 9.5 Mo 17:45 S1/01 A5

Die Bestimmung der Strangeness-Formfaktoren des Nukleons bei niedrigem Impulsübertrag — •Boris Gläser[1], David Balaguer Rios[1], Sebastian Baunack[1,3], Luigi Capozza[1,2], Jürgen Diefenbach[1], Yoshio Imai[1], Jeong-Han Lee[1], Frank Maas[1,2,3], Maria Carmen Mora Espi[1,2], Ernst Schilling[1], Dietrich von Harrach[1] und Christoph Weinrich[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence Mainz

Die Bestimmung der Strange-Quark-Beiträge zu den Vektor-Formfaktoren des Nukleons gibt Aufschluß über die Verteilung der strange Quark-Antiquarkverteilungen im Nukleon. Zu diesem Zweck bedient sich die A4-Kollaboration der paritätsverletzenden Elektron-Proton-Streuung. Am Elektronenbeschleuniger MAMI der Johannes Gutenberg-Universität Mainz wurde die Asymmetrie in der elastischen Streuung longitudinal polarisierter Elektronen an unpolarisiertem Wasserstoff gemessen. Dies ermöglicht den exklusiven Nachweis von Seequarks.

Dieser Beitrag stellt die Messung der Asymmetrie bei einem Impulsübertrag von 0.1(GeV/c)^2 unter Rückwärtsstreuwinkeln vor. Die daraus resultierende Linearkombination für den seltsamen elektrischen und magnetischen Formfaktor des Protons wird mit den Welt-Datenpunkten anderer Kollaborationen bei gleichem Q^2 vorgestellt. Separierte Strangeness-Formfaktoren werden vorgestellt und diskutiert.

HK 9.6 Mo 18:00 S1/01 A5

Parity violation asymmetry in the inelastic electron-proton scattering at the A4 experiment — •Luigi Capozza[1,2], David

Balaguer Ríos[2], Sebastian Baunack[2,3], Jürgen Diefenbach[2], Boris Gläser[1,2], Yoshio Imai[2], Eva-Maria Kabuss[2], Jeong-Han Lee[2], Frank Maas[1,2,3], Maria Carmen Mora Espí[1,2], Ernst Schilling[2], Dietrich von Harrach[2], and Christoph Weinrich[2] — [1]Helmholtz-Institut Mainz — [2]Institut für Kernphysik, Johannes Gutenberg-Universität 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 single spin asymmetries in the electron-proton scattering. The apparatus was designed for measuring asymmetries in the elastic scattering, separating elastic and inelastic events by measuring the energy of the scattered particles in an homogeneous PbF_2 electromagnetic calorimeter. However, also inelastic events have been recorded during the measurements and contain threshold pion production and $\Delta(1232)$ resonance excitation. In order to extract parity violation asymmetries from these data, background contributions to the energy spectrum need to be estimated in MC simulations. An update of the A4 MC containing the contribution of π^0 decay gammas from double-pion production will be presented.

HK 9.7 Mo 18:15 S1/01 A5

Pion-Photon Reaction in Pion-Nucleus Scattering at COMPASS — •Markus Krämer — Technische Universtität München, Garching, Germany

COMPASS is a fixed-target experiment at CERN, which uses muon and hadron beams produced at the SPS to address a wide variety of physics topics. An important aspect of the scientific program of COMPASS is the study of pion-photon interaction, which are accessible through the Primakoff reaction. In 2009 a two-weeks long period of data recording was dedicated for this study. Among the studied final states are exclusive $\pi^-\pi^0\pi^0$ events, which are analyzed to measure the cross section of radiative processes. For this purpose the contribution of radiative and strong processes are determined through a partial-wave decomposition.

Supported by BMBF, MLL and the Cluster of Excellence Exc153 "Origin and Structure of the Universe"

HK 10: Heavy Ion Collision and QCD Phases III

Zeit: Montag 16:30–18:30 Raum: S1/01 A01

Gruppenbericht HK 10.1 Mo 16:30 S1/01 A01

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

Electron-positron (dielectron) pairs 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. Therefore measurements in pp collisions serve as a medium-free baseline while the measurements in p-Pb collisions help to separate cold nuclear matter effects from those of the hot and dense medium.
In this contribution, recent dielectron measurements in the central barrel of ALICE are presented. The dielectron invariant mass and pair transverse momentum distributions will be compared to those from expected hadronic sources in pp collisions at $\sqrt{s} = 7$ TeV and in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV. From those distributions we discuss also constraints on the heavy-flavour production. The status of the analysis of Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV and an outlook to measurements at $\sqrt{s_{\rm NN}} = 5.02$ TeV will also be presented. Supported by BMBF and the Helmholtz Association.

HK 10.2 Mo 17:00 S1/01 A01

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 ultrarelativistic heavy-ion collisions. Electron-positron pairs are created during all stages of collision and do not interact strongly. Thus they carry important information unperturbed by strong final-state effects allowing us to probe the space-time evolution of the system including effects of chiral symmetry restoration.

Measurement of dielectron production in pp collisions serves as important vacuum reference to quantify modifications observed in heavy-ion collisions. In this talk we present the current status of dielectron measurements with ALICE central barrel spectrometer in pp collisions at centre-of-mass energies of 13 TeV collected during the LHC operation in 2015. Electrons are identified based on specific energy loss measurements in the Inner Tracking System (ITS) and the Time Projection Chamber (TPC) as well as time-of-flight information. Aspects of dielectron production in high-multiplicity pp collisions will also be discussed.

HK 10.3 Mo 17:15 S1/01 A01

Treatment of the ω resonance in transport approaches observed through dilepton production — •Jan Staudenmaier[1,2], Janus Weil[1], Stephan Endres[1,2], and Hannah Petersen[1,2,3] — [1]Frankfurt Institute for Advanced Studies — [2]Goethe University Frankfurt — [3]GSI Helmholtzzentrum für Schwerionenforschung

In this talk we discuss the treatment of ω Dalitz decay as well as the effect of the electromagnetic Dalitz decay of N^* resonances on the ω spectral function. Both are observed through the dilepton spectrum.

We begin with a presentation of the employed hadronic transport approach called SMASH that is designed to describe the non-equilibrium evolution of hadronic matter in heavy-ion collisions. After explaining the basic principles and foundations of the model, we present the description of dilepton production within SMASH. The main contribution of the dilepton spectra in the energy range of a few AGeV originates from resonance decays. First results of the dilepton production with SMASH including dilepton invariant mass spectra are shown and compared to other transport approaches.

Furthermore we investigate two different treatments of the ω Dalitz decay. The decay is either described as a direct Dalitz decay or via an intermediate ρ meson. Finally we discuss the electromagnetic Dalitz decay of N^* resonances via the ω and its effect on the ω spectral function, which is accessible through the dilepton spectrum.

HK 10.4 Mo 17:30 S1/01 A01

Polarization of exclusive dilepton production in pion-nucleon collisions — •Enrico Speranza[1,2], Miklós Zétényi[3], and Bengt Friman[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [2]Technische Universität Darmstadt — [3]Wigner Research Centre for Physics, Budapest, Hungary

A study of the polarization of the virtual photon in the process $\pi N \to N e^+ e^-$ is presented [1]. Effective interactions describing only the physical degrees of freedom for baryon resonances up to spin-5/2 are employed to compute the spin-anisotropy coefficient for isolated intermediate baryon resonances. It is shown that a given spin state of the intermediate resonance exhibits a characteristic angular dependence of the spin-anisotropy coefficient. Furthermore, the anisotropy coefficient resulting from the interference between resonances with different spin is presented. Our results show that the polarization of the photon provides information that is useful for disentangling the resonance contributions to elementary dilepton production processes [2]. Moreover, it is argued that the study of polarization observables can provide information on the production process and equilibration mechanism in heavy-ion collisions.

[1] E. Speranza, M. Zétényi, and B. Friman (to be published)
[2] W. Przygoda (HADES Collaboration), talk presented at The 10th International Workshop on the Physics of Excited Nucleons, NSTAR2015, 25-28 May 2015, Osaka

HK 10.5 Mo 17:45 S1/01 A01

Background rejection in dilepton analysis with the CBM-MVD — •Erik Krebs for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The structure of the QCD phase diagram for moderate temperatures

and high baryon chemical potentials is still practically unexplored. Dilepton measurements could provide information on the onset of deconfinement and on the subject of chiral symmetry restoration. The light vector mesons ρ, ω and ϕ are known to be excellent probes of the strongly interacting matter under extreme conditions. The leptonic decay channels of these mesons are of special interest as the leptons leave the hot and dense fireball without strong interaction and may reveal information on the characteristics of the matter created in the collisions. However, electrons from photon-conversions and Dalitz decays of pions are the main contributors to a large combinatorial background obscuring the information carried by the rare dileptons.

Studies have been made about whether the Micro-Vertex Detector (MVD) of the Compressed Baryonic Matter (CBM) experiment can contribute to reduce this background by reconstructing the low momentum partner of background pair in the MVD. CBM has no detectors for electron identification in front of the magnetic field posing an additional challenge to dielectron analysis. Methods for background rejection will be presented in this contribution. The capabilities of CBM detector to reconstruct a thermal radiation will be addressed.

*This work has been supported by BMBF (05P12RFFC7), GSI and HIC for FAIR.

HK 10.6 Mo 18:00 S1/01 A01

Reconstruction of the Δ(1232) resonance in AuAu collisions at 1.23 AGeV with HADES — •Georgy Kornakov — Technische Universität Darmstadt

Direct reconstruction of the Δ(1232) resonance via its decay into charged hadrons, together with higher Δ excited states and N* may provide insights into the mechanisms of sub-threshold particle production and fix better sources contributing to the di-leptons at freeze-out. Here we present the analysis of the inclusive spectra of $\pi^{\pm}p$ measured in Au+Au collisions at 1.23 AGeV by HADES. The yield, mass and width of resonance structures as a function of transverse momentum, rapidity and its dependence with centrality will be discussed.

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

HK 10.7 Mo 18:15 S1/01 A01

Goldstone-Bosonen in inhomogenen Phasen stark-wechselwirkender Materie — •Marco Schramm und Michael Buballa — Institut für Kernphysik, Technische Universität Darmstadt, Deutschland

Das Phasendiagramm stark wechselwirkender Materie weist eine reiche Struktur auf. In verschiedenen Modellen wurde gezeigt, dass kristalline Phasen mit einem räumlich modulierten chiralen Kondensat in Bereichen niedriger Temperatur und mittlerer Dichten auftreten können, die den sonst gefundenen Phasenübergang erster Ordnung ersetzen. In dieser Phase sind neben der chiralen Symmetrie, auch die Translations- und Rotationsinvarianz gebrochen. Wir leiten die damit verbundenen Goldstone-Bosonen in einem Nambu–Jona-Lasinio Modell explizit her und diskutieren ihre Eigenschaften. Diese sind relevant, um Transporteigenschaften zu bestimmen oder Auswirkungen auf die Stabilität der inhomogenen Phase in einer Erweiterung über die sonst übliche Mean-Field Näherung hinaus zu untersuchen.

HK 11: Nuclear Astrophysics II

Zeit: Montag 16:30–18:30 Raum: S1/01 A02

Gruppenbericht HK 11.1 Mo 16:30 S1/01 A02

Constraining nuclear physics input-parameters for the synthesis of heavy elements via cross-section measurements of charged-particle induced reactions — •Philipp Scholz, Felix Heim, Jan Mayer, Lars Netterdon, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Nuclear physics plays an important role in the nucleosynthesis of elements in stars. Especially for the production mechanisms of heavy elements in the γ process, the rapid proton-capture process or the weak r-process, cross sections are calculated in the scope of the Hauser-Feshbach statistical model. The obtained values crucially depend on input-parameters like the γ-ray strength functions or particle+nucleus optical-model potentials.
Constraining or excluding different adopted models for these nuclear physics input-parameters is achieved by precise cross-section measurements and their comparison to theory. During the last years, different charged-particle induced reaction cross sections at sub-Coulomb energies have been measured in Cologne by means of either the in-beam method with HPGe detectors or the actiation technique.
This talk is going to present the experimental setups as well as recent results for the ^{92}Mo(p,γ) and ^{98}Ru(α,γ) reactions and α-induced reactions on ^{108}Cd.
Supported by the DFG (INST 216/544-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.

HK 11.2 Mo 17:00 S1/01 A02

Cross-section measurement of the ^{108}Cd(α,n)^{111}Sn reaction at the Cologne Clover Counting Setup — •Felix Heim, Jan Mayer, Lars Netterdon, Philipp Scholz, and Andreas Zilges — Institute of Nuclear Physics, University of Cologne

About 30 to 35 neutron deficient nuclei cannot be synthesized via neutron capture processes. The main mechanism that is used to describe their origin is the so-called γ-process, i.e. a photodesintegration reaction network on stable seed nuclei in explosive stellar environments. The network of this process includes so many different reactions and nuclei that cross-section values are predominantly calculated in the scope of the Hauser-Feshbach statistical model. The obtained values heavily depend on the input-parameters like the γ-ray strength function or particle+nucleus optical-model-potential (OMPs). In order to extend the available experimental database the ^{108}Cd(α,n)^{111}Sn reaction cross section was investigated at ten energies between 10.2 MeV and 13.5 MeV via the activation technique using the Cologne Clover Counting Setup. As this reaction is almost completely sensitive to the α-decay width, the results were compared to statistical model calculations using different models of the α-OMP. In this talk the experimental setup, the results of the cross-section measurement as well as the results from the statistical model calculations will be presented.
Supported by the DFG (INST 216/544-1) and the ULDETIS project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.

HK 11.3 Mo 17:15 S1/01 A02

Partial cross sections of the ^{92}Mo(p,γ) reaction and the γ-strength in ^{93}Tc — •Jan Mayer, Lars Netterdon, Philipp Scholz, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

With an isotopic abundance of more than 14 %, ^{92}Mo is the most abundant p nucleus. The γ-process nucleosynthesis is believed to produce ^{92}Mo, but fails to explain its large abundance. Further studies require an accurate description of nuclear physics input parameters for the calculation of reaction cross sections in the scope of the Hauser-Feshbach statistical model.

In order to improve these parameters, total and partial cross-section values of the ^{92}Mo(p,γ)^{93}Tc reaction were measured by means of the in-beam method at seven different proton energies between 3.7 MeV and 5.3 MeV. The γ-rays emitted during the irradiation were detected by the high-purity germanium detector array HORUS at the Institute for Nuclear Physics, University of Cologne. The $\gamma\gamma$-coincidence method was applied to correlate γ-ray cascades in ^{93}Tc with their origin in the ^{92}Mo+p compound state.

In this talk, the final results for the measured total and partial cross sections are presented and compared to Hauser-Feshbach calculations using the statistical model code TALYS.

This project was supported by the ULDETIS project within the UoC Excellence Initiative institutional strategy. J.M. and P.S. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

HK 11.4 Mo 17:30 S1/01 A02

Nuclear resonance fluorescence on ^{87}Rb* — •Benjamin Brückner[1], Jan Glorius[1,2], René Reifarth[1], Kerstin Sonnabend[1], Deniz Savran[2], Johann Isaak[2], and Ronald Schwengner[3] — [1]Goethe Universität Frankfurt am Main, 60438

Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany

The aim of the nuclear resonance fluorescence (NRF) investigation of ^{87}Rb is the determination of the γ-strength function. For the astrophysical s-process, the γ-strength function of this specific nucleus can be used to calculate the cross section of neutron capture on the branching point nucleus ^{86}Rb. This branching point together with ^{85}Kr determines the abundance ratio of strontium isotopes, which could be used to probe stellar models. As one part of the ^{87}Rb campaign, an NRF experiment on ^{87}Rb has been carried out using bremsstrahlung at 13.2 MeV at ELBE@HZDR. An overview of the experimental setup as well as of the preliminary results will be given. *supported by DFG(SO907/2-1)

HK 11.5 Mo 17:45 S1/01 A02

^{91}Nb(p,γ) or There and back again — •Benedikt Thomas[1], Andrey Blazhev[2], Rugard Dressler[3], Ulrich Giesen[4], Jan Glorius[1], Milan Kritčka[5], Markus Reich[1], René Reifarth[1], Dorothea Schumann[3], Kerstin Sonnabend[1], and Karl-Oscar Zell[2] — [1]Goethe University Frankfurt a. M., Germany — [2]University of Cologne, Germany — [3]Paul-Scherrer Institute, Villigen, Switzerland — [4]Physikalisch-Technische Bundesanstalt, Braunschweig, Germany — [5]Charles University, Prague, Czech Republic

The cross section of the reaction ^{91}Nb(p,γ)^{92}Mo is of special interest to answer questions about the production of the most abundant p nucleus ^{92}Mo. With ^{91}Nb being a radioactive nucleus the measurement of this reaction in standard kinematics is a big challenge.

To produce a sufficent number of ^{91}Nb isotopes an enriched ^{92}Mo target was activated by protons at $E_p = 19$ MeV. Afterwards the produced ^{91}Nb isotopes will be separated chemically and applied onto a tungsten backing. This will lead to approximately 10^{16} ^{91}Nb isotopes.

The high proton current delivered by the HF-linear-accelerator FRANZ currently built at Goethe University Frankfurt, Germany, enables the execution of measurement with such limited amount of target material. The goal of our investigation is the determination of the cross section of the ^{91}Nb(p,γ)^{92}Mo reaction at 2 MeV proton energy and thereby in the astrophysical relevant energy region. We will present the current status and the next steps towards the measurement of this cross section.

This work is supported by DFG (SO907/2-1) and HIC for FAIR.

HK 11.6 Mo 18:00 S1/01 A02

Bestimmung des ^{10}Be(n,γ) - Wirkungsquerschnitts — •Meiko Volknandt[1], Klaus Eberhardt[2], Anne Endres[1], Matthias Fix[1], Tanja Heftrich[1], Stefan Heinitz[3], Enno Hrivula[1], Arnd Junghans[4], Franz Käppeler[5], Alberto Mengoni[6], Rene Reifarth[1], Stefan Schmidt[1], Dorothea Schumann[3], Mario Weigand[1] und Norbert Wiehl[2] — [1]Goethe Universität Frankfurt, Frankfurt, Germany — [2]Johannes Gutenberg-Universität Mainz, Mainz, Germany — [3]Paul Scherrer Institut, Villigen, Switzerland — [4]Helmholtzzentrum Dresden-Rossendorf, Dresden, Germany — [5]Karlsruhe Institute of Technology, Karlsruhe, Germany — [6]CERN, Geneva, Switzerland

Um die beobachtete solare Elementhäufigkeitsverteilung mit theoretischen Modellen rekonstruieren zu können und ein umfassendes Verständnis der primordialen und stellaren Nukleosynthese zu erlangen, ist eine genaue Kenntnis der Reaktionsraten der einzelnen Nuklide notwendig.
Über eine Aktivierung im Neutronenfluss des TRIGA-Forschungsreaktors in Mainz wurden Messungen zur Bestimmung des Neutroneneinfangwirkungsquerschnitts von ^{10}Be für den thermischen und epithermischen Bereich durchgeführt. Die Aktivität des erzeugten, kurzlebigen ($t_{1/2}$ = 13,8 s) ^{11}Be wurde mit Hilfe von $LaBr_3$ Szintillationsdetektoren gemessen. Der ^{10}Be(n,γ) - Wirkungsquerschnitt wurde erstmalig bestimmt.
Dieses Projekt wurde gefördert durch das FP/2007-2013 des *European Research Council Grant Agreement n. 615126.*

HK 11.7 Mo 18:15 S1/01 A02

The investigation of quasi-free scatering reactions with the two-proton-halo nucleus ^{17}Ne — •Christopher Lehr[1], Thomas Aumann[1], Felix Wamers[2], and Justyna Marganiec[1] — [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. It was studied in exclusive measurements of one-pronton-removal reactions. Polyethylene (CH_2) and carbon (C) were used as targets. Thus it is possible to reconstruct the pure H contribution of the CH_2 data by subtracting the carbon background.

The resulting events are clean (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 separatly.

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 12: Structure and Dynamics of Nuclei III

Zeit: Montag 16:30–18:15 Raum: S1/01 A03

Gruppenbericht HK 12.1 Mo 16:30 S1/01 A03

Spectroscopy of light and heavy transfer products following multinucleon transfer reactions — •Andreas Vogt[1], Benedikt Birkenbach[1], Peter Reiter[1], Lorenzo Corradi[2], Daniele Montanari[3], and Suzana Szilner[4] for the LNL 11.22-Collaboration — [1]IKP, Universität zu Köln — [2]INFN - LNL, Italy — [3]INFN Padova, Italy — [4]RBI Zagreb, Croatia

Multinucleon transfer reactions (MNT) are a competitive tool to populate exotic neutron-rich nuclei. Excited reaction products have been measured in ^{136}Xe + ^{238}U at 1 GeV with the high-resolution γ-ray tracking array AGATA coupled to the mass spectrometer PRISMA at LNL (INFN, Italy). Fission and transfer events are discriminated by exploiting kinematic coincidences between the binary reaction products. Mass yields have been extracted and compared with calculations based on the GRAZING model for MNT reactions. Population yields for nuclei in the actinide region were obtained and compared to x-ray yields measured by AGATA. Nuclear structure information of neutron-rich actinide nuclei are a benchmark for theoretical models providing predictions for the heaviest nuclei. An extension of the ground-state rotational band in ^{240}U was achieved and evidence for an extended first negative-parity band in ^{240}U is found. The results are compared to recent mean-field and DFT calculations. Based on relative cross-section distributions for various reaction channels, perspectives and limitations for the production of the hard-to-reach neutron-rich isotopes with this experimental method will be presented. Supported by the German BMBF (05P12PKFNE TP4), ENSAR-TNA03, BCGS.

HK 12.2 Mo 17:00 S1/01 A03

Reduced transition probabilities in ^{80,82,84,86}Se — •Julia Litzinger for the Cologne-LNL-Collaboration — Institut für Kernphysik, Universität zu Köln, 50937 Köln, Germany

The systematic investigation of exotic nuclei around the N=50 shell-closure is of high interest for nuclear structure research, as single particle-, particle-hole- and collective excitations coexist in this region of nuclei. Transition probabilities from lifetimes of excited states give insight to nuclear structure and allow to probe nuclear models, i.e. the nuclear shell model. We performed a recoil-distance-Doppler-shift experiment at the INFN, Legnaro, using the Cologne Plunger for the RDDS technique, the PRISMA magnetic spectrometer for the event-by-event particle identification and the AGATA spectrometer in its demonstrator configuration for the γ-ray detection and tracking. Using a ^{82}Se beam and a ^{238}U target ^{80,84,86}Se nuclei were produced in excited states via multi-neutron transfer reactions. ^{82}Se nuclei were excited via multiple-step Coulomb excitation. Because of low statistics $\gamma\gamma$-coincidences could not be used for the lifetime analysis. Therefore special care has to be taken to consider all relevant feeding. In order to

better estimate effects caused by unobserved side feeding different gates on the total kinetic energy loss of the recoils were investigated. Experimental results on transition probabilities in ^{80,82,84,86}Se isotopes will be presented and discussed in terms of large-scale shell-model calculations we performed.

HK 12.3 Mo 17:15 S1/01 A03

Coulomb excitation of ^{48}K — •Burkhard Siebeck[1], Christopher Bauer[2], Andrey Blazhev[1], Hilde De Witte[3], Kerstin Geibel[1], Herbert Hess[1], Malin Klintefjord[4], Janne Pakarinen[5], Elisa Rapisarda[3,6], Peter Reiter[1], Michael Seidlitz[1], Marcus Scheck[7], David Schneiders[1], Tim Steinbach[1], Didier Voulot[6], Nigel Warr[1] und Frederik Wenander[6] — [1]IKP, Universität zu Köln — [2]IKP, TU Darmstadt — [3]KU Leuven — [4]University of Oslo — [5]University of Jyväskylä — [6]CERN, Genf — [7]University of the West of Scotland, Paisley

Potassium isotopes in the direct vicinity of doubly-magic nuclei are of great interest and subject of recent shell model calculations. These show that the ground states of most K isotopes are dominated by a π0p0h configuration, while ^{47}K and ^{49}K have a major π2p2h contribution. However, the situation is not clear for the odd-odd isotope ^{48}K, which shows a mixture between 0p0h and 2p2h. In order to study the coupling between the $\nu p_{3/2}$-shell and the $\pi s_{1/2}$-, $\pi d_{3/2}$-shells, transition matrix elements are deduced from a Coulomb excitation experiment performed with MINIBALL at REX-ISOLDE. A ^{104}Pd target was irradiated by a radioactive ^{48}K beam. γ rays of both target and projectile deexcitation have been observed. Those yields, together with available spectroscopic data, allow the detemination of transition matrix elements with GOSIA2. The new findings are compared to shell model calculations.

Supported by BMBF (05P09PKCI5 und 05P12PKFNE)

HK 12.4 Mo 17:30 S1/01 A03

First dedicated in-beam X-ray measurement in heavy-ion fusion reactions — •C. Berner[1,3], W. Henning[2,3], D. Mücher[1], R. Gernhäuser[1], K. Morita[3], K. Morimoto[3], D. Kaji[3], S. Hellgartner[1], R. Lutter[4], L. Maier[1], Y. Wakabayashi[3], and H. Baba[3] — [1]Technische Universität München, Lehrstuhl E12 — [2]Argonne National Laboratory, Physics Division — [3]RIKEN, Research Group for Superheavy Elements — [4]Ludwig-Maximilians-Universität, München

We report on an experiment aiming at in-beam X- ray spectroscopy of heavy and superheavy elements (SHE). The goal is to establish K-X-ray spectroscopy as a sensitive tool to identify SHE produced in fusion reactions. SHE, formed after cold or hot fusion, are usually identified via the alpha-decay products, which have to be connected to well-known elements. However, various theories predict spontaneous fission as the dominant decay mode for the daughter nuclides. Additionally, half-lives of these elements are expected to increase to values impeding the identification of SHE solely by their decay. The in-beam identification of the characteristic X-rays would precisely allow to identify the charge number of the produced SHE. Experiments were performed at the RIKEN Nishina Centre for Accelerator based Science by using the gas-filled magnet separator GARIS for superheavy element detection. A high-purity, low-energy planar germanium LEGe-detector was adapted to the GARIS system at the target place for the first time in order to measure the element-characteristic, prompt X-ray emission. Supported by DFG Cluster: "Origin and structure of the Universe"

HK 12.5 Mo 17:45 S1/01 A03

Decay Spectroscopy at SHIP with a new Focal Plane Detector System — •Andrew. K. Mistry for the SHIP Decay Spectroscopy-Collaboration — Helmholtz Institute Mainz

Decay spectroscopy of the heaviest elements remains a crucial tool in nuclear structure physics in testing a variety of theoretical models predicting the next proton and neutron shell stabilization region beyond 208Pb [1]. Experimental measurements of alpha-decay energies and half-lives, ordering and configurations of ground state and excited levels, and the determination of high-K isomers provide necessary information in constraining these models. To this end, a new focal plane detection system for decay spectroscopy has been designed and developed at GSI for the SHIP separator [2]. It consists of a double sided silicon strip implantation detector surrounded by 4 single sided silicon strip detectors on each side in a box formation with a compact design, allowing for good germanium solid angle coverage for gamma ray detection. The data acquisition is based on FEBEX flash ADC modules, developed at GSI [3], for digital signal processing enables an almost deadtime free system. Recently, a commissioning run was successfully performed using the device. In my talk I will present recent highlights of decay spectroscopy at SHIP, and demonstrate results from measurements assessing the performance of the new setup.

[1] R-D. Herzberg & P.T. Greenlees Progress in Particle and Nuclear Physics 61, 674 (2008)
[2] D. Ackermann et.al., GSI Annual report (2015)
[3] N. Kurz, J. Hoffmann et al., GSI Scientific Report 2011, p. 252-3;

HK 12.6 Mo 18:00 S1/01 A03

Laser spectroscopy of nobelium isotopes — •Premaditya Chhetri for the RADRIS-Collaboration — TU Darmstadt, Darmstadt

Laser spectroscopy of the heaviest elements with Z>100 allows studying the influence of relativistic and QED effects on the atomic shell structure. Furthermore, nuclear ground state properties can be extracted from isotopic shifts and the hyperfine structure of the atomic transitions. The low production rates of a few atoms per second and the so far unknown atomic structure make such studies quite challenging. Applying the Radiation Detected Resonance Ionization Spectroscopy (RADRIS) technique [1] at the SHIP velocity filter at GSI, offered us the possibility to observe the first laser spectroscopic signal on nobelium (Z=102). In this talk the RADRIS setup and the results on laser spectroscopy of the isotopes $^{252-254}$No will be discussed.

[1]. H. Backe et. al. Eur. Phys. J. D 45, 99 (2007)

HK 13: Structure and Dynamics of Nuclei IV

Zeit: Montag 16:30–18:30 Raum: S1/01 A04

Gruppenbericht HK 13.1 Mo 16:30 S1/01 A04

A systematic fast-timing study of even-even nuclei in the well deformed A 170-180 region. — •J. Jolie[1], J.M. Régis[1], M. Dannhoff[1], R.B. Gerst[1], V. Karayonchev[1], C. Müller-Gattermann[1], M. Rudigier[1,2], N. Saed-Samii[1], S. Stegemann[1], and A. Blazhev[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Department of Physics, University of Surrey

At the Cologne Tandem accelerator we are performing a systematic study of lifetimes in the ground state bands of well deformed even-even nuclei in order to increase the precision of the ns-ps lifetimes and to solve inconsistencies in the literature. The measurements are done using Orange spectrometers, LaBr3(Ce) scintillators and Ge detectors. The data are analyzed using the slope and the generalized centroid difference method. The latter allows the measurement of lifetimes down to 5 ps [1]. First results on Yb, Hf and W isotopes will be presented.

This work is supported by the DFG under grant JO 391/16-1.

[1] J.M. Régis et al. Nucl. Instr. and Meth. in Phys. Res. A 726, 191 (2013)

HK 13.2 Mo 17:00 S1/01 A04

Lifetime measurements in ^{170}Yb using the Generalized Centroid Difference Method — •Vasil Karayonchev, Jean-Marc Régis, Jan Jolie, Moritz Dannhoff, Nima Saed-Samii, and Andrey Blazhev — Institute of Nuclear Physics, University of Cologne, Cologne, Germany

An experiment using the electronic $\gamma-\gamma$ "fast-timing" technique was performed at the 10MV Tandem Van-De-Graaff accelerator of the Institute for Nuclear Physics, Cologne in order to measure lifetimes of the yrast states in ^{170}Yb. The lifetime of the first 2^+ state was determined using the slope method, which means by fitting an exponential decay to the "slope" seen in the energy-gated time-difference spectra. The value of $\tau = 2.201(57)$ ns is in good agreement with the lifetimes measured using other techniques. The lifetimes of the first 4^+ and the 6^+ states are determined for the first time. They are in the ps range and were measured using the generalized centroid difference method, an extension of the well-known centroid-shift method and developed for fast-timing arrays. The derived reduced transition probabilities $B(E2)$

values are compared with calculations done using the confined beta soft model and show good agreement within the experimental uncertainties.

This work is supported by the DFG under grant JO 391/16-1.

HK 13.3 Mo 17:15 S1/01 A04

Fast-timing lifetime measurement of ^{178,180}Hf — •Johannes Wiederhold[1], Ralph Kern[1], Volker Werner[1], Norbert Pietralla[1], Nico Marginean[2], Raluca Marginean[2], Cristina Roxana Nita[2], Sorin Pascu[2], Dorel Bucurescu[2], Dan Mihai Filipescu[2], Nicoleta Florea[2], Dan Gabriel 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 the 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. The lifetimes $\tau(2_1^+)$ of ^{178}Hf and ^{180}Hf have been measured using fast electronic scintillation timing (FEST) at the 9 MV tandem accelerator of the IFIN-HH near Bucharest. Excited States of ^{180}Hf were populated via coulomb excitation and of ^{178}Hf via β^+-decay following the reaction ^{174}Yb(^{7}Li,3n)^{178}Ta. Because the target of ^{180}Hf was contaminated by 5% of ^{178}Hf and both isotopes have nearly the same transition energies (ΔE $\leq$ 1 keV) for the $4_1^+ \rightarrow 2_1^+$- and $2_1^+ \rightarrow 0_{gs}^+$-transitions, a correction has to be applied using the lifetime of the 2_1^+-state of ^{178}Hf. Preliminary results for these lifetimes will be presented. This work was supported by the DFG under the Grant No. SFB 634 and the U.S. DOE Grant No. DE-FG02-91ER40609.

HK 13.4 Mo 17:30 S1/01 A04

Quadrupole collectivity in ^{138,140,142}Xe — •Corinna Henrich, Thorsten Kroell, and Stoyanka Ilieva for the IS411 and EXILL-FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

The region around the doubly magic nucleus ^{132}Sn is of special interest as both single-particle and mean-field approaches can be applied by theory. In order to gain further understanding on the nuclear structure in this region, a 'safe' Coulomb excitation experiment was carried out at REX-ISOLDE (CERN, Geneva) using the MINIBALL spectrometer (IS411 campaign). As only a small center-of-mass range on the particle detector was accessible, the sensitivity on the quadrupole moments of the first 2^+ and 4^+ state using just that data is relatively small. Therefore, additional information provided by the direct lifetime measurement at ILL (Grenoble, France) using the EXILL&FATIMA spectrometer was crucial for the analysis. The final results of the analysis along with a comparison to predictions of several theoretical models is presented.

Supported by BMBF under contracts 06DA9036I, 05P12RDCIA and 05P15RDCIA, by the EU under contracts EURONS 506065 and ENSAR 262010, by ILL and by HIC for FAIR.

HK 13.5 Mo 17:45 S1/01 A04

Lifetimes of excited states in neutron-rich Xe isotopes — •Stoyanka Ilieva and Thorsten Kroell for the EXILL-FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt

The EXILL&FATIMA campaign at ILL, Grenoble is the first prompt-fission γ-ray spectroscopy experiment performed with a mixed array of Ge detectors (EXILL) and fast $LaBr_3$(Ce) scintillators (FATIMA). The lifetimes of excited states, populated by neutron-induced fission of ^{235}U and ^{241}Pu targets, were directly measured. The high-resolution EXILL detector gives us the possibility to identify the nuclides of interest among the large amout of produced fission fragments. Using the generalized centroid difference method [1] to analyse the data from FATIMA we could measure lifetimes down to $\approx$ 10 ps.

The lifetime of an excited state is a direct measure for the strength (collectivity) of a transition. The properties of the excited states in even-even nuclei can be largely described by quadrupole and octupole degrees of freedom. This contribution will present the current status of the analysis for the neutron-rich even-even ^{138,140,142}Xe isotopes which lie in the vicinity of the double shell closure $Z = 50$ and $N = 82$. Through the direct lifetime measurement we aim to study the evolution of quadrupole and octupole collectivity above ^{132}Sn.

[1] *J.-M. Régis et al., NIM A 763 (2014) 210*

Supported by ILL, by BMBF under contracts 05P12RDCIA and 05P12RDNUP, and by HIC for FAIR.

HK 13.6 Mo 18:00 S1/01 A04

Exited-state lifetimes in neutron-rich Ce isotopes from EXILL&FATIMA — •P. Koseoglou[1], V. Werner[1,2], N. Pietralla[1], I. Stoyanka[1], C. Bernards[2], A. Blanc[3], A.M. Bruce[4], R.B. Cakirli[5], N. Cooper[2], G. de France[6], P. Humby[7], M. Jentschel[3], J. Jolie[8], U. Koester[3], T. Kröll[1], P. Mutti[3], Z. Patel[7], V. Paziy[9], Zs. Podolyak[7], P.H. Regan[7], J.-M. Régis[8], O.J. Roberts[4], N. Saed-Samii[8], G.S. Simpson[10], T. Soldner[3], C.A. Ur[11], W Urban[3], D. Wilmsen[8], and E. Wilson[7] — [1]IKP TU-Darmstadt, Darmstadt, Germany — [2]Yale University, USA — [3]ILL Grenoble, France — [4]University of Brighton, England — [5]MPIK Heidelberg, Germany — [6]GANIL Caen, France — [7]University of Surrey, England — [8]KP University of Cologne, Germany — [9]Universidad Complutense, Spain — [10]PSC Grenoble, France — [11]INFN Legnaro, Italy

235U and 241Pu fission fragments were measured by a mixed spectrometer consisting of high-resolution Ge and fast LaBr3(Ce)-scintillator detectors at the high-flux reactor of the ILL. Prompt γ-ray cascades from the nuclei of interest are selected via Ge-Ge-LaBr3-LaBr3 coincidences. The good energy resolution of the Ge allow precise gates to be set, selecting the cascade, hence, the nucleus of interest. The excellent timing performance of the LaBr3 detectors in combination with the General Centroid Difference method allows the measurement of lifetimes in the ps range in preparation for the FATIMA experiment at FAIR. The first results on neutron-rich Ce isotopes are presented. Supported by HGS-HIRe

HK 13.7 Mo 18:15 S1/01 A04

Lifetime measurements in self-conjugate nuclei ^{44}Ti, ^{48}Cr and ^{52}Fe — •K. Arnswald, P. Reiter, B. Birkenbach, A. Blazhev, T. Braunroth, A. Dewald, C. Fransen, B. Fu, A. Hennig, R. Hirsch, L. Lewandowski, J. Litzinger, C. Müller-Gatermann, D. Rosiak, N. Saed-Samii, D. Schneiders, M. Seidlitz, B. Siebeck, T. Steinbach, A. Vogt, K. Wolf, and K.O. Zell — Institut für Kernphysik, Universität zu Köln

Reduced transition strengths expressed with $B(E2)$ values are sensitive signatures to describe collective excitations of atomic nuclei and are indispensable to understand nuclear shell structures. Along the $N = Z$ line in the $1f_{7/2}$ shell they provide stringent tests of recent shell-model interactions. So far, $B(E2, 2_1^+ \rightarrow 0_{\text{g.s.}}^+)$ values for the self-conjugate $^{44}_{22}$Ti, $^{48}_{24}$Cr, $^{52}_{26}$Fe isotopes are known only with considerable errors. Recoil Distance Doppler-Shift (RDDS) experiments were performed employing the Cologne coincidence plunger device to measure lifetimes with high precision in order to deduce model-independent $B(E2)$ values. Excited states in the nuclei of interest were populated with fusion-evaporation reactions. γ rays were detected by an array of 12 HPGe detectors. Precise $B(E2, 2_1^+ \rightarrow 0_{\text{g.s.}}^+)$ values are measured to be 204^{+16}_{-14} e^{2}fm^4, 262 ± 3 e^{2}fm^4, and 269 ± 8 e^{2}fm^4 for ^{44}Ti, ^{48}Cr, and ^{52}Fe, respectively. The results are compared to recent shell-model calculations on the basis of GX1A interaction [1]. While the excitation energies are reproduced quite well, the B(E2) values show considerable differences.

[1] M. Honma *et al.* Phys. Rev. C 69, 034335 (2004)

HK 14: Instrumentation III

Zeit: Montag 16:30–18:30 Raum: S1/01 A3

HK 14.1 Mo 16:30 S1/01 A3

The detector response simulation for the CBM Silicon Tracking System as a tool for hit error estimation — •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 designed to explore the QCD phase diagram in the region of high net-baryon densities. As the central detector component, the Silicon Tracking System (STS) is based on double-sided micro-strip sensors. To achieve realistic modelling, the response of the silicon strip sensors should be precisely included in the 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.

The current implementation of the STS digitizer comprises non-uniform energy loss distributions (according to the Urban theory), thermal diffusion and charge redistribution over the read-out channels due to interstrip capacitances. Using the digitizer, one can test an influence of each physical processes on hit error separately. We have developed a new cluster position finding algorithm and a hit error estimation method for it. Estimated errors were verified by the width of pull distribution (expected to be about unity) and its shape.

Supported by HIC for FAIR and HGS-HIRe.

HK 14.2 Mo 16:45 S1/01 A3

CBM First-level Event Selector Input Interface — •Dirk Hutter 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.

To allow efficient event selection, the FLES performs timeslice building, which combines the data from all given input links to self-contained, overlapping processing intervals and distributes them to compute nodes. Partitioning the input data streams into specialized containers allows to perform this task very efficiently.

The FLES Input Interface defines the linkage between FEE and FLES data transport framework. Utilizing a custom FPGA board, it receives data via optical links, prepares them for subsequent timeslice building, and transfers the data via DMA to the PC's memory. An accompanying HDL module implements the front-end logic interface and FLES link protocol in the front-end FPGAs. Prototypes of all Input Interface components have been implemented and integrated into the FLES framework. In contrast to earlier prototypes, which included components to work without a FPGA layer between FLES and FEE, the structure matches the foreseen final setup. This allows the implementation and evaluation of the final CBM read-out chain.

An overview of the FLES Input Interface as well as studies on system integration and system start-up will be presented.

HK 14.3 Mo 17:00 S1/01 A3

Control software for the CBM readout chain — •Pierre-Alain Loizeau — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter (CBM) experiment, which will be built at FAIR, will use free-streaming readout electronics to acquire high-statistics data-sets of physics probes in fixed target heavy-ion collisions. Since no simple signatures suitable for a hardware trigger are available for most of them, reconstruction and selection of the interesting collisions will be done in software, in a computer farm called First Level Event Selector (FLES).

The raw data coming from the detectors is pre-processed, pre-calibrated and aggregated in a FPGA based layer called Data Preprocessing Boards (DPB).

IPbus will be used to communicate with the DPBs and through them with the elements of the readout chain closer to detectors. A slow control environment based on this software is developed by CBM to configure in an efficient way the DPBs as well as the Front-End Electronics and monitor their performances.

This contribution will present the layout planned for the slow control software, its first implementation and corresponding test results.

HK 14.4 Mo 17:15 S1/01 A3

Weiterentwicklung des ALICE-Tier2-Betriebs bei GSI — •Sören Fleischer und Kilian Schwarz für die ALICE-Kollaboration — GSI, Darmstadt, Deutschland

Die GSI betreibt seit 2004 ein Tier2-Zentrum für das ALICE-Experiment. Zur Verfügung gestellt werden derzeit 1000 TB Speicherplatz sowie 13400 HEP-SPEC06 an Rechenleistung durch z.Zt. AMD Opteron 6238 CPUs. Das Storage-Backend basiert auf einem Lustre-Dateisystem. Der Zugriff von sowohl lokalen als auch externen Clients findet, wie in der gesamten ALICE-Umgebung, über das xroot-Protokoll statt.

Ein Upgrade auf ein neues Cluster mit Intel Xeon E5-2660 v3 CPUs steht z.Zt. an. Dieses wird sich im Green IT Cube, dem neuen Rechenzentrum für FAIR, befinden.

Um die Zuverlässigkeit und Skalierbarkeit des Tier2-Betriebs zu erhöhen, wurden etliche Verbesserungen vorgenommen, sowie einige Workflows zur Automatisierung in den Gebieten Monitoring (monit), Konfigurationsmanagement (chef), und Versionsverwaltung (git) implementiert, die in dieser Präsentation vorgestellt werden.

HK 14.5 Mo 17:30 S1/01 A3

Common barrel and forward CA tracking algorithm — •Pugach Mykhailo[1,2,3], Sergey Gorbunov[1,2], and Ivan Kisel[1,2] for the PANDA-Collaboration — [1]Goethe-Universität, Frankfurt — [2]Frankfurt Institute for Advanced Studies, Frankfurt — [3]KINR, Kyiv, Ukraine

There are complex detector setups which consist of barrel (cylindrical) and forward parts, and such systems require a special approach in the registered charged particles track finding procedure. Currently the tracking procedure might be performed in both parts of such detector independently from each other, but the final goal on this direction is a creation of a combined tracking, which will work in both parts of the detector simultaneously.

The basic algorithm is based on Kalman Filter (KF) and Cellular Automata (CA). And the tracking procedure in such a complex system is rather extraordinary as far as it requires 2 different models to describe the state vector of segments of the reconstructed track in the mathematical apparatus of the KF-algorithm. To overcome this specifics a mathematical apparatus of transition matrices must be developed and implemented, so that one can transfer from one track model to another. Afterwards the work of the CA is performed, which reduces to segments sorting, their union into track-candidates and selection of the best candidates by the chi-square criteria after fitting of the track-candidate by the KF.

In this report the algorithm, status and perspectives of such combined tracking are described.

HK 14.6 Mo 17:45 S1/01 A3

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, Forschungszentrum Jülich GmbH — [2]JSC, Forschungszentrum Jülich GmbH

The PANDA experiment, one of the four scientific pillars of the FAIR facility currently in 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 the broad physics scope and the similar signature of signal and background events, PANDA's strategy for data acquisition is to continuously record data from the whole detector and use this global information to perform online event reconstruction and filtering. A real-time rejection factor of up to 1000 must be achieved to match the incoming data rate for offline storage, making all components of the data processing system computationally very challenging.

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. For this reason, a massively parallel solution exploiting multiple Graphic Processing Units (GPUs) is under investigation.

The talk will present the core concepts of the algorithms being developed for primary trackfinding, along with details of their implemen-

tation on GPUs.

HK 14.7 Mo 18:00 S1/01 A3

Time-based MRPC detector response simulations for the CBM time-of-flight system — •Christian Simon and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut und Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität Heidelberg, 69120 Heidelberg, Deutschland

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. The time-of-flight (TOF) wall of CBM 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 self-triggered digitization and readout scheme of CBM comprising online event reconstruction preparatory Monte Carlo (MC) transport and response simulations including the MRPC array need to be carried out in a time-based fashion. While in an event-based simulation mode interference between MC tracks in a detector volume owing to rate effects or electronics dead time is confined to a single event, time-based response simulations need to take into account track pile-up and interference across events. A proposed time-based digitizer class for CBM-TOF within the CbmRoot software framework will be presented.
The project is partially funded by BMBF 05P12VHFC7 and by EU/FP7-HadronPhysic3/WP19.

HK 14.8 Mo 18:15 S1/01 A3

Simulation and Optimisation of a Position Sensitive Scintillation Detector with Wavelength Shifting Fibers for Thermal Neutrons — •Matthias Herzkamp[1], Thomas Brückel[2], Günter Kemmerling[2], Achim Stahl[3], and Stefan van Waasen[1,4] — [1]ZEA-2, Forschungszentrum Jülich, Deutschland — [2]JCNS, Forschungszentrum Jülich, Deutschland — [3]III. Physikalisches Institut B, RWTH Aachen, Deutschland — [4]Faculty of Engineering, University of Duisburg-Essen, Deutschland

In neutron scattering experiments it is important to have position sensitive large scale detectors for thermal neutrons. A detector based on a neutron scintillator with wave length shifting fibers(WLSF) is a new kind of such a detector. We present the simulation of the detector in its entirety, taking into account the microscopic structure of the scintillation material as well as the WLSF attachment.

The scintillator consists of a converter and a scintillation powder bound in a matrix. In our case lithium-6 converts thermal neutrons into high energetic alpha and triton particles. The scintillation material is silver doped zinc sulfide. The WLSFs are positioned next to the scintillator plate in an orthogonal grid and are bent back at the edges to guide the light to PMTs. This arrangement drastically reduces the necessary number of light detection devices, which enables to build cost-efficient large-area detectors.

With our complete model of the detector it is possible to optimize its microscopic and macroscopic parameters with regard to detection efficiency and position sensitivity.

HK 15: Instrumentation IV

Zeit: Montag 16:30–18:00 Raum: S1/01 A2

Gruppenbericht HK 15.1 Mo 16:30 S1/01 A2

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

The Compressed Baryonic Matter experiment will investigate the phase diagram of strongly interacting matter in nucleus-nucleus collisions at highest net baryon densities using a number of rare probes and bulk observables. Its key component – the Silicon Tracking System – will reconstruct up to 1000 charged particle trajectories per Au+Au collision at up to 10 MHz interaction rate and will measure their momenta. The system design employs high-granularity sensors matching the non-uniform track density and fast self-triggering electronics with a the free streaming data acquisition system and online event selection. The required momentum resolution of $\Delta p/p \sim 1.5\%$ dictates the need of the low-mass design with material budget of 0.3-1%X$_0$ per station.

The eight tracking stations of the STS operating in the aperture of a dipole magnet with 1 T field will cover the polar angles between 2.5° and 25°. The stations with a total sensor area of 4.2 m^2 will comprize 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 strctures.

The progress with the final components will be discussed, in particular sensors, readout cables and readout ASICs. The assembly of the detector module components into full-scale prototypes and the engineering of the mechanical structure of the STS will be presented.

*Supported by EU-Horizon2020 CREMLIN and BMBF.

HK 15.2 Mo 17:00 S1/01 A2

Quality assurance of the silicon microstrip sensors for the CBM experiment — •Iaroslav Panasenko[1,2] and Pavel Larionov[3] for the CBM-Collaboration — [1]Physikalisches Institut, Universität Tübingen, Germany — [2]Institute for Nuclear Research, Kiev, Ukraine — [3]University of Frankfurt, Germany

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 track multiplicity will reach up to 700 within the detector aperture covering the polar angle 2.5° and 25°. High track density as well as stringent requirements to the momentum resolution (∼1%) require a system with high channel granularity and low material budget.

The STS will be constructed of about 1200 double-sided silicon microstrip sensors with 58 μm pitch and a total area of ∼4 m^2 with all together 2.1 million channels will be read out.

In this talk the quality assurance of double-sided silicon microstrip sensors will be discussed. This includes both visual and electrical characterization. For this purpose dedicated equipment has been set up in the clean rooms of the GSI Detector Laboratory and at Tübingen University. Results of the electrical characterization of prototype microstrip sensors CBM06 will be presented.

Work supported by BMBF under grant 05P12VTFCE.

HK 15.3 Mo 17:15 S1/01 A2

Systematic study of radiation hardness of single crystal CVD diamond material investigated with an Au beam and IBIC method. — •Jerzy Pietraszko[1], Antoine Draveny[2], Tetyana Galatyuk[2], Veljko Grilj[3], Wolfgang Koenig[1], and Michael Träger[1] for the HADES-Collaboration — [1]GSI, Darmstadt, Germany — [2]TU, Darmstadt, Germany — [3]RBI, Zagreb, Croatia

For the future high rate CBM experiment at FAIR a radiation hard and fast beam detector is required. The detector has to perform precise T0 measurement (sigma < 50ps) and should also offer decent beam monitoring capability. These tasks can be performed by utilizing single-crystal Chemical Vapor Deposition (ScCVD) diamond based detector. A prototype, segmented, detector have been constructed and the properties of this detector have been studied with a high current density beam (about $3{\cdot}10^6$/s/mm^2) of 1.23 A GeV Au ions in HADES. The irradiated detector properties have been studied at RBI in Zagreb by means of IBIC method. Details of the design, the intrinsic properties of the detectors and their performance after irradiation with such beam will be reported.

This work has been supported by BMBF (05P12RFGHJ, 05P15RFFCA), GSI, HIC for FAIR, VH-NG-823 and AIDA2020.

HK 15.4 Mo 17:30 S1/01 A2

Gamma-Imaging mit hochsegmentierten HPGe-Detektoren — •Tim Steinbach[1], Rouven Hirsch[1], Benedikt Birkenbach[1], Jürgen Eberth[1], Roman Gernhäuser[2], Herbert Hess[1], Lars Lewandowski[1], Ludwig Maier[2], Peter Reiter[1], Michael Schlarb[2], Benedikt Weiler[2] und Max Winkel[2] — [1]IKP Universität zu Köln, Köln, Deutschland — [2]E12 Technische Universität München, München, Deutschland

Mit ortsempfindlichen hochsegmentierten HPGe-Detektoren und einem Double-Sided-Silicon-Strip-Detector (DSSSD) wird eine Compton-Kamera für die Bildgebung von γ-Strahlung am IKP betrie-

ben. Die Compton-Streuereignisse werden für den Nachweis des Emissionsortes der γ-Strahlung sowohl im koinzidenten Betrieb der beiden Detektoren als auch im Einzelbetrieb des HPGe-Detektors selektiert. Die für die Bildgebung notwendige Bestimmung der Wechselwirkungsorte der γ-Strahlung im großvolumigen HPGe-Detektor wird mittels Impulsformanalyse (PSA) der 37 Detektorsignale erreicht. Die Ortsauflösung ist für die Lokalisierung der γ-Quelle ebenso entscheidend wie die hervorragende Energieauflösung des HPGe-Detektors. Die PSA aus dem AGATA Projekt wurde mit Hinblick auf eine bestmögliche Winkelauflösung der Compton-Kamera bei maximaler Nachweiseffizienz optimiert. Gefördert durch BMBF Projekt 02MUK013D und 02NUK013F.

HK 15.5 Mo 17:45 S1/01 A2

Pulse Shape Analysis Optimization with segmented HPGe-Detectors — •Lars Lewandowski, Peter Reiter, and Benedikt Birkenbach for the AGATA-Collaboration — Institut für Kernphysik Universität zu Köln

Measurements with the position sensitive, highly segmented AGATA HPGe detectors rely on the gamma-ray-tracking GRT technique which allows to determine the interaction point of the individual gamma-rays hitting the detector. GRT is based on a pulse shape analysis PSA of the preamplifier signals from the 36 segments and the central electrode of the detector. The achieved performance and position resolution of the AGATA detector is well within the specifications. However, an unexpected inhomogeneous distribution of interaction points inside the detector volume is observed as a result of the PSA even when the measurement is performed with an isotropically radiating gamma ray source. The clustering of interaction points motivated a study in order to optimize the PSA algorithm or its ingredients. As a main result the impact of the transient signals of neigboring segments on the final PSA result was enhanced by introducing a weighting factor in the χ^2 minimization. The final result shows a significant improvement of the angular resolution and PSA performance in general. Supported by the German BMBF (05P12PKFNE TP4)

HK 16: Hadron Structure and Spectroscopy III

Zeit: Dienstag 14:00–16:00 Raum: S1/01 A5

Gruppenbericht HK 16.1 Di 14:00 S1/01 A5

Measurement of the Two-Photon Exchange in the Elastic $e^{\pm}p$ Scattering at the OLYMPUS Experiment at DESY — •Dmitry Khaneft and OLYMPUS Collaboration — Helmholtz-Institut Mainz, Mainz, Deutschland

The OLYMPUS experiment aims to resolve the experimental discrepancy in the determination of the ratio of the proton electric to magnetic form factor, $R = G_E/G_M$, extracted using Rosenbluth separation and polarization transfer technique. This discrepancy can be explained by a two-photon exchange contribution in lepton-nucleon scattering. A measurement of the elastic scattering cross section ratio $\sigma_{e^+p}/\sigma_{e^-p}$ will allow a direct measurement of the two-photon exchange amplitude. The OLYMPUS experiment was carried out at DESY Hamburg, Germany using 2 GeV electron and positron beams in the DORIS storage ring incident on an internal hydrogen gas target. Multiple independent luminosity monitors were operated in parallel to the main spectrometer during data taking to allow for a precise relative luminosity measurement. Approximately 4.45 fb^-1 of integrated luminosity were collected. The OLYMPUS experiment and the status of the analysis will be discussed.

HK 16.2 Di 14:30 S1/01 A5

Solenoid spectrometer studies for the P2 experiment at MESA — •Dominik Becker[1], Kathrin Gerz[1], Sebastian Baunack[1], Thomas Jennewein[1], Krishna S. Kumar[3], Frank E. Maas[1,2], Razvan D. Bucoveanu[4], and Hubert Spiesberger[4] for the P2-Collaboration — [1]PRISMA Cluster of Excellence and Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany — [2]Helmholtz Institue Mainz, Germany — [3]Department of Physics and Astronomy, Stony Brook University, Stony Brook, USA — [4]PRISMA Cluster of Excellence and Institute of Physics, Johannes Gutenberg University, Mainz, Germany

The goal of Project P2 is to determine the electroweak mixing angle $\sin^2(\theta_W)$ to a precision of 0.15 % at low momentum transfer ($Q^2 = 0.004$ GeV^2/c^2). The experiment will be performed at the future MESA accelerator facility in Mainz. The experimental method comprises a measurement of the proton's weak charge Q_W^p to a relative uncertainty of 1.9 % via the parity violating asymmetry in elastic electron-proton scattering. In the talk, the experimental method as well as the achievable precision in the determination of the electroweak mixing angle will be presented. Furthermore, results of Geant4 simulations which were carried out to study a possible experimental setup will be shown.

HK 16.3 Di 14:45 S1/01 A5

Measurement of the electromagnetic form factors of the proton in the Q^2 range 0.5 to 2 GeV^2/c^2 — •Julian Müller for the A1-Collaboration — Institut für Kernphysik, Mainz

In spring 2015 a new measurement of the form factors of the proton was performed at the MAMI accelerator in Mainz. The form factors will be determined via elastic electron proton scattering, measured with the three spectrometer facility of A1. Now, that the higher beam energies provided by a third stage of the accelerator are available, we were able to increase the limit in Q^2 from 0.5 up to 2 GeV^2/c^2. Therefore, the main focus of this experiment will be the precise determination of the magnetic form factor of the proton. This talk will cover the experimental setup and the current status of the analysis. Together with previous experiments at A1 at lower values of Q^2, we aim to contribute to the solution of the proton radius puzzle.

HK 16.4 Di 15:00 S1/01 A5

Feasibility studies for the measurement of time-like proton electromagnetic form factors in reactions of the type $\bar{p}p \to \mu^+\mu^-$ at PANDA-FAIR — •Iris Zimmermann, Alaa Dbeyssi, Dmitry Khaneft, Frank Maas, Manuel Zambrana, and Cristina Morales for the PANDA-Collaboration — Helmholtz-Institut Mainz

In this contribution the latest 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 will be presented. 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. One advantage of using this channel is that radiative corrections due to final state radiation are suppressed by the heavy mass of the muon. Measuring $\bar{p}p \to \mu^+\mu^-$ will also serve as a consistency check of the TL em FF data from $\bar{p}p \to e^+e^-$. 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. For the analysis of the processes of interest, different methods have been used and are compared.

HK 16.5 Di 15:15 S1/01 A5

Study of Excited Ξ Baryons in Antiproton-Proton Collisions with the P̄ANDA Detector — •Jennifer Pütz, Albrecht Gillitzer, and James Ritman for the PANDA-Collaboration — Forschungszentrum Jülich

Understanding the excitation pattern of baryons is indispensable for a deep insight into the mechanism of non-perturbative QCD. Up to now only the nucleon excitation spectrum has been subject to systematic experimental studies while very little is known on excited states of double or triple strange baryons.
In studies of antiproton-proton collisions the PANDA experiment is well-suited for a comprehensive baryon spectroscopy program in the multi-strange and charm sector. A large fraction of the inelastic p̄p cross section is associated to final states with a baryon-antibaryon pair together with additional mesons, giving access to excited states both in the baryon and the antibaryon sector.
In the present study we focus on excited Ξ states. For final states

containing a $\Xi\bar{\Xi}$ pair cross sections up to the order of μb are expected, corresponding to production rates of $\sim 10^6$/d at a Luminosity $L = 10^{31}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}$ (5% of the full value). A strategy to study the excitation spectrum of Ξ baryons in antiproton-proton collisions will be discussed. The reconstruction of reactions of the type $\bar{\mathrm{p}}\mathrm{p} \to \Xi^*\bar{\Xi}$ (and their charge conjugated) with the $\bar{\mathrm{P}}$ANDA detector will be presented based on a specific exemplary reaction and decay channel.

HK 16.6 Di 15:30 S1/01 A5

Upper limit determination of the η-decay $\eta \to \pi^0 + e^+ + e^-$ with WASA-at-COSY* — •Florian Bergmann, Kay Demmich, Nils Hüsken, Karsten Sitterberg, and Alfons Khoukaz for the WASA-at-COSY-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

Investigations on symmetries and symmetry breaking is a major part of the WASA-at-COSY physics program. They allow for a better understanding of the physics within the standard model. An elegant way to search for violation of conservation laws, which are directly connected to symmetry breaking effects, is the study of rare meson decays. At the WASA-at-COSY facility an extensive physics program on η-meson decays has been performed with high statistics which are required to obtain new limits on, e.g., the C, P and T symmetry breaking or combinations thereof.
In this contribution the status 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 will be presented and discussed. The dominant C-conserving contribution to this decay via a $\pi^0 + \gamma^* + \gamma^*$ intermediate state has an expected branching ratio of less than 10^{-8} in the standard model. An observation of a significantly higher branching ratio would indicate the presence of a C-violating process.

*Supported by FFE program of the Forschungszentrum Jülich.

HK 16.7 Di 15:45 S1/01 A5

Messung des elektromagnetischen Formfaktors des η' Mesons — •Sascha Wagner und Achim Denig für die A2-Kollaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Elektromagnetische Übergangsformfaktoren gewähren uns einen Einblick in die intrinsische Struktur der Hadronen. Zudem stellen die Formfaktoren von leichten pseudoskalaren Mesonen eine wichtige Größe dar, um die theoretische Unsicherheit der hadronischen Licht-Licht-Streuung in Bezug auf das anomale magnetische Moment des Myons zu reduzieren. In Beschleunigerexperimenten sind diese z. B. mit dem Crystal Ball-Aufbau am Mainzer Mikrotron (MAMI) im zeitartigen Bereich über Zerfälle zugänglich.

Innerhalb der A2-Kollaboration am MAMI werden Experimente mit Bremsstrahlungsphotonen durchgeführt. 2014 fanden gezielte Experimente zur Photoproduktion von η' und ω Mesonen mit dem neuen End-point Tagger statt, einer Photonmarkierungsanlage, die hauptsächlich für Messungen des η' entwickelt wurde.

In diesem Beitrag wird speziell auf die Messung des Dalitz-Zerfalls $\eta' \to \gamma^*\gamma \to e^+e^-\gamma$ mit dem Crystal Ball/TAPS-Aufbau eingegangen. Es werden Simulationsstudien für die wichtigsten Untergrundprozesse sowie erste Analysen der in 2014 gemessenen Daten vorgestellt.

Gefördert durch die DFG im Rahmen des SFB1044.

HK 17: Heavy Ion Collision and QCD Phases IV

Zeit: Dienstag 14:00–15:45 Raum: S1/01 A01

Gruppenbericht HK 17.1 Di 14:00 S1/01 A01

Strangeness Production in Au+Au Collisions at 1.23 AGeV measured with HADES — •Heidi Schuldes for the HADES-Collaboration — Goethe-Universität Frankfurt

In Au+Au collisions at 1.23 AGeV incident energy all particles carrying open and hidden strangeness are produced below their respective free nucleon-nucleon threshold. As a consequence, the production cross sections is very sensitive to medium effects like momentum distributions, two- or multi-step collisions and modification of the in-medium spectral distribution of the produced states [1]. For the first time at such low energies, a close to complete set of open and hidden strange hadrons has been reconstructed including the following hadron yields: p, $\pi^{\pm}$, $K^{\pm}$, K^0, ϕ, Λ.
In total 7.3 Billion of the 40% most central Au(1.23 GeV per nucleon)+Au collisions have been analyzed for this investigation. The data has been recorded with HADES and a substantially improved reconstruction method has been employed to reconstruct the hadrons with high purity in a wide phase space region. In this contribution we present differential, acceptance corrected yields and a comparison to yield calculated in SHM. Special emphasis will be on the relative production yields of ϕ to K^-.
Supported by BMBF (05P12RFGHJ, 05P15RFFCA), GSI, HIC for FAIR, HGS-HIRe and H-QM.
[1] C.Hartnack et al., Phys. Rept. 510, 119 (2012).

HK 17.2 Di 14:30 S1/01 A01

In-medium kaon absorption in pion-induced reactions — •Joana Wirth[1,2], Laura Fabbietti[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

In 2014 the HADES collaboration successfully performed two experimental campaigns with secondary pion beams. Hereby, one main focus was the investigation of the production as well as the properties of K^0_S, K^+, Φ and K^- in cold nuclear matter generated in pion-nucleon reactions ($\pi^- + A$, $A = C, W$) at $p_{\pi^-} = 1.7$ GeV/c.
As already verified by the FOPI collaboration, the K^0 production in pion-induced reactions mainly takes place at the surface of the nuclei ($\sigma \sim A^b, b = 2/3$). While K^- can be absorbed in nuclear matter through strangeness exchange processes ($K^-N \to Y\pi$), no conventional absorption mechanism exists for K^0 and K^+. The question can be raised now how the K^- yield behaves? If an increase of the absorption with A would be dominant, a $b < 2/3$ should be observed. Although, a drop of the effective mass and thus a decrease of the kinematical threshold would lead to $b > 2/3$.
In this talk we are showing the recent study of the K^- absorption achieved on the basis of the comparison of K^-/K^+ ratios in both nuclear environments.
∗ supported by the DFG cluster of excellence "Origin and Structure of the Universe"

HK 17.3 Di 14:45 S1/01 A01

Production of strange hadrons in charged jets in Pb–Pb collisions measured with ALICE at the LHC — •Alice Zimmermann for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

Studies of jet production characterize the properties of the hot and dense strongly interacting matter created in ultra-relativistic heavy-ion collisions. Specifically, measurements of strange hadrons in jets may clarify the role of fragmentation processes in the anomalous baryon to meson ratio at intermediate particle p_{T}, firstly observed in A-A collisions at RHIC and later confirmed in lead-lead (Pb–Pb) collisions at the LHC. Surprisingly, also measurements in proton-lead (p–Pb) collisions at the LHC showed this anomaly, although to a lesser extent.

In this contribution, we present measurements of the p_{T} spectra of $\Lambda(\overline{\Lambda})$ baryons and $\mathrm{K}^0_{\mathrm{S}}$ mesons produced in association with charged jets in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. The analysis is based on data recorded by ALICE at the LHC, exploiting its excellent particle identification capabilities. The baryon to meson ratios of strange particles associated with jets are studied in the 10 % most central events. A comparison is shown to the ratios obtained for inclusive particle production and for particles stemming from the underlying event as well as to PYTHIA proton-proton (pp) simulations. It is furthermore compared to the results obtained from charged jets in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV.

HK 17.4 Di 15:00 S1/01 A01

multi-strange hyperons triggering at SIS 100 — •hamda cherif for the CBM-Collaboration — Göethe Universität Frankfurt am Main

The Compressed Baryonic Matter (CBM) project at the future facility FAIR will be a dedicated heavy ion experiment operating in fixed target mode at beam energies up to 11A GeV for ions delivered by SIS 100 accelerator. The experimental challenge is to identify hadrons and

to select events containing multi-strange hyperons in an environment with up to 1000 charged particles per central collision at reaction rates of up to 10 MHz. A strategy for online event selection for multi-strange hyperons (such as Ξ- , Ξ+, Ω- and Ω+) is developed based on simulated data using the identification of daughter particles in ToF detector and the decay topology in STS detector. The selection strategy developed for Au+Au collision at 10A GeV and extended to lower energies available at SIS100 will be presented.

HK 17.5 Di 15:15 S1/01 A01

Hadron production within PHSD — •Pierre Moreau — Frankfurt Institute for Advanced Studies, Universitat Frankfurt, Frankfurt am Main, Germany

We study the production of (anti-) strange and multi-strange hadrons in heavy-ion collisions from FAIR/NICA to LHC energies within the Parton-Hadron-String Dynamics (PHSD) microscopic transport approach, which contains the partonic and hadronic dynamics. By showing the channel decomposition for the strangeness production we demonstrate how with increasing energy the production in the QGP dominates the hadronic production. We observed traces from the QGP by looking at a verity of *bulk* observables like the excitation functions of particle yields, pt- and rapidity distributions, centrality dependencies of yields, etc. A striking disagreement between the PHSD results and the available data persists for bombarding energies below $\sqrt{s_{NN}} \approx$ GeV where the strangeness production is significantly underestimated as in earlier HSD studies. This finding implies that the strangeness enhancement seen experimentally at FAIR/NICA energies cannot be attributed to a deconfinement phase transition or crossover but probably involves the approximate restoration of chiral symmetry in the hadronic phase.

HK 17.6 Di 15:30 S1/01 A01

Studies of the two-baryon interaction with ALICE — •Maria Nicassio for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The interaction among baryons has been the subject of intense theoretical studies for many years. Nonetheless it is still poorly known for systems that include heavy strange baryons.

Experimentally, few data from scattering experiments exist and they are not enough to constrain theory. The increasing energies of the LHC and the unprecedented sensitivity of its detectors give to this subject a new chance to be explored by studying two-baryon momentum correlations. At the high energies of the LHC indeed, baryon production is copious especially in the most central Pb–Pb collisions and correlation functions can be measured with good precision and differentially in event multiplicity also for multi-strange baryons.

Details on the measurements and the strategy to extract the parameters characteristic of the strong interaction (scattering lengths and effective radii) using Lednicky-Lyuboshitz analytical model will be discussed with particular focus on the ongoing studies of the pΞ systems, never measured before.

HK 18: Heavy Ion Collision and QCD Phases V

Zeit: Dienstag 14:00–15:30 Raum: S1/01 A4

HK 18.1 Di 14:00 S1/01 A4

Neutral meson measurement via photon conversions in p-Pb collisions with ALICE at the LHC — •Annika Passfeld for the ALICE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

The measurement of particle production in p-Pb collisions at high LHC energies allows the study of fundamental properties of quantum chromodynamics (QCD) at low parton momentum fraction x and high gluon densities.

Moreover it is important as reference for heavy ion collisions. It can show whether the initial state of the colliding nuclei plays a role in the observed suppression of hadron production at high p_T in Pb-Pb collisions. The measurement of neutral pions has the advantage of large statistics of identified particles over a relatively large transverse momentum range. In addition, the neutral pion and η spectra are crucial for the background determination of other analyses like the direct photon measurement.

In this talk the $\pi^0 \to \gamma\gamma$ and $\eta \to \gamma\gamma$ analyses using photon conversions will be presented. Differential invariant cross sections as well as the nuclear modification factor R_{p-Pb} will be shown for minimum bias collisions and different charged particle multiplicities for both mesons.

HK 18.2 Di 14:15 S1/01 A4

Statistical model analysis of hadron yields at SIS energies — •Manuel Lorenz for the HADES-Collaboration — Goethe Universität

The HADES data from p+Nb collisions at center of mass energy of $\sqrt{s_{NN}}$= 3.2 GeV are analyzed by employing a statistical model. Accounting for the identified hadrons π^0, η, Λ, K^0_s, ω allows a surprisingly good description of their abundances with parameters $T_{chem} = (99 \pm 11)$ MeV and $\mu_b = (619 \pm 34)$ MeV, which fits well in the chemical freeze-out systematics found in heavy-ion collisions. In supplement we reanalyze our previous HADES data from Ar+KCl collisions at $\sqrt{s_{NN}}$= 2.6 GeV as well as the recent Au+Au data at $\sqrt{s_{NN}}$= 2.4. Comparing the description of yields and the regularity of freeze-out parameters obtained from the three samples, we discuss equlibration in heavy-ion collisions in this energy regime. Supported by BMBF (05P12RFGHJ,05P15RFFCA), GSI and HIC for FAIR.

HK 18.3 Di 14:30 S1/01 A4

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

ALICE as the dedicated heavy-ion experiment at the LHC is designed to investigate the properties of the quark-gluon 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.

PHOS and EMCal, the electromagnetic calorimeters of the experiment, measure the energy and position of photons and therefore allow for the reconstruction of neutral mesons via their two-photon decay channel.

The status of the neutral meson measurement in pp and p-Pb collisions with the ALICE PHOS and EMCal will be presented.

Supported by BMBF and the Helmholtz Association.

HK 18.4 Di 14:45 S1/01 A4

Measurement of neutral mesons via combination of calorimeter and conversion photons in pp collisions with ALICE at the LHC — •Daniel Mühlheim for the ALICE-Collaboration — Institut für Kernphysik, Westfälische-Wilhelms Universität Münster

The ALICE experiment is dedicated to the investigation of the so-called Quark-Gluon Plasma (QGP) which is created in highly energetic Pb-Pb collisions. In order to identify and understand the effects which are not related to the creation of the QGP, the analysis of pp collisions plays an important role. One point of general interest is the measurement of photons. They can be regarded as an ideal probe to study the QGP, since they do not participate in the strong interaction. Hence, they are able to escape the medium unaffected.

There are two different principles to measure photons in ALICE. One way is to make use of electromagnetic calorimeters. The other possibility is to look for photon conversions which occur within the detector material. Both detection principles are combined in order to reconstruct neutral mesons. Since the two detection systems are independent, this method provides an important cross-check for the respective systems. It also profits from the excellent resolution of the conversion method as well as from the high reconstruction efficiency of a calorimeter.

I will introduce this so-called hybrid method in detail and present the current status of neutral meson analysis in pp collisions. Moreover, a first look into the direct photon extraction will be presented.

HK 18.5 Di 15:00 S1/01 A4

Contribution submission to the conference Darmstadt 2016

Measurement of the η meson in Pb-Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV in the ALICE experiment at LHC — •Lucia Leardini for the ALICE-Collaboration — Physicalische Institut Heidelberg

Neutral mesons are probes for studying the energy loss of partons traversing the hot and dense medium, the Quark-Gluon Plasma, that is formed in heavy-ion collisions. Moreover, the study of π^0 and η mesons in Pb-Pb collisions is necessary for the direct-photon measurement as these mesons constitute its most important background. The η meson production in the transverse momentum range $1 < p_T < 20$ GeV/c has been measured at midrapidity by the ALICE experiment at the Large Hadron Collider (LHC) in central and semi-central Pb–Pb collisions at $\sqrt{s_{NN}}$=2.76 TeV. The low p_T part of the measurement relies on the Photon Conversion Method (PCM), based on the reconstruction of photon conversions by the Inner Tracking System (ITS) and the Time Projection Chamber (TPC). The ALICE Electromagntic calorimeter (EMCal) provides the high p_T part of the neutral mesons spectra.
The η invariant yields, η/π^0 ratio and η R_{AA} will be shown and compared to predictions.

HK 18.6 Di 15:15 S1/01 A4

Measurement of η mesons produced in p-p collisions at $\sqrt{s_{NN}}$=13 TeV with ALICE — •Meike Danisch for the ALICE-Collaboration — Physikalisches Institut der Uni Heidelberg

Studying proton-proton collisions with ALICE at the LHC can not only be used to test predictions from Quantum Chromodynamics (QCD), but is also an important step towards the analysis of Pb-Pb collisions. Comparing the results of both analyses, one can study the hot and dense state of matter which is produced in heavy ion collisions. Neutral mesons can, for example, provide information on the energy loss of partons traversing the Quark Gluon Plasma (QGP). Furthermore, they constitute the largest background contribution for direct photons, which are also a very important tool to study the properties of the QGP. 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 so-called 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 for the precise measurement of both photons and neutral mesons, especially at low transverse momenta. Apart from shortly introducing the photon conversion method, first results of the η meson analysis, using data from p-p collisions at the world's highest center-of-mass collision energy of 13 TeV per nucleon, will be shown.

HK 19: Nuclear Astrophysics III

Zeit: Dienstag 14:00–16:00 Raum: S1/01 A02

Gruppenbericht HK 19.1 Di 14:00 S1/01 A02

Direkte Reaktionen für die Astrophysik — •Mario Weigand, Lukas Bott, Benjamin Brückner, Philipp Erbacher, Stefan Fiebiger, Matthias Fix, Jan Glorius, Kathrin Göbel, Tanja Heftrich, Ole Hinrichs, Jan Dominik Kaiser, Christoph Langer, Florian Ludwig, Thien Tam Nguyen, Markus Reich, René Reifarth, Kilian Scheutwinkel, Zuzanna Slavkovská, Benedikt Thomas, Meiko Volknandt, Daniel Veltum, Clemens Wolf und Ashkan Taremi Zadeh — Goethe-Universität Frankfurt a. M., Germany

Die Häufigkeitsverteilung der Elemente im Sonnensystem bildet einen Forschungsschwerpunkt der Nuklearen Astrophysik. Für das Verständnis der zugrunde liegenden Nukleosynthese in Sternen werden Daten über eine Vielzahl von Reaktionsraten benötigt. Die Elemente schwerer als Eisen werden primär durch sukzessive Neutroneneinfänge und Betazerfälle in Sternen verschiedener Stadien erzeugt. Darüber hinaus existieren Isotope, deren Entstehung mit Hilfe von Protonen- und Gamma-induzierten Reaktionen erklärt wird.
Die Forschungsgruppe „Experimentelle Astrophysik" der Goethe-Universität Frankfurt bestimmt Reaktionsraten mit verschiedenen experimentellen Methoden. In diesem Beitrag werden bisherige Ergebnisse vorgestellt und ein Ausblick über künftige Projekte gegeben.
Gefördert durch: Helmholtz International Center for FAIR, BMBF (05P15RFFN1), European Research Council im Rahmen des European Unions's Seventh Framework Programme (FP/2007-2013) / ERC Grant Agreement n. 615126.

HK 19.2 Di 14:30 S1/01 A02

Isospin-asymmetry expansion of the nuclear equation of state — •Corbinian Wellenhofer[1], Jeremy W. Holt[2], Norbert Kaiser[1], and Wolfram Weise[1,3] — [1]Technische Universität München — [2]University of Washington — [3]ECT*

The isospin-asymmetry dependence of the nuclear equation of state obtained from microscopic chiral two- and three-body interactions in many-body perturbation theory is examined in detail. The quadratic, quartic and hexic Maclaurin coefficients in the isospin-asymmetry expansion of the free energy per particle of homogeneous nuclear matter are calculated using finite difference approximations, and the resulting polynomials are compared to the full isospin-asymmetry dependent free energy. It is found that in the low-temperature and high-density regime where the radius of convergence of the isospin-asymmetry expansion is generically zero the inclusion of higher-order terms beyond the leading quadratic approximation leads to a worse description of the full isospin-asymmetry dependence. Only at high temperatures and densities below nuclear saturation density does the inclusion of the quartic and hexic coefficients lead to an improved approximation.

HK 19.3 Di 14:45 S1/01 A02

A comparison of equation of state models with different cluster suppression mechanisms — •Stefan Typel[1] and Helena Pais[2] — [1]GSI, Darmstadt — [2]University of Coimbra, Portugal

In order to model the transition from clustered matter at subsaturation densities to uniform nucleon matter at baryon densities above nuclear saturation, a mechanism for the dissolution of clusters has to be implemented in theoretical approaches for the equation of state. A widely used heuristic method is the excluded-volume mechanism that assumes a finite size of nucleons and nuclei. An alternative description introduces medium-dependent mass shifts that mainly originate from the action of the Pauli principle.

In this contribution the predictions for the chemical composition and the thermodynamic properties of neutron star matter at finite temperatures in a statistical excluded-volume model [1,2] are compared with those of a mass-shift approach in a generalized relativistic density functional [2,3,4]. Since both description use the same interaction model for the nucleons, the observed differences can be attributed to the cluster description.

[1] M. Hempel, J. Schaffner-Bielich, Nucl. Phys. A 837 (2010) 210.
[2] M. Hempel at al., Phys. Rev. C 84 (2011) 055804.
[3] S. Typel et al., Phys. Rev. C 81 (2010) 015803.
[4] S. Typel, arXiv:1504.01571[nucl-th] (2015).

HK 19.4 Di 15:00 S1/01 A02

Quartic isospin-asymmetry energy of nuclear matter from chiral pion-nucleon dynamics — •Norbert Kaiser — Physik Department T39, Technische Universität München

Based on a chiral approach to nuclear matter, the quartic term in the expansion of the equation of state of isospin-asymmetric nuclear matter is calculated [Phys. Rev. C **91**, 065201 (2015)]. The contributions to the quartic isospin asymmetry energy $A_4(k_f)$ arising from 1π-exchange and chiral 2π-exchange in nuclear matter are calculated analytically together with three-body terms involving virtual $\Delta(1232)$-isobars. From these interaction terms one obtains at saturation density $\rho_0 = 0.16\,\mathrm{fm}^{-3}$ the value $A_4(k_{f0}) = 1.5\,\mathrm{MeV}$, more than three times as large as the kinetic energy part. Moreover, iterated 1π-exchange exhibits components for which the fourth derivative with the respect to the isospin-asymmetry parameter δ becomes singular at $\delta = 0$. The genuine presence of a non-analytical term $\delta^4 \ln|\delta|$ in the expansion of the energy per particle of isospin-asymmetric nuclear matter is demonstrated by evaluating a s-wave contact interaction at second order.
Work supported in part by DFG and NSFC (CRC110).

HK 19.5 Di 15:15 S1/01 A02

Nuclear matter within the self-consistent Green's function

approach using chiral interactions⋆ — •Arianna Carbone — Institut für Kernphysik, TU Darmstadt

The combination of ab initio many-body approaches and chiral interactions derived from the underlying quantum theory, QCD, has provided for the past two decades a promising framework to obtain a realistic description of infinite nuclear matter. This analysis is fundamental to shed light on many aspects of nuclear systems, from the limits of nuclear existence to the astrophysical processes in neutron-star mergers. To address these questions, we have recently extended the scope of self-consistent Green's function theory (SCGF) to include three-body forces. I will present studies of the microscopic and bulk properties of symmetric nuclear and pure neutron matter, both at zero and finite temperature. The results show how the inclusion of three-body forces is crucial to predict the empirical properties of symmetric nuclear matter. These also contribute to stiffen the neutron matter equation of state, which is important for neutron stars.

⋆ This work was supported by the DFG through Grant SFB 634 and by the Alexander von Humboldt Foundation through a Humboldt Research Fellowship for Postdoctoral Researchers

HK 19.6 Di 15:30 S1/01 A02

Neutron drops with the optimized effective potential method⋆ — •Thomas Krüger[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung

Neutron drops are a unique benchmark system to test nuclear interactions and constrain energy-density functionals, especially in the neutron-rich regime of the nuclear chart. We use the optimized effective potential method for the first time to second order with local chiral interactions to calculate neutron drops in harmonic traps. Our calculations are a first step towards calculations of nuclei in ab initio density functional theory, which connects energy density functionals to chiral effective field theory interactions.

⋆This work was supported by the DFG through Grant SFB 634 and by the ERC Grant No. 307986 STRONGINT.

HK 19.7 Di 15:45 S1/01 A02

Large-scale HFB calculation with exact blocking for odd-A nuclei — •Alexander Arzhanov[1,2], Gabriel Martínez-Pinedo[1,2], Tomás R. Rodríguez[3], and Luís M. Robledo[3] — [1]Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, D-64291 Darmstadt, Germany — [3]Departamento de Física Teórica, Universidad Autónoma de Madrid, E-28049 Madrid, Spain

Any realistic model of r-process nucleosynthesis requires accurate predictions of nuclear masses for isotopes beyond the reach of currently available experimental facilities, thus one has to rely on theoretical nuclear masses. Self-consistent mean-field (SCMF) theories based on energy density functionals (EDF) were actively developing in the recent decades. However, due to computational comlexity most of systematic surveys did not treat the odd-A nuclei at the same self-consistent level as the even-even isotopes. We performed a fully self-consistent large-scale calculation of nuclear masses using the exact blocking presciption with time-reversal symmetry breaking for odd-A nuclei within Hartree-Fock-Bogolyubov (HFB) framework with Gogny EDF. We analyse and compare the results for odd-A nuclei with the experimental values as well as commonly employed equal filling approximation. Supported by Helmholtz Association through Nuclear Astrophysics Virtual Institute (VH-VI-417).

HK 20: Structure and Dynamics of Nuclei V

Zeit: Dienstag 14:00–15:30 Raum: S1/01 A03

Gruppenbericht HK 20.1 Di 14:00 S1/01 A03

Studying the γ-decay behaviour of the Pygmy Dipole Resonance — •Simon G. Pickstone, Vera Derya, Andreas Hennig, Mark Spieker, Michael Weinert, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The Pygmy Dipole Resonance (PDR) has been studied extensively in the past decade [1,2]. However, one important property, the γ-decay branching ratio to excited states, is still not known systematically. To access this observable, the particle-γ coincidence method is used at the dedicated SONIC@HORUS setup. It consists of up to twelve silicon detectors for particle identification and ejectile energy determination and the 14 HPGe detector array HORUS for high-resolution γ-ray spectroscopy. Due to the good energy resolution of the silicon detectors, a narrow gate on a specific excitation energy can be set, which allows for a sensitive and straightforward state to state determination of branching ratios.

Branching ratios for 1^- states in ^{92}Mo and ^{94}Mo from (p,p'γ) experiments and the decay pattern of 1^- states in ^{120}Sn from a (d,pγ) experiment will be shown, as well as possible theoretical interpretations. Together with γ-decay studies from the γ^3 setup at HIγS, these experiments allow for a systematic study of the PDR decay pattern to better understand the underlying structure of low-lying E1 strength.

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

[1] D. Savran, T. Aumann, and A. Zilges, PPNP **70** (2013) 210
[2] A. Bracco, F.C.L. Crespi, and E.G. Lanza, EPJ A **52** (2015) 99

HK 20.2 Di 14:30 S1/01 A03

Probing the Pygmy Dipole Resonance in ^{140}Ce by means of the (p,p'γ) reaction at intermediate energy — •V. Derya[1], S. Bagchi[2], J. Endres[1], E. Fiori[3], M.N. Harakeh[2,4], N. Kalantar-Nayestanaki[2], M.A. Najafi[2], S. Pascu[1], S.G. Pickstone[1], N. Pietralla[5], C. Rigollet[2], C. Romig[5], D. Savran[3], M. Spieker[1], H.J. Wörtche[2], and A. Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne, Germany — [2]KVI-CART, University of Groningen, the Netherlands — [3]GSI, Darmstadt, Germany — [4]GANIL, CEA/DSM-CNRS/IN2P3, Caen, France — [5]TU Darmstadt, Germany

The Pygmy Dipole Resonance (PDR) has been studied using various experimental methods [1], including systematic (α,α'γ) and (γ,γ') experiments [1] as well as (^{17}O,^{17}O'γ) experiments [2]. Protons at 80 MeV were used as a complementary hadronic probe in a (p,p'γ) coincidence experiment on ^{140}Ce. The experiment was performed at KVI in Groningen, the Netherlands. Due to a higher energy per nucleon compared to the previously used α particles of 34 MeV/u, the proton-induced reaction is more sensitive to the inner parts of the dipole transition density. Results of this experiment including DWBA calculations will be presented and discussed.

Supported by the DFG (ZI 510/7-1), EURONS, and the Alliance Program of the Helmholtz Association (HA216/EMMI). S.G.P. and M.S. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

[1] D. Savran, T. Aumann, and A. Zilges, PPNP **70** (2013) 210
[2] A. Bracco, F.C.L. Crespi, and E.G. Lanza, EPJ A **51** (2015) 99

HK 20.3 Di 14:45 S1/01 A03

Selective excitation and γ-decay studies of the Pygmy Dipole Resonance in ^{120}Sn with SONIC@HORUS — •Michael Weinert, Vera Derya, Andreas Hennig, Simon G. Pickstone, Mark Spieker, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne.

The excitation of states belonging to the Pygmy Dipole Resonance (PDR) in ^{120}Sn was observed in a ^{119}Sn(d,pγ) experiment, using the SONIC@HORUS setup at the 10 MV Tandem accelerator in Cologne. The setup, consisting of 6 ΔE-E silicon and 14 HPGe detectors, allows a selection of reaction, excitation, and deexcitation channels in an offline analysis, due to complete kinematics. Several excited states were identified as $J^\pi = 1^{(-)}$ states by comparison with results from a nuclear resonance fluorescence experiment [1], establishing the (d,p) reaction as an additional tool to study the PDR. Preliminary analysis shows that a γ-decay branching to the first 2^+ state is observed and branching ratios can be determined. The contribution will present the experiment and principles of the data analysis needed to select transitions from $J^\pi = 1^-$ states. Furthermore, the latest status of the analysis will be presented, including branching ratios and branching-corrected B(E1) values, which will allow a more stringent comparison with recent inelastic proton scattering data [2].

Supported by DFG (ZI 510/7-1). S.G.P., M.S., and J.W. are supported

by the Bonn-Cologne Graduate School of Physics and Astronomy.
[1] B. Özel *et al.*, Phys. Rev. C **90** (2014) 024304
[2] A.M. Krumbholz *et al.*, Phys. Lett. B **744** (2015) 7-12

HK 20.4 Di 15:00 S1/01 A03

Low-lying dipole strengths of ^{50,54}Cr* — •H Pai[1], P C Ries[1], T Beck[1], J Beller[1], R Beyer[2], M Bhike[3,4], V Derya[5], U Gayer[1], J Isaak[6,7], Fnu Krishichayan[3,4], B Löher[6], V O Nesterenko[8], N Pietralla[1], G Martinez-Pinedo[1], L Mertes[1], V Yu Ponomarev[1], C Romig[1], D Savran[6,7], R Schwengner[2], W Tornow[3,4], V Werner[1], J Wilhelmy[5], A Zilges[5], and M Zweidinger[1] — [1]Technische Universität Darmstadt, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [3]Duke University, Durham, USA — [4]TUNL, Durham, USA — [5]IKP, Universität zu Köln, Germany — [6]EMMI and GSI, Darmstadt, Germany — [7]FIAS, Frankfurt am Main, Germany — [8]JINR, Dubna, Russia

Low-lying electric and magnetic dipole strengths (E1 and M1, respectively), particularly the Pygmy Dipole Resonance (PDR), low-energy orbital M1 mode, and Spin-flip M1 excitations, of atomic nuclei have drawn considerable attention in the last decade. The low-lying dipole strengths of ^{54}Cr and ^{50}Cr were studied with the method of nuclear resonance fluorescence up to 9.7 MeV, using bremsstrahlung provided by the superconducting Darmstadt electron linear accelerator S-DALINAC. 33 and 52 spin-1 states were observed in ^{50}Cr and ^{54}Cr, respectively. Parity quantum numbers were determined with a polarized photon scattering at the HIγS, TUNL in Durham, USA. Microscopic calculations within the QPM, QRPA, and Shell Model were performed to interpret the dipole strengths distributions of ^{50,54}Cr.

*Supported by the DFG under contract No. SFB 634 and ZI 510/7-1 and by HIC for FAIR.

HK 20.5 Di 15:15 S1/01 A03

Pygmy-dipol resonance in nerutron-rich Sn-isotopes — •Joachim Tscheuschner and Thomas Aumann for the DALI-LaBr RIBF-Collaboration-Collaboration — TU Darmstadt, Darmstadt, Germany

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 first results of the ongoing analysis are presented. This project is supported by HIC for FAIR.

HK 21: Instrumentation V

Zeit: Dienstag 14:00–15:45 Raum: S1/01 A2

Gruppenbericht HK 21.1 Di 14:00 S1/01 A2

The Micro Vertex Detector of the $\overline{\text{P}}$ANDA Experiment — •Tommaso Quagli — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, 35392 Gießen

PANDA is a key experiment of the future FAIR facility, under construction in Darmstadt, Germany. It will study the collisions between an antiproton beam and a fixed proton or nuclear target. The Micro Vertex Detector (MVD) is the innermost detector of the apparatus and its main task is the precise identification of primary and secondary vertices. The central requirements include high spatial and time resolution, triggerless readout with high rate capability, good radiation tolerance and low material budget. The detector is composed of four concentric barrels and six forward disks, instrumented with silicon hybrid pixel detectors and double-sided silicon microstrip detectors.

This talk will provide an overview of the design and the status of the MVD. Recent developments of prototypes of the hardware components for the pixel and strip parts, including the silicon sensors, the readout electronics and the mechanical and electrical infrastructure, will be presented along with the latest test results.

This work was supported by BMBF, HIC for FAIR, HGS-HIRe, JCHP and INFN.

HK 21.2 Di 14:30 S1/01 A2

Ein Röntgenspektrometer auf der Basis von hochspannungstauglichen CMOS-Sensoren mit hochdotiertem Dopiniggradienten im aktiven Medium* — •Dennis Doering für die CBM-MVD-Kollaboration — Goethe-Universität, Frankfurt

Eine Materialanalyse, welche feinste Konzentrationen von Verunreinigungen nachweisen kann, ist die Röntgenfluoreszenzanalyse. Gesucht wird hierfür eine passende Detektortechnologie. Hierzu schlagen wir CMOS-Sensoren vor, wie sie am IPHC Straßburg für Anwendungen in der Schwerionen- und Teilchenphysik entwickelt werden. CMOS-Sensoren zeichnen sich durch ihr geringes Rauschen aus, wodurch sie besonders geeignet sind, Röntgenstrahlung mit einer Energie von wenigen keV nachzuweisen. Weiterhin zeichnen sie sich durch ihre hohe Granularität als ratenfest aus, können unabhängig von aufwändiger (Kühl)-Infrastruktur betrieben werden sowie auch in kommerziellen CMOS-Fertigungsstraßen kostengünstig hergestellt werden.
Wir zeigen in diesem Beitrag, wie aus der Signalantwort eines konventionellen CMOS-Sensors eine Energieinformation mit guter Präzision extrahiert werden kann. Weiterhin demonstrieren wir, wie der Nachteil der geringen Quanteneffizienz durch die seit kurzem verfügbaren, hochspannungstauglichen CMOS-Sensoren mit hochdotiertem Dopiniggradienten im aktiven Medium verbessert werden kann.
Eine mögliche Anwendung kann schließlich die Echtzeitüberwachung auf Spurenverunreinigungen im Trinkwasser mittels Röntgenfluoreszenzanalyse sein.

*gefördert durch das BMBF (05P12RFFC7), HIC for FAIR und GSI.

HK 21.3 Di 14:45 S1/01 A2

Status of the radiation hardness of CMOS Monolithic Active Pixels Sensors for the CBM experiment* — •Benjamin Linnik 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. Therefore, a dedicated vertex detector is required which will be equipped with CMOS Monolithic Active Pixels Sensors (MAPS). A joined research activity of the Goethe University Frankfurt and the IPHC Strasbourg explores strategies to match the radiation hardness of these sensors with the requirements.
In the past, it could be shown that combining an improved high resistivity ($1 - 8$ kΩcm) sensitive medium with the features of a 0.18 μm CMOS process can improve the radiation hardness of the sensors. In 2015, it was tried to further improve the radiation hardness by applying a external depletion voltage. Two prototype sensors were studied. Furthermore, the first full-integrated 0.18 μm CMOS-sensor FSBB was tested in beam and laboratory. We will show first results from irradiated samples at low operation temperatures.

*supported by BMBF (05P12RFFC7), HGS-HIRe, HIC for FAIR und GSI.

HK 21.4 Di 15:00 S1/01 A2

Radiation tolerance of microstrip sensors for the CBM Silicon Tracking System — •Ievgeniia Momot[1,3], Hanna Malygina[1,3], and Johann Heuser[2] for the CBM-Collaboration — [1]Goethe-Universität, Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [3]KINR, Kyiv, Ukraine

The Silicon Tracking System (STS), the core detector of CBM experiment located in the dipole magnet, provides track reconstruction and momentum determination of charged particles originating from beam-target interactions. The response of double-sided silicon micro-strip sensors to hits by charged particles will be used for the track reconstruction. The radiation load of the CBM experiment is expected to be 10^{14} 1-MeV n_{eq}/cm^2, which may have significant influence on the detector response. The development of radiation tolerant prototype STS microstrip sensors irradiated up to 10^{14} 1-MeV n_{eq}/cm^2 will be reviewed. Results on charge collection efficiency studies with the latest silicon sensor prototypes with double metallization or external interstrip cables for connecting strips will be presented.

Supported by HIC for FAIR and HGS-HIRe.

HK 21.5 Di 15:15 S1/01 A2

High Voltage Active Pixel Sensors for the PANDA Luminosity Detector — •T. Weber, F. Feldbauer, P. Jasinski, A. Karavdina, R. Klasen, H. Leithoff, S. Maldaner, C. Motzko, S. Pflüger, and M. Fritsch — Institut für Kernpysik und Helmholtz Institut Mainz

The PANDA-Experiment will be part of the new FAIR accelerator center at Darmstadt, Germany. It is a fixed target experiment using a antiproton beam with very high resolution for precision measurements in the field of hadron spectroscopy. For a variety of measurements like energy-scans the precise determination of the luminosity is needed.

The luminosity detector will determine the luminosity by measuring the angular distribution of elastically scattered antiprotons very close to the beam axis (3-8 mrad). To reconstruct antiproton tracks four layers of silicon monolithic active pixel sensors (HV-MAPS) will be used. Those sensors are currently under development by the Mu3e-collaboration in Heidelberg.

In the talk the concept of the luminosity measurement is shortly introduced before results of laboratory and beam time measurements with a tracking station consisting of HV-MAPS prototypes are presented.

HK 21.6 Di 15:30 S1/01 A2

Measurements of Proton-Proton Elastic Scattering by the KOALA Experiment at COSY — •Qiang Hu[1,2], James Ritman[2], and Huagen Xu[2] — [1]Institute of Modern Physics, CAS, 730000 Lanzhou, China — [2]IKP and JARA-FAME, Forschungszentrum Juelich, 52425 Juelich, Germany

The KOALA experiment is being built to measure the differential cross section spectrum for antiproton-proton elastic scattering in the squared 4-momentum transfer region ($|t| \sim [0.0008, 0.1]$ $(\mathrm{GeV/c})^2$) at HESR. That data is an essential input to enable the $\overline{\mathrm{P}}$ANDA luminosity determination to obtain the desired absolute precision of 3%. The complete KOALA experiment setup will be composed of one forward arm to measure the scattered projectile and two recoil arms to measure the recoil target. In a first step, one recoil detector has been constructed and commissioned at COSY by measuring proton-proton elastic scattering at 2.5, 2.8 and 3.2 GeV/c. The differential cross-section spectrum as a function of t has been reconstructed at each beam momentum after background subtraction and efficiency correction. The resulting spectra are parameterized in terms of the total cross section σ_t, the ratio of the real to imaginary part of the forward amplitude ρ and the nuclear slope b. These parameters, as well as the normalization coefficient have been extracted by analyzing the characteristic shape of the t spectra with the parameterized expression and the optical theorem. The relative differential cross sections have been obtained after normalization. The methods and the final differential cross section spectra will be presented in this talk.

HK 22: Instrumentation VI

Zeit: Dienstag 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 22.1 Di 14:00 S1/01 A3

Status of the R3B calorimeter CALIFA — •Max Winkel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, and Patrick Remmels for the R3B-Collaboration — Technische Universtät München

The R^3B detector system at the new Facility for Antiproton and Ion Resarch (FAIR) will allow high resolution experiments with the most exotic nuclei at the isospin frontier using kinematically complete measurements. Examples of the physics program to investigate the evolution of nuclear shells and single particle structure far away from stability are quasi-free scattering, Coulomb excitation and knockout reactions.

A crucial component for these purposes is the CALorimeter for In Flight detection of γ-rays and high energy charged pArticles (CALIFA) surrounding the reaction area. The electromagnetic 4π-calorimeter is highly segmented into 2656 scintillation crystals to enable an excellent Doppler reconstruction while maintaining good calorimetric properties. A major challenge is the high dynamic energy range, necessary for various experiments, reaching from $E \sim 100$ keV γ rays up to $E \sim 700$ MeV protons. This goal is achieved by a dedicated, fully digital readout using a real time signal processing firmware.

In this report, the detector design as well as recent developments and results of various prototype tests are presented, including an R^3B pilot experiment involving prototypes of all R^3B detectors.

Supported by BMBF (05P12WOFNF, 05P15WOFNA) and GSI (TMLFRG1316).

HK 22.2 Di 14:30 S1/01 A3

Calibration and Monitoring System for the CALIFA Calorimeter — •Patrick Remmels, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, and Max Winkel for the R3B-Collaboration — Physik Department, Technische Universität München

One of the major components of the R^3B-experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt is the 4π-calorimeter CALIFA. The stability of all 2560 detector channels depends on the experimental conditions and its monitoring is essential for a high resolution spectroscopy. A newly developed digital pulse generator emulates the complex signal created in the CsI(Tl) crystals in order to calibrate the online pulse shape analysis for particle identification, background suppression and energy measurements. Further applications include deadtime studies and pileup discrimination in the general readout. The full implementation of 160 channels of pulse generation on the digital readout platform FEBEX allows an in spill separation of physical and calibration events in the continuous data stream. Setup, performance and first applications will be presented in this talk. Supported by BMBF (05P12 WOFNF, 05P15 WOFNA) and GSI (TMLFRG1316).

HK 22.3 Di 14:45 S1/01 A3

Measurement of the CALIFA PETAL response to cosmic-rays and AmBe source — •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 gamma-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 work, we investigated response of one CALIFA PETAL using high-energy gamma-rays from a AmBe source and atmospheric muons. In addition, we compare the experimental data with simulations using the GEANT4 package in order to verify these.
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 22.4 Di 15:00 S1/01 A3

Avalanche Photo Diode Based Readout of the Crystal Barrel Calorimeter — •Martin Urban for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The CBELSA/TAPS experiment at ELSA in Bonn has measured double polarization observables in meson photoproduction off the proton in the last few years. To be able to extend these measurements in future also to purely neutral final states produced off a polarized neutron target with high efficiency, the main calorimeter consisting of 1320 CsI(Tl) crystals has to be integrated into the first level trigger.

Key requirement to achieve this goal was the upgrade of the existing PIN photo diode by a new avalanche photo diode (APD) readout. The main advantage of the new readout system is to provide a fast timing signal which allows a fast decision on the number of cluster in an event.

The upgrade of the calorimeter has been finalized during the last year. Beside the status of the upgrade, this talk will focus on the single crystal calibration and on the development of a new light pulser system.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16) and Schweizerischer Nationalfonds.

HK 22.5 Di 15:15 S1/01 A3

Testaufbau zur Vermessung von Avalanche-Photo-Dioden für das PANDA-Kalorimeter — •Jan Haase für die PANDA-Kollaboration — Institut für Experimentalphysik 1 - Ruhr-Universität Bochum

Das PANDA-Experiment wird an der im Bau befindlichen Beschleunigeranlage FAIR (Facility for Antiproton and Ion Research) am GSI Helmholtzzentrum für Schwerionenforsching in Darmstadt aufgebaut. Der Detektor wird über ein homogenes elektromagnetisches Kalorimeter basierend auf Bleiwolframatkristallen ($PbWO_4$) verfügen. Mit dem Kalorimeter soll ein Energiebereich von 10 MeV bis etwa 15 GeV abgedeckt werden. Dabei werden die ca. 16000 Bleiwolframatkristalle mit Hilfe von Avalanche-Photo-Dioden (APD) und Vakuum-Photo-Tetroden (VPTT) ausgelesen.

Es wird hier die Entwicklung eines neuen Testaufbaus zur Vermessung von Avalanche-Photo-Dioden der Firma Hamamatsu vorgestellt. Ziel der Messung ist es, die Eigenschaften entsprechend der Verstärkung bei verschiedenen Betriebsspannungen und Temperaturen zu untersuchen. Dabei wird ein LED-basiertes Lichtpulsersystem genutzt, welches die Szintillationspulse im späteren Experiment nachbildet. Es werden erste Testmessungen und Untersuchungen dargelegt.

Gefördert durch das BMBF.

HK 22.6 Di 15:30 S1/01 A3

Influence of the Light Collection Non Uniformity in Strongly Tapered PWO Crystals on the Energy Resolution of the PANDA EMC — •Stefan Diehl[1], Peter Drexler[1], Valery Dormenev[1], Till Kuske[1], Rainer W. Novotny[1], Christoph Rosenbaum[1], Peter Wieczorek[2], Andrea Wilms[2], and Hans-Georg Zaunick[1] — [1]2nd Physics Institute, JLU Giessen — [2]GSI Helmholtzzentr. für Schwerionenforsch., Darmstadt

The barrel part of the target EMC of the PANDA detector at the future FAIR facility will consist of 11 crystal geometries with a different degree of tapering. Due to the tapering the crystals show a non uniformity in light collection. For the most tapered crystals the light detected by the photo-sensor is enhanced by a factor 1.4, if the scintillation light is created in the front part of the crystal. This effect causes a smearing of the response, resulting in a reduction of the energy resolution. Therefore, one lateral crystal side face has been de-polished for a set of test crystals, decreasing the non uniformity from around 40% to less than 5%. The present contribution will compare the response of a 3x3 matrix of crystals with one de-polished side in the final PANDA EMC configuration, with an identical matrix of polished crystals using a tagged photon beam in the energy range from 50 MeV up to 1 GeV and the results from GEANT4 simulations. A significant improvement of the energy resolution can be observed for the matrix with de-polished crystals in the energy range above 200 MeV, while the resolution stays at the same level between 50 MeV and 200 MeV. *The project is supported by BMBF, GSI and HIC for FAIR.

HK 22.7 Di 15:45 S1/01 A3

Improved prototype of the backward end - cap PANDA electromagnetic calorimeter at FAIR — Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[2,3], Alaa Dbeyssi[2,3], Frank Maas[2,3], •Oliver Noll[1,2], and David Rodríguez Piñeiro[2,3] for the PANDA-Collaboration — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH

The PANDA experiment wants to achieve a deeper understanding of the strong interaction. It is built at the new accelerator facility FAIR in Darmstadt. The electromagnetic process group in Mainz is developing the backward end-cap (BWEC) of the electromagnetic calorimeter. The prototype (PROTO16) serves for testing the final BWEC components for cooling, insulating, place consumption, photon read-out, electronics and signal transmission. PROTO16 got some major updates in the last year. The aim of these updates has been to improve the signal transmission for a better signal to noise ratio. New line driver boards have been developed. In the frame work of the signal enhancement, the latest version of the PANDA calorimeter preamplifier (APFEL-ASIC 1.5) has been introduced. Besides using geographical addressing, the key advantage is the individual biasing of the avalanche photodiodes. Furthermore, the slow control monitoring has been improved and detector stability has been enhanced. Two beam times with an 855 MeV electron beam at the Mainz Microtron Facility served for testing the improvements. This contribution will discuss the results in terms of signal quality and detector stability.

HK 23: Hadron Structure and Spectroscopy IV

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A5

Gruppenbericht HK 23.1 Di 16:30 S1/01 A5

Light Meson Spectroscopy in Electron-Positron and Antiproton-Proton Annihilations — •Malte Albrecht, Bertram Kopf, Marc Pelizäus, Julian Pychy, Fritz-Herbert Heinsius, and Ulrich Wiedner — Inst. f. Experimentalphysik I, Ruhr-Universität Bochum

QCD predicts exotic bound states, such as states with gluonic degrees of freedom like glueballs or hybrids in the mass region between 1 and $2\,\mathrm{GeV}/c^2$. Especially radiative decays of charmonia and the antiproton-proton annihilation process provide an excellent laboratory to study the light meson sector, since both are referred to as 'gluon-rich' processes.

Due to the presence of many broad and often overlapping states in the light meson sector, the properties of the contributing resonances can mostly only be accessed via a full partial wave analysis.

Recent results from analyses of radiative charmonium decays using data from the BESIII experiment at the symmetric electron-positron collider BEPCII in Beijing, as well as the Crystal Barrel/LEAR experiment are presented. Parts of the analyses from both annihilation processes are performed utilizing the user-friendly partial wave analysis software PAWIAN, which is being developed in Bochum.

Apart from a deeper understanding of the light meson spectrum and the existence of possible exotic states, the analyses are an important step towards the analysis of data from the upcoming PANDA experiment at FAIR.

Supported by the DFG

HK 23.2 Di 17:00 S1/01 A5

Model Selection in Partial-Wave Decomposition — •Karl Bicker, Suh-Urk Chung, Oliver Drotleff, Jan Friedrich, Boris Grube, Fabian Krinner, Stephan Paul, Dimitry Ryabchikov, and Sebastian Uhl — Physik Department, E18, Technische Universität München

Model selection in the context of partial-wave decomposition of data from diffractive dissociation reactions is a daunting task. Due to the large number of possible waves which are conceivable to contribute to the measured distributions, an almost infinite number of models can be constructed. We will present a method which uses a maximum-likelihood estimation together with a prior function to select an appropriate set of partial waves that describes the data at hand. This work is supported by BMBF, MLL München and the DFG Cluster of Excellence Exc153.

HK 23.3 Di 17:15 S1/01 A5

Helizitätsformalismus im Amplitudenanalyse-Framework ComPWA — •Stefan Pflüger[1], Mathias Michel[1], Florian Feldbauer[1,2], Miriam Fritsch[1,2], Klaus Götzen[1,3], Wolfgang Gradl[2], Frank Nerling[1,3], Klaus Peters[1,3] und Peter Weidenkaff[2] — [1]Helmholtz Institut Mainz — [2]Johannes Gutenberg Universität Mainz — [3]GSI Helmholtzzentrum Darmstadt

Die Suche nach neuen konventionellen sowie exotischen hadronischen Zuständen, wie z.B. Hybriden oder Gluebällen, erfordert die Identifizierung möglicher Kandidaten und die eindeutige Einordnung bereits bekannter Zustände. Dazu wird in einem Großteil der Analysen eine Amplitudenanalyse (PWA) benötigt. Zu diesem Zweck wird das

neue, flexible und effiziente PWA-Framework ComPWA entwickelt. Es ist modular gestaltet, was es erlaubt, problemlos weitere Modelle und Formalismen hinzuzufügen, wie auch gleichzeitig mehrere Datensätze (auch verschiedener Experimente) simultan zu analysieren. Außerdem werden verschiedene Minimierungs- und Bewertungsstrategien zur Verfügung gestellt. Dabei wird die Software fortwährend mit Daten laufender Experimente wie z.B. BESIII validiert und getestet. In diesem Vortrag wird das neu entwickelte Helizitätsamplituden-Modul vorgestellt, welches unter Verwendung eines Expertensystems die automatische Konstruktion und Berechnung von Helizitätsamplituden erlaubt.

HK 23.4 Di 17:30 S1/01 A5

Rescattering effects for a three-body final state — •Mikhail Mikhasenko and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The isobar model is a phenomenological approach commonly used to describe multiparticle final states as sequential two-body decays into intermediate resonances (isobars), which then decay into the final state observed in the experiment without further interaction. We stress that in presence of a significant inelasticity in the reaction, strong effects of rescattering appear which can produce a resonance-like enhancement in the subchannels as well as in the three body invariant mass. The Khury-Treiman equations inspired by unitarity and analyticity are a powerful tool to investigate the influence of rescattering. We show that the leading order triangle diagram already gives a good approximation to the complete rescattering series. We discuss the effect of rescattering for several examples: the 3π final state related to the $a_1(1420)$ observed by COMPASS and VES experiments, $J/\Psi pK$ related to the recently observed pentaquark candidates and $J/\Psi\pi\pi$ related to exotic XYZ states. The work is supported by BMBF.

HK 23.5 Di 17:45 S1/01 A5

Extraction of the amplitude of the $\pi^+\pi^-$ subsystem in diffractively produced $\pi^-\pi^+\pi^-$ at COMPASS — •Fabian Krinner — Physik-Department E18, Technische Universität München

The two-stage Compass spectrometer has collected a huge data set of tens of millions of events for the channel $\pi^- p \to \pi^-\pi^+\pi^- p$. Therefore, spectroscopy analyses in this channel are dominated by systematic effects. The established method to analyze these data is Partial-Wave Analysis (PWA). For multi-particle final states PWA usually assumes subsequent two-particle decays, i.e. in case of $\pi^-\pi^+\pi^-$ one additional intermediate state which decays into $\pi^+\pi^-$. Fixed mass shapes for this intermediate state, the so-called isobar, have to be assumed. These shapes, which in the most simple case may be given by a Breit-Wigner amplitude, have to be put into the analysis beforehand and therefore may introduce a model dependence leading to increased systematic uncertainties. We present a first analysis of diffractively produced $\pi^-\pi^+\pi^-$ events using a new method, which instead allows to extract binned isobar amplitudes directly from the data in a more model-independent way.

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.

HK 23.6 Di 18:00 S1/01 A5

Modeling of non-resonant Deck-like contributions in diffractive-dissociation reactions at COMPASS — •Dmitri Rybachikov — 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 spectrum of light-meson resonances is studied in diffractive-dissociation reactions using a 190 GeV/c π^- beam. The flagship channel is the $\pi^-\pi^+\pi^-$ final state, for which COMPASS has recorded the currently largest data sample. The extraction of resonances from these data is limited mainly by the understanding of non-resonant components. One of the main non-resonant production mechanisms in this reaction is the Deck effect. We will present studies of a model of the Deck process and compare it to COMPASS data.

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.

HK 24: Heavy Ion Collision and QCD Phases VI

Zeit: Dienstag 16:30–18:00 Raum: S1/01 A01

HK 24.1 Di 16:30 S1/01 A01

Multi-strange Hyperons and Hypernuclei reconstruction at the CBM experiment — •Iouri Vassiliev[1], Ivan Kisel[1,2,3], and Maksim Zyzak[1,2,3] for the CBM-Collaboration — [1]GSI, Darmstadt, Germany — [2]FIAS, Franfurt am Main, Germany — [3]Goethe Universitat, Franfurt am Main, Germany

The main goal of the CBM experiment at FAIR is to study the behaviour 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. In central Au+Au collisions at top SIS100 energies the nuclear fireball will be compressed, according to transport model calculations, to more than 8 times saturation density ρ_0. At such densities, the nucleon will start to melt and to dissolve into their constituents. The calculations predict that the dense fireball spend a relatively long time within the phase coexisting region. This is especially well suited for generating signals of the phase transition. 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. Results of feasibility studies of the multi-strange hyperons, hypernuclei and dibaryons in the CBM experiment will be presented.

HK 24.2 Di 16:45 S1/01 A01

Σ hyperons reconstruction by the missing mass method — Ivan Kisel[1,2,3], •Pavel Kisel[1,3,4], Peter Senger[3], Iouri Vassiliev[3], and Maksym Zyzak[1,2,3] 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 the CBM experiment is a comprehensive study of the QCD phase diagram in a region of Qaurk-Gluon Plasma (QGP) and possible phase transition to the QGP phase.

One of the expected signals of QGP formation is enhanced strangeness production. Being abundant particles, Σ^+ and Σ^- carry out a large fraction of produced strange quarks. Therefore, reconstruction of Σ hyperons completes the picture of strangeness production.

Σ^+ and Σ^- have all decay modes with at least one neutral daughter. However, these particles have a lifetime sufficient to be registered by the tracking system: $c\tau$ = 2.4 cm for Σ^+ and $c\tau$ = 4.4 cm for Σ^-. For their identification the missing mass method is proposed to be applied. The method allow to obtain a large efficiency in the level of several percents together with a high signal to background level.

HK 24.3 Di 17:00 S1/01 A01

Λ and K^0_S Reconstruction in Au+Au Collisions at 1.23A GeV with HADES — •Timo Scheib for the HADES-Collaboration — Goethe-Universität, Frankfurt

We use a high statistic data sample of 7.3x10^9 recorded Au(1.23A GeV)+Au events to investigate Λ baryon and K^0_S meson production below their free nucleon-nucleon threshold. Both particles have never been observed below their NN threshold in heavy-ion collisions before. We highlight details of the analysis procedure such as event selection, particle identification and topological cuts on the decay kinematics before presenting and discussing the transverse energy spectra as well as production yields and their rapidity dependence.

This work has been supported by BMBF (05P12RFGHJ, 05P15RFFCA), GSI and HIC for FAIR.

HK 24.4 Di 17:15 S1/01 A01

Nachweis von Σ^0 - Hyperonen in p + Nb Stößen* — Laura Fabbietti, Jürgen Friese und •Tobias Kunz für die HADES-Kollaboration — Physik Department, Technische Universität München

Im HADES-Experiment an der GSI Darmstadt wurde in der Reaktion p + Nb bei E = 3.5 GeV u.a. auch die Strangeness Produktion detailliert analysiert. Ein interessanter Aspekt ist dabei der Anteil an Λ^0-Hyperonen, die durch den Zerfall primär erzeugter Σ^0-Teilchen entstehen. Wir haben versucht, in den aufgezeichneten $4,2 \cdot 10^9$ Ereignissen Σ^0 Kandidaten durch den Zerfall $\Sigma^0 \to \Lambda\gamma \to p\pi^- e^+ e^-$ zu identifizieren. In dem Datensatz mit insgesamt 1,1 $\cdot 10^6$ rekonstruierten Λs wurden etwa 1000 koinzidente Elektronen-Paare nachgewiesen. In dem Vortrag wird der aktuelle Stand der Analyse von Experiment- und Simulationsdaten vorgestellt.

* Unterstützt durch das Excellence Cluster Universe

HK 24.5 Di 17:30 S1/01 A01

K* dynamics in heavy-ion collisions — •Andrej Ilner, Daniel Cabrera, and Elena Bratkovskaya — Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

The dynamics of strange vector meson resonances (K* and anti-K*) in heavy-ion collisions is studied within the off-shell microscopic Parton-Hadron-String Dynamics (PHSD) transport approach. In-medium modification of the(anti-)K* properties in hot and dense environment is accounted for the production of resonances at hadronisation as well as at the hadronic (anti-)K + pion reactions. We investigate the influence of the in-medium effects on the final experimental observables. Since experimentally K*'s resonances are reconstructed via their decay to kaons and pion, we study the "distortion" of the true K*'s spectra by hadronic rescattering and absorption of the decay particles (K's and pions) at relativistic energies.

HK 24.6 Di 17:45 S1/01 A01

Hypertriton production in Pb–Pb collisions with ALICE at the LHC — •Lukas Kreis for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt

The ALICE experiment at the CERN LHC is devoted to the study of nucleus–nucleus collisions at the highest energies ever reached in the laboratory. The excellent particle identification allows to discern particles in a wide range of mass. The secondary vertices can be reconstructed within the Inner Tracking System. These capabilities enable the study of light hypernuclei in heavy-ion collisions. In this talk the ongoing investigation of hypertriton and anti-hypertriton production in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV is presented, following the previous analysis at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. The decay products are identified based on their specific energy loss in the Time Projection Chamber. The ${}^3_{\Lambda}\mathrm{H}$ and ${}^3_{\Lambda}\overline{\mathrm{H}}$ are reconstructed using the invariant mass of ${}^3\mathrm{He}$ and π^- and ${}^3\overline{\mathrm{He}}$ and π^+, respectively.

HK 25: Heavy Ion Collision and QCD Phases VII

Zeit: Dienstag 16:30–18:00 Raum: S1/01 A4

Gruppenbericht HK 25.1 Di 16:30 S1/01 A4

A Bayesian approach to particle identification in ALICE — •Jeremy Wilkinson for the ALICE-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg

Particle identification (PID) is one of the major strengths of the ALICE detector at the LHC, and provides essential insight into quark-gluon plasma formation in heavy-ion collisions. PID is most effective when complementary identification techniques (such as specific energy loss in the Time Projection Chamber, or flight times measured by the Time Of Flight detector) are combined, however with standard PID techniques it can be difficult to combine these signals, especially when detectors with non-Gaussian responses are used.

Here, an alternative probabilistic PID approach based on Bayes' theorem will be presented. This method facilitates the combination of different detector technologies based on the combined probability of a particle type to produce the signals measured in various detectors. The Bayesian PID approach will be briefly outlined, and benchmark analyses will be presented for high-purity samples of pions, kaons, and protons, as well as for the two-pronged decay $\mathrm{D}^0 \to \mathrm{K}^-\pi^+$, comparing the performance of the standard PID approach with that of the Bayesian approach. Finally, prospects for measuring the Λ_c baryon in the three-pronged decay channel $\Lambda_\mathrm{c}^+ \to \mathrm{pK}^-\pi^+$ will be presented.

HK 25.2 Di 17:00 S1/01 A4

Performance of centrality determination in heavy-ion collisions with CBM experiment — •Viktor Klochkov and Ilya Selyuzhenkov for the CBM-Collaboration — GSI, Darmstadt

The goal of the CBM experiment at FAIR is to investigate the properties of compressed baryonic matter. The measurement of physics observables in heavy-ion collisions requires information about event geometry. A magnitude of the impact parameter, which is among the most important parameters to describe collision geometry, cannot be measured directly in experiment. One can estimate it by measuring produced particle's multiplicities or energy of the spectator fragments. Typically, the collisions are divided into centrality classes which corresponds to the ranges of impact parameter with e.g. centrality class 0-5% corresponds to most central events, and 95-100% to the most peripheral collisions. Sensitivity to the range of impact parameters with the Silicon Tracking System (STS) and Projectile Spectator Detector (PSD) to select centrality classes in the CBM experiment will be presented. The STS is measuring the multiplicity of the particles produced in the nuclei overlap zone and different areas of the PSD are sensitive to both spectator fragments and produced particles.

Supported by the GSI Helmholtzzentrum für Schwerionenforschung.

HK 25.3 Di 17:15 S1/01 A4

Flow harmonics in Au-Au collisions at 1.23 AGeV with HADES — •Behruz Kardan and Christoph Blume for the HADES-Collaboration — Goethe-Universiät, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron and hadron production in heavy-ion collisions with unprecedented precision. With the high statistics of seven billion Au-Au collisions at 1.23 AGeV recorded in 2012 the investigation of higher-order flow harmonics is possible for the first time at these energies.

Collective flow phenomena are a sensitive probe for the properties of extreme QCD matter. However, their interpretation relies on the understanding of the initial conditions, e.g. the eccentricity of the nuclear overlap region. Based on Glauber Monte Carlo calculations the primordial anisotropic configuration of the colliding nuclei is examined. Event-by-event flow observables and their fluctuations are deduced and compared with measured data. Besides the standard event-plane method, these analyses apply different methods such as Scalar Product, Lee-Yang Zeroes and Cumulants. Furthermore multi-particle azimuthal correlation technique can be utilized to disentangle the contributions from collective and from non-flow processes involved in the dynamical evolution of heavy-ion reactions.

Supported by BMBF (05P15RFFCA), HGS-HIRe, H-QM, GSI and HIC for FAIR.

HK 25.4 Di 17:30 S1/01 A4

Physics performance studies with the CBM-TRD — •Julian Book for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

The CBM Experiment at SIS100 will provide unique capabilities to study strongly interacting matter at extreme densities. It might allow to locate the chiral and deconfinement phase transition in this energy regime.

The electron-setup of the CBM experiment is composed of a ring-imaging Cherenkov detetcor (RICH), followed by four layers of transition radiation detectors (TRD) and a time-of-flight detector (TOF). They will provide the necessary particle identification to study low-mass vector mesons and thermal radiation in the intermediate mass range (1-3 GeV/c^2) mediated via dielectron pairs at central rapdity ($|y| < 1.5$). In addition, the TRD contributes to the analysis of J/ψ decaying into two electrons by suppression of pions, which will allow to study J/ψ production near threshold. The unique capabilities to identify fragments via the $\mathrm{d}E/\mathrm{d}x$-measurement provided by the TRD allows the investigation of hyper-nuclei such as the ${}^6_{\Lambda\Lambda}\mathrm{He}$.

After a brief description of the apparatus, the performance of the TRD in central Au+Au collisions at $\sqrt{s_{\mathrm{NN}}} = 4.11$ GeV and p+Au collsions at $\sqrt{s_{\mathrm{NN}}} = 7.62$ GeV will be shown.

HK 25.5 Di 17:45 S1/01 A4

Kalman filter based approach for reconstruction of short-lived particles — •Maksym Zyzak[1,2,3] and Ivan Kisel[1,2,3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Frankfurt Institute for Advanced Studies — [3]Goethe-Universität Frankfurt

Today the most interesting physics of the heavy-ion experiments is hidden in the properties of short-lived particles, that can be reconstructed only through their decay products — daughter particles. Short-lived particles that have a very small production probability or small branching ratio of the channel, which is suitable for registration, are usually of the particular interest.

In order to process accurately events of the experiment interest, the algorithms for particles reconstruction should be efficient, that requires precise mathematical estimations. The KF Particle package for the CBM experiment, which is based on the Kalman filter method, provides rich and mathematically correct functionality for reconstruction of decays. It allows to obtain physical parameters of the particle as well as their errors. Also, KF Particle contains the mass and topological constraints, which are of the particular importance for reconstruction of decay trees like multi-strange hyperons and resonances.

HK 26: Fundamental Symmetries

Zeit: Dienstag 16:30–18:30 Raum: S1/01 A02

Gruppenbericht HK 26.1 Di 16:30 S1/01 A02

The *a*SPECT experiment - an overview and latest results — •Alexander Wunderle for the aSPECT-Collaboration — Johannes Gutenberg-Universität Mainz

The *a*SPECT retardation spectrometer measures the $\beta - \nu$ angular correlation coefficient a in free neutron β-decay. This measurement can be used to determine the ratio $\frac{g_A}{g_V}$ of the weak coupling constants, as well as to search for physics beyond the Standard Model.

In spring/summer 2013 *a*SPECT had a successful beam time at the Institut Laue-Langevin. The goal of this beam time is to improve the current uncertainty of a from $\frac{\Delta a}{a} \sim 5\%$ to about 1%. The data analysis is in its final stage and will be finished soon. In order to achieve an uncertainty of 1%, the systematics of *a*SPECT have to be understood accordingly. This understanding is obtained from systematic tests and measurements of a with different parameter settings for the spectrometer during the beam time. Additionally, offline measurements have been performed to determine the effect on the systematics, e.g. work-function fluctuations of the electrodes, the magnetic field ratio of the spectrometer and detailed tests of the detector electronics. These measurements are used as input for sophisticated simulations of the spectrometer to understand and reduce the systematic uncertainties further.

In this talk we will present an overview of *a*SPECT and its measuring principle. The beam time 2013 will be presented in detail, including the current status of the data analysis and preliminary results for systematic effects and their uncertainties.

HK 26.2 Di 17:00 S1/01 A02

The neutron lifetime experiment τSPECT — •Marcus Beck[1,2], Klaus Eberhardt[1,2], Christopher Geppert[1], Jan Haack[1], Werner Heil[1], Jan Kahlenberg[1], Jan Karch[1], Sergey Karpuk[1], Fabian Kories[1], Kim Ross[1], Christian Siemensen[1], Yuri Sobolev[1], and Norbert Trautmann[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz

The decay of the free neutron into a proton, electron and antineutrino is the prototype of semi-leptonic weak decays and plays a key role in particle physics and astrophysics.

The most precise measurements of the neutron lifetime to date use ultra-cold neutrons (UCN) stored in material vessels. Their accuracy is limited by systematic errors, mainly caused by anomalous losses of UCN during storage at the vessel walls. With the magnetic storage of neutrons these systematic limitations can be avoided and an accuracy of 0.1-0.3 s for the lifetime of the neutron can be reached.

The neutron lifetime experiment τSPECT has been set up a the research reactor TRIGA Mainz. τSPECT uses a combination of magnetic multipole fields for radial storage and the superconducting aSPECT magnet for longitudinal storage of UCN. In this presentation, the status of τSPECT and the results of first commissioning measurements will be presented.

HK 26.3 Di 17:15 S1/01 A02

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

Neutron beta decay is the simplest semileptonic weak decay and described accurately by the standard model using the first CKM-matrix element, Vud, and the ratio of vector and axial vector couplings, λ, as parameters. Kinematic correlation coefficients, spectra and the neutron lifetime are accessible experimantally, 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 determanitaion of Vud from neutron beta decay. Moreover a precise measurement of λ allows to derive limits on non-standard-model couplings by combining with measurements of other observables.

In this talk we present the neutron decay spectrometer Perkeo III and results of the currently most precise measurement of the beta asymmetry. This measurement was carried out at the PF1B cold neutron beam line at the Institut Laue-Langevin.

HK 26.4 Di 17:30 S1/01 A02

Measurement of the Proton Asymmetry with PERKEO III - First Results — •Lukas Raffelt[1,2], Christoph Roick[1], Michael Klopf[3], Heiko Saul[3,5], Wilfried Mach[3], Daniel Moser[3,4], Hartmut Abele[3], Gertrud Konrad[3,6], Bastian Märkisch[1], Ulrich Schmidt[2], and Torsten Soldner[4] — [1]Technische Universität München, Garching — [2]Physikalisches Institut, Heidelberg — [3]Atominstitut, Wien — [4]Institut Laue-Langevin, Grenoble, Frankreich — [5]FRM-II, Garching — [6]SMI, ÖAW, Wien

Precision measurements of angular correlation coefficients in neutron beta decay allow tests of the Standard Model and a determination of the ratio of coupling constants $\lambda = g_A/g_V$ of the weak interaction.

In our last beamtime in 2014/15 we measured the proton asymmetry C with the instrument PERKEO III at the ILL (Grenoble). This will provide a crosscheck of other measurements of several neutron decay correlation coefficients and might be sensitive to contributions of scalar and tensor interactions. Currently the only precision measurement of the proton asymmetry has been performed in 2008 with PERKEO II.

The new spectrometer with an improved detector concept and operation with a pulsed beam allows for an in depth analysis of systematic effects. Electrons and protons from the decay were measured in a combined detector. The protons are converted to secondary electrons using thin foils at high voltage.

This talk will present first results of the ongoing data analysis with focus on the systematic effects of the proton detection.

HK 26.5 Di 17:45 S1/01 A02

Status of the PERC experiment on neutron beta decay — •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, 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 CKM matrix element Vud.

In this talk we will present the status of the new instrument PERC (Proton Electron Radiation Channel), which is currently under construction at the FRM II, Garching, by an international collaboration. PERC is designed to improve measurements of several correlation coefficients in neutron decay by an order of magnitude.

HK 26.6 Di 18:00 S1/01 A02

Characterisation of work function fluctuations for high-precision experiments — •Jan Kahlenberg[1], Martin Babutzka[2], Marcus Beck[1,3], Edward Bickmann[1], Werner Heil[1], Ernst W. Otten[1], Christian Schmidt[1], Kerstin Schoenung[2], and Alexander Wunderle[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Karlsruher Institut für Technologie — [3]Helmholtz-Institut Mainz

For a wide range of high-precision experiments in physics, well-defined electric potentials for achieving high measurement accuracies are required. An accurate determination of the electric potential is crucial for the measurement of the neutrino mass (KATRIN) as well as the measurement of the $e^- - \bar{\nu}_e$ correlation coefficient a in free neutron decay (aSPECT). Work function fluctuations on the electrodes lead to uncertainties in the distribution of the electric potential.

For aSPECT, the electric potential has to be known at an accuracy of 10 mV. However, due to the patch effect of gold, work function fluctuations of several 100 meV can occur. Therefore, the work function distributions of the gold-plated electrodes have been measured using a Kelvin probe. Furthermore, the change of work function distributions over time as well as the influence of relative humidity on the work function measurement have been investigated.

HK 26.7 Di 18:15 S1/01 A02

Extraction of moments of net-particle event-by-event fluctuations in the CBM experiment — •Volodymyr Vovchenko[1,2,3] and Ivan Kisel[1,2] for the CBM-Collaboration — [1]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [2]Goethe University, Frankfurt am Main, Germany — [3]Taras Shevchenko University, Kyiv, Ukraine

The future CBM experiment at FAIR will employ high intensity beams and large acceptance detectors in order to study the properties of the strongly interacting matter produced in heavy-ion collisions at high baryon densities. The search for the conjectured critical point of QCD is one the important tasks. It is predicted from statistical physics that higher moments of event-by-event fluctuations are very sensitive to the proximity of the critical point. This argument is explicitly demonstrated with the van der Waals equation of state. Thus, it was suggested that higher moments of fluctuations of conserved charges can be used as probes for the critical behavior.

The statistical convergence of cumulants of different order is explored. The extraction of scaled variance, skewness, and kurtosis of proton distribution from simulated UrQMD events is performed and the efficiency correction described by binomial distribution is accounted for. The validity of this correction is tested with different modelings of the CBM detector response: from binomial distribution with fluctuating event-by-event efficiency to a full-scale GEANT simulation. The obtained results indicate that a more elaborate efficiency correction is needed in order to accurately reconstruct moments of higher orders.

HK 27: Structure and Dynamics of Nuclei VI

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A03

Gruppenbericht HK 27.1 Di 16:30 S1/01 A03

Results of the latest EXL campaign — •Mirko von Schmid for the EXL E105-Collaboration — Institut für Kernphysik, TU Darmstadt

EXL (**EX**otic nuclei studied in **L**ight-ion induced reactions at storage rings) is a project within NUSTAR at FAIR. It aims for the investigation of light-ion induced direct reactions in inverse kinematics with radioactive ions in storage rings at the future FAIR facility.

The existing ESR at GSI, together with its internal gas-jet target, provides the unique opportunity to perform this kind of experiments on a smaller scale already today. With a detector setup developed specifically for this experiment, we successfully investigated nuclear reactions with a stored radioactive beam for the very first time. As a part of the first EXL campaign we investigated the reaction ^{56}Ni(p, p)^{56}Ni in order to measure the differential cross section for elastic proton scattering and deduce the nuclear matter distribution and the radius of ^{56}Ni. Furthermore, as a feasibility study, we excited the GMR of ^{58}Ni by utilizing the ^{58}Ni(α, α')^{58}Ni reaction.

The results of this campaign and the current status of the project will be presented in this contribution.

This work was supported by BMBF (06DA9040I, 05P12RDFN8, 05P15RDFN1), the European Community FP7-Capacities, contract ENSAR № 262010, HIC for FAIR, GSI-RUG/KVI collaboration agreement and TU Darmstadt-GSI cooperation contract.

Gruppenbericht HK 27.2 Di 17:00 S1/01 A03

Status and Outlook of the FRS Ion Catcher at GSI — •Jens Ebert — Justus-Liebig-Universität Gießen

Exotic nuclei are produced in stellar processes like the p- and r-process and are essential for our understanding of nucleosynthesis beyond iron. They have an unusual ratio of neutrons to protons and short half-lives in common. Important production methods for exotic nuclei in the laboratory are projectile fragmentation and fission of heavy ions. Nuclei produced this way have energies up to several GeV/u and must be slowed down and separated from other beam products and contaminants for high-accuracy low-energy experiments with traps and lasers. This is tested by the FRS Ion Catcher, which is a test bench for the low energy branch of the Super-FRS at FAIR. There, the nuclei are separated in-flight, range-bunched, slowed-down in the fragment separator and subsequently thermalized in a cryogenic stopping cell. The ions extracted from the stopping cell will be transported to a multiple-reflection time-of-flight mass spectrometer for high accuracy mass measurements, decay spectroscopy or separation and preparation for further experiments.

A novel technical method allows mass measurements of nuclides with half-lifes of about 1ms such as ^{215}Po. From our online campaign in 2014 almost background-free α-spectroscopy, mass selected decay spectroscopy and measurements of excitation energies and isomeric ratios will be presented together with instrumental advances.

HK 27.3 Di 17:30 S1/01 A03

Twenty-five New Mass Values from Measurements Performed with Isochronous Mass Spectrometry — •Marcel Diwisch[1], Ronja Knöbel[1,2], Zygmunt Patyk[3], Hans Geissel[1,2], Wolfgang R. Plass[1,2], Christoph Scheidenberger[1,2], and Helmut Weick[2] for the FRS-ESR-Collaboration — [1]Justus-Liebig-Universität Gießen, Germany — [2]GSI, Darmstadt, Germany — [3]National Centre for Nuclear Research - NCBJ Swierk, Warszawa, Poland

Masses of uranium fission fragments have been measured with the FRS-ESR facility at GSI. In order to increase the mass resolving power and particle identification for non-isochronous particles, $B\rho$-tagging was applied in one out of two experiments. A new method of data analysis, using a correlation matrix for the combined data set from the two experiments, has provided reliable experimental mass values for 25 different neutron-rich isotopes for the first time. The new masses were obtained for nuclides in the element range from Ge to Ce. The results have been compared with theoretical predictions. At the neutron shell N=82 the comparison of experimental data for tin and cadmium isotopes show both strong shell effects in agreement with spectroscopy experiments and modern shell-model calculations.

HK 27.4 Di 17:45 S1/01 A03

Isotope shift measurements in the D2-transition of neutron-rich Ca-isotopes using the ROC technique at COLLAPS — •Christian Gorges for the COLLAPS-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

Calcium isotopes have been of great interest in nuclear physics for decades because of its two stable doubly magic nuclei within the isotopic chain. Recently, this has been revived by experiments revealing possible new shell closures at $N = 32$ and $N = 34$ [1]. The $4s\ ^2S_{1/2} \rightarrow 4p\ ^2P_{3/2}$ transition (D2) is sensitive to the quadrupole moments of the odd isotopes and is therefore the preferred transition for studies of short-lived isotopes as they were recently reported up to $^{52}Ca^+$ [2] using optical fluorescence detection. To extend the investigations further towards ^{54}Ca a more sensitive approach is required. Hence, we have adapted the COLLAPS collinear laser beamline at ISOLDE for the application of β-decay detection after optical pumping and state-selective neutralization (ROC) [3].

[1] D. Steppenbeck et al., Nature 502, 207 (2013)
[2] R. F. Garcia Ruiz et al., Phys. Rev. C 91, 041304(R) (2015)
[3] L. Vermeeren et al., Phys. Rev. Lett 68, 1679 (1992)

HK 27.5 Di 18:00 S1/01 A03

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.
Isomeric ratios and excitation energies of isomers of short-lived exotic nuclei can be determined at the FRS Ion Catcher at GSI. At the FRS, projectile and fission fragments are produced at relativistic energies, separated in-flight and range-focused. They are slowed down and thermalized in a cryogenic stopping cell. In a multi-purpose RFQ beamline alpha spectroscopy can be performed. Alternatively the ions can be transported to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), where masses of the ground and isomeric states can be measured simultaneously with high resolving power. The MR-TOF-MS can also be used to spatially separate the ions in order to provide isomerically clean ion beams.
During a recent experiment isomer-to-ground state ratios and excitation energies of uranium projectile and fission fragments produced at 1 GeV/u were measured. The ratios, measured with the MR-TOF-MS, were verified by alpha spectroscopy. Furthermore the ratios were compared to calculations based on an abrasion-ablation model of fragmentation.

HK 28: Structure and Dynamics of Nuclei VII

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A04

Gruppenbericht HK 28.1 Di 16:30 S1/01 A04

The low-lying collective multipole response of atomic nuclei — •Mark Spieker[1], Vera Derya[1], Andreas Hennig[1], Pavel Petkov[1,2,3], Simon G. Pickstone[1], Sarah Prill[1], Vera Vielmetter[1], Michael Weinert[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)

We present experimental results on the low-lying multipole response, which were obtained with the recently established DSA-method in Cologne [1]. Nuclear level lifetimes in the sub-ps regime are extracted by means of centroid-shifts utilizing the $(p, p'\gamma)$ reaction at the 10 MV FN-Tandem accelerator in Cologne [1,2]. The scattered protons are coincidently detected with the deexciting γ rays using the SONIC@HORUS detector array, which allows for a precise determination of the reaction kinematics. In addition to the pioneering results on octupole and hexadecapole mixed-symmetry states of ^{96}Ru [2], this contribution will feature new results on low-lying quadrupole-octupole coupled states and on the low-lying $E2$ strength of ^{112,114}Sn, which was recently discussed to be generated due to a quadrupole-type oscillation of the neutron skin against the isospin-saturated core [3]. Supported by the DFG (ZI-510/7-1). M.S., S.G.P., S.P., and J.W. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy. [1] A. Hennig et al., NIM A **758**, 171 (2015), [2] A. Hennig et al., PRC **90**, 051302(R) (2014), [3] M. Spieker et al., PLB **752**, 102 (2016)

HK 28.2 Di 17:00 S1/01 A04

Pygmy quadrupole resonance as a manifestation of the nuclear skin — •Nadia Tsoneva[1,2] and Horst Lenske[2] — [1]Frankfurt Institute for Advanced Studies (FIAS), 60438 Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gieβen, Germany

Recently, a new mode of nuclear excitation called pygmy quadrupole resonance (PQR) was theoretically predicted in the framework of energy-density functional (EDF) theory plus three-phonon quasiparticle-phonon model (QPM) in Sn isotopic chain. It is closely connected with higher order multipole vibrations of nuclear skin induced by the action of the electromagnetic and hadronic external fields. The predictions initiated new experiments using $(^{17}O,^{17}O'\gamma)$, $(\alpha, \alpha'\gamma)$ and (γ, γ') reactions which were carried out in ^{124}Sn nucleus. The aim was to probe for the first time experimentally, the possibility of existence of PQR. The detailed analysis of the obtained experimental results in comparison with the EDF+QPM theory indicates clearly the presence of a multitude of discrete low-energy 2^+ excitations of neutron type which can be addressed to PQR mode. The independent measurements of B(E2) values with different probes and the theory allow to identify the dominant isoscalar character of these states. Furthermore, newly determined γ-decay branching ratios exclude a statistical origin of the PQR strength. The latter are important to discriminate between PQR and multiphonon excitations.
The work is supported by the HIC for FAIR within the framework of the LOEWE program.

HK 28.3 Di 17:15 S1/01 A04

Niveaudichte und Gammastärkefunktion von ^{208}Pb* — •Sergej Bassauer und Peter von Neumann-Cosel — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Die totale Niveaudichte sowie die Gammastärkefunktion inklusive der E1-, E2- und M1-Beiträge für den Kern ^{208}Pb wurden bestimmt. Diese basieren auf Daten aus polarisierter inelastischer Protonenstreuung, die in einem Anregungsenergiebereich zwischen 5 und 20 MeV am Research Center for Nuclear Physics (RCNP), Osaka, Japan aufgenommen wurden, sowie anderen Experimenten [1,2,3]. Die Ergebnisse werden mit experimentellen Daten anderer Gruppen [4] sowie mit theoretischen Modellen verglichen [5,6,7].
*Gefördert durch die DFG im Rahmen des SFB 1245.

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HK 28.4 Di 17:30 S1/01 A04

Wavelet and fluctuation analysis of ^{120}Sn and ^{90}Zr(p,p') reaction data — •Andreas Ebert[1], Anna Maria Krumbholz[1], Chihiro Iwamoto[2], Peter von Neumann-Cosel[1], and Atsushi Tamii[2] — [1]Institut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Physics, Osaka

In the recent years the wavelet analysis has been established as a tool in nuclear structure physics. For an analysis of the fine structure in the energy region of giant resonances the Discrete [1] and Continous Wavelet Transform [2] allows the determination of a phenomenological background and the extraction of characteristic scales, respectively, from scattering data. Furthermore a fluctuation analysis [3] provides spin- and parity-resolved level densities. Data on the Giant Dipole Resonance from ^{120}Sn and ^{90}Zr(p,p') reactions performed with a 295 MeV beam scattered under zero degrees at the Research Center for Nuclear Physics (RCNP) in Osaka/Japan [4,5,6] are analyzed. The extracted scales and level densities are compared with various theoretical predictions and decay mechanisms are identified.
*Supported by the DFG through SFB 1245.
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HK 28.5 Di 17:45 S1/01 A04

The electric dipole response of neutron rich tin isotopes — •Andrea Horvat[1], Thomas Aumann[1], Konstanze Boretzky[2], Jacob Johansen[3], Dominic Rossi[1], Fabia Schindler[1], and Philipp Schrock[4] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Aarhus University, Denmark —

[4]The University of Tokyo, Japan

Studies of the dipole response in medium heavy and heavy neutron rich nuclei reveal valuable information about the isospin dependence of the nuclear equation of state. Therefore an experimental campaign investigating both the electric dipole response via Coulomb excitation and neutron removal along the tin isotope chain ($^{124-134}$Sn) has been carried out at the R3B (Reactions with Relativistic Radioactive Beams) setup at GSI (Helmholtzzentrum für Schwerionenforschung) for which the analysis is ongoing.

The E1 response was induced via relativistic Coulomb scattering by a lead target in inverse kinematics, and calls for a kinematically complete determination of all reaction products in order to reconstruct the excitation energy by means of the invariant mass method. The goal is to obtain the Coulomb excitation cross section up to the adiabatic cut-off energy, covering the giant dipole resonance (GDR) range.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, NAVI and the BMBF project 05P15RDFN1.

HK 28.6 Di 18:00 S1/01 A04

Nuclear reactions of neutron-rich Sn isotopes investigated at relativistic energies at R^{3}B — •Fabia Schindler[1], Thomas Aumann[1], Konstanze Boretzky[2], Philipp Schrock[3], Andrea Horvat[1], 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 of neutron-rich matter.

Assuming a geometrical description of reaction processes as in the eikonal approximation, nuclear-induced reactions are a good tool to probe the neutron skin. 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.

For this purpose, reactions of neutron-rich tin isotopes in the A=124-134 mass range have been measured on a carbon target at the R^{3}B-setup at GSI in inverse kinematics in a kinematically complete manner. Preliminary results for the reaction cross sections of ^{124}Sn will be presented.

This work is supported by HIC for FAIR, the GSI-TU Darmstadt cooperation, NAVI and the BMBF project 05P15RDFN1.

HK 29: Instrumentation VII

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A2

HK 29.1 Di 16:30 S1/01 A2

FPGA helix tracking algorithm for PANDA — •Yutie Liang[1], Martin Galuska[1], Thomas Gessler[1], Wolfgang Kühn[1], Jens Sören Lange[1], David Münchow[1], and Hua Ye[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut, University of Giessen — [2]Institute of High Energy Physics, CAS, China

The PANDA detector is a general-purpose detector for physics with high luminosity cooled antiproton beams, planed to operate at the FAIR facility in Darmstadt, Germany. The central detector includes a silicon Micro Vertex Detector (MVD) and a Straw Tube Tracker (STT). Without any hardware trigger, large amounts of raw data are streaming into the data acquisition system. The data reduction task is performed in the online system by reconstruction algorithms programmed on FPGAs (Field Programmable Gate Arrays) as first level and on a farm of GPUs or PCs as a second level. One important part in the system is the online track reconstruction. In this presentation, an online tracking algorithm for helix tracking reconstruction in the solenoidal field is shown. The VHDL-based algorithm is tested with different types of events, at different event rate. Furthermore, a study of T0 extraction from the tracking algorithm is performed. A concept of simultaneous tracking and T0 determination is presented.

* This work was supported in part by BMBF (05P12RGFPF), the LOEWE-Zentrum HICforFAIR and the JCHP FFE(COSY-099).

HK 29.2 Di 16:45 S1/01 A2

The Prototype Triggerless Data Aquisition of the PANDA Experiment — •Milan Wagner, Simon Reiter, Sören Lange, and Wolfgang Kühn for the PANDA-Collaboration — II. Physikalisches Institut

The PANDA detector will operate with a very high interaction rate of up to 20 MHz, in a free streaming mode without hardware trigger. Data filtering will be performed by complete online event reconstruction with a highly parallelized farm of FPGAs as first level and on a farm of GPUs or PCs as a second level. The requirement is a back- ground reduction by a factor of >1000. A prototype trigger-less data acquisition (PTDAQ) system for the detector validation measurements comprises free streaming and synchronization readout, for event building and filtering has been developed. A first in beam environment test was performed at the Mainzer Mikrotron, reading out the barrel electromagnetic calorimeter prototype (Proto120). *This work is supported by BMBF(05P12RGFPF), HGS-HIRe for FAIR and the LOEWE-Zentrum HIGforFAIR.

HK 29.3 Di 17:00 S1/01 A2

A test system for electronics components of the PANDA MVD. — •Alessandra Lai, Tobias Stockmanns, and James Ritman for the PANDA-Collaboration — Forschungszentrum Juelich

The PANDA experiment is one of the main devices at the upcoming Facility for Antiproton and Ion Research(FAIR), under construction in Darmstadt, Germany. This fixed target experiment will study the transition region between perturbative and non-perturbative QCD in the energy regime of the charmonium. The innermost sub-detector system of the target spectrometer of the PANDA experiment is the Micro Vertex Detector(MVD). Two types of silicon detectors will be used: pixel detectors and double-sided strip detectors. Two front-end chips are required: the Torino Pixel ASIC(ToPix) and the PANDA Strip ASIC(PASTA). Both are designed to transmit data at a rate of several hundred Megabits per second and are capable of handling the expected hit rate in hot spots of the detector. One key component in the development of new front-end electronics is a test system capable to handle these high rates. It should be flexible enough to test different kinds of front-end electronics and it should be easy to adapt to new prototypes. Therefore, an FPGA-based system is the ideal candidate. For this test system suitable firmware and a software framework are needed. Such a system is under development at the Forschungszentrum Jülich. The main component of the Jülich Digital Readout System(JDRS) is a Virtex 6 FPGA on a development board from Xilinx.

In this talk, the mentioned read-out system will be introduced and lab tests with the front-end electronics of the MVD will be presented.

HK 29.4 Di 17:15 S1/01 A2

Evaluation of a feature extraction framework for FPGA firmware generation during a beam-test at CERN-SPS for the CBM-TRD experiment — •Cruz de Jesus Garcia Chavez, Carlos Enrique Munoz Castillo, and Udo Kebschull for the CBM-Collaboration — Infrastructure and Computer Systems in Data Processing (IRI), Goethe University, Frankfurt am Main, Germany

A feature extraction framework has been developed to allow easy FPGA firmware generation for specific feature extraction algorithms in order to find and extract regions of interest within time-based signals. This framework allows the instantiation of multiple well-known feature extraction algorithms such as center of gravity, time over threshold and cluster finder, just to mention a few of them. A graphical user interface has also been built on top of the framework to provide a user-friendly way to visualize the data-flow architecture across processing stages. The FPGA platform constraints are automatically set up by the framework itself. This feature reduces the need of low-level hardware configuration knowledge that would normally be provided by the user, centering the attention in setting up the processing algorithms for the given task more than in writing hardware description code.

During November 2015, a beam-test was performed at the CERN-SPS hall. The presented framework was used to generate a firmware for the SysCore3 FPGA development board used to readout two TRD detectors by means of the SPADIC 1.0 front-end chip. The framework architecture, design methodology, as well as the achieved results during the mentioned beam-test will be presented.

HK 29.5 Di 17:30 S1/01 A2

Overview and Future Developments of the FPGA–based DAQ of COMPASS — Yunpeng Bai[1], Martin Bodlak[2], Vladimir Frolov[3], Vladimir Jary[4], Stefan Huber[1], Igor Konorov[1], Dmytro Levit[1], Josef Novy[3,4], •Dominik Steffen[1,3], and Miroslav Virius[4] — [1]Physik-Department E18, Technische Universität München — [2]Department of Low-Temperature Physics, Charles University Prague — [3]European Organization for Nuclear Research - CERN — [4]Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University

COMPASS is a fixed–target experiment at the SPS accelerator at CERN dedicated to the study of hadron structure and spectroscopy. In 2014, an FPGA–based data acquisition system (FDAQ) was deployed. Its hardware event builder consisting of nine custom designed FPGA–cards replaced 30 distributed online computers and around 100 PCI cards. As a result, the new DAQ provides higher bandwidth and better reliability. By buffering the data, the system exploits the spill structure of the SPS averaging the maximum on–spill data rate of 1.5 GB/s over the whole SPS duty cycle. A modern run control software allows user–friendly monitoring and configuration of the hardware nodes of the event builder. From 2016, it is planned to wire all point–to–point high–speed links via a fully programmable crosspoint switch. The crosspoint switch will provide a fully customizable DAQ network topology between front–end electronics, the event building hardware, and the readout computers. It will therefore simplify compensation for hardware failure and improve load balancing.

HK 29.6 Di 17:45 S1/01 A2

Data acquisition at the BGO-OD experiment — •Daniel Hammann for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment, located at the 3.5 GeV electron accelerator ELSA in Bonn, is investigating photo-production of mesons. It combines a highly segmented electromagnetic calorimeter, covering almost 4π, with an open dipole spectrometer for the forward angles. To acquire the data from the various detectors of the setup, a distributed data acquisition system was set up. A global trigger signal is distributed using a dedicated FPGA based synchronization system. This trigger signal is also used as hardware reference for all time measurements. Offline reconstruction of the trigger logic allows to further improve the time reference in software. An even more precise timing reference can be derived from the ELSA acceleration frequency. A dedicated TDC measures the phase difference between the global trigger signal and the ELSA frequency. With this the knowledge of the event time is only limited by the intrinsic resolution of the TDC and the electron bunch length.

supported by the DFG within the SFB / TR16

HK 29.7 Di 18:00 S1/01 A2

The CBM-STS front-end electronics — •Adrian Rodriguez Rodriguez for the CBM-Collaboration — GSI Helmholtzzentrum fur Schwerionenforschung GmbH

The Silicon Tracking System (STS) of the CBM experiment is based on double-sided silicon microstrip sensors, arranged in 8 tracking stations. It poses the most demanding requirements in terms of readout rates and electronics density of all CBM detectors. The STS-XYTER is a 128 channel, low power, self triggering ASIC which provides timing and energy information for each hit sensor strip. One of the main goals on the chip design is to achieve a low level noise performance (below 1000 e^- rms). The first version of the chip has been tested and characterized in prototype front-end board. The second version of the ASIC is under revision to be submitted in early 2016. An overview of main tests outcomes and an outlook on version 2 will be presented.

*Supported by EU-Horizon2020 CREMLIN and HIC for FAIR.

HK 30: Instrumentation VIII

Zeit: Dienstag 16:30–18:15 Raum: S1/01 A3

Gruppenbericht HK 30.1 Di 16:30 S1/01 A3

Test of Time-Reversal Invariance at COSY — •Yury Valdau[1,2], Dieter Eversheim[1], and Bernd Lorentz[3] — [1]Helmholz Institute für Strahlen- und Kernphysik, University Bonn, Germany — [2]National Research Center "Kurchatov Institute" Petersburg Nuclear Physics Institute B.P. Konstantinov, Gatchina, Leningrad district 188300, Russia — [3]Forschungszentrum Jülich, Institute für Kernphysik, Wilhelm-Johnen-Straße, Jülich, 52425

The experiment to test the Time Reversal Invariance at Cosy (TRIC) is under the preparation by the PAX collaboration. It is planned to improve present limit on the T-odd P-even interaction by at least one order of magnitude using a unique genuine null observable available in double polarized proton-deuteron scattering. The TRIC experiment is planned as a transmission experiment using a tensor polarized deuterium target placed at the internal target place of the Cooler-Synchrotron COSY-Jülich. Total double polarized cross section will be measured observing a beam current change due to the interaction of a polarized proton beam with an internal tensor polarized deuterium target from the PAX atomic beam source. Hence, in this experiment COSY will be used as an accelerator, detector and ideal zero degree spectrometer. In addition to the high intensity polarized proton beam and high density polarized deuterium target, a new high precision beam current measurement system will be prepared for the TRIC experiment. In this report status of all the activities of PAX collaboration towards realization of the TRIC experiment will be presented.

HK 30.2 Di 17:00 S1/01 A3

Precise measurements and shimming of magnetic field gradients in the low field regime — •Fabian Allmendinger[1], Olivier Grasdijk[3], Werner Heil[2], Klaus Jungmann[3], Sergei Karpuk[2], Hans-Joachim Krause[4], Andreas Offenhäuser[4], Maricel Repetto[2], Ulrich Schmidt[1], Yuri Sobolev[2], Lorenz Willmann[3], and Stefan Zimmer[2] for the MIXed-Collaboration — [1]Physikalisches Institut , Universität Heidelberg — [2]Institut für Physik, Universität Mainz — [3]University of Groningen — [4]Peter Grünberg Institut, Forschungszentrum Jülich

For many experiments at the precision frontier of fundamental physics, the accurate measurement and knowledge of magnetic field gradients in particular in the low field regime ($<\mu$T) is a necessity: On the one hand, in the search for an Electric Dipole Moment (EDM) of free neutrons or atoms, field gradients contribute to geometric-phase-induced false EDM signals for particles in traps. On the other hand, clock comparison experiments like the ^{3}He/^{129}Xe spin clock experiment suffer from gradients, since the coherent T_2^*-time of free spin precession, and thus the measurement sensitivity, scales $\propto |\nabla \vec{B}|^{-2}$. Here we report on a new and very effective method, to shim and to measure tiny magnetic field gradients in the range of pT/cm by using effective T_2^*-measurement sequences in varying the currents of trim coils of known geometry.

HK 30.3 Di 17:15 S1/01 A3

Generation of narrow peaks in spectroscopy of charged-particles — •Dirk Dubbers[1] and Ulrich Schmidt[2] — [1]Physikalisches Institut der Universität, INF 226, 69120 Heidelberg — [2]Physikalisches Institut der Universität, INF 226, 69120 Heidelberg

In spectroscopy of charged particles, narrow peaks may appear in initially smooth continuous spectra if magnetic transport of the particles is involved. Such anomalies can occur in all systems with less than 100% geometric detection efficiency. As unexpected peaks may be misinterpreted as new physics, their generation is investigated, both analytically and experimentally, for various detector configurations, including those used in searches for the spontaneous decay of the vacuum in heavy-ion collisions.

HK 30.4 Di 17:30 S1/01 A3

A novel enhanced calibration method for DSSSD detectors — •Levent Kaya, Andreas Vogt, Peter Reiter, Benedikt Birkenbach, Rouven Hirsch, Michael Seidlitz, and Nigel Warr — Institut für Kernphysik, Universität zu Köln

Double-sided silicon strip detectors (DSSSD) are employed for the detection of charged particles in low-energy nuclear physics providing position and energy information for the impinging particle. Intersecting areas of both p- and n-side strips form individual pixel segments allowing for a high detector granularity. However, due to limitation in

fabrication and the response of readout electronics, the performance of different channels may vary. In order to achieve best energy information, a calibration of each p- and n-side strip with a very high precision is mandatory. DSSSD responses are analyzed employing energy correlation matrices between adjacent strips in order to determine charge-sharing and energy-loss effects. A novel calibration method is based on the fact that each event is registered simultaneously on the p- and n-side strips. A two-dimensional calibration procedure allows for a significant enhancement of the energy resolution. In this way, the performance of DSSSDs with position-dependent radiation damage is improved clearly by excluding locally damaged detector areas without losing the information of complete p- or n-side strips. Supported by Bonn-Cologne Graduate School.

HK 30.5 Di 17:45 S1/01 A3

Quantitative detection of microscopic lithium distributions with neutrons — •Giulia Neri[1], Roman Gernhäuser[1], Josef Lichtinger[1], Sonja Winkler[1], Dominik Seiler[1], Michael Bendel[1], Julia Kunze-Liebhäuser[2], Jassen Brumbarov[2], Engelbert Portenkirchner[2], Axel Renno[3], and Georg Rugel[3] — [1]Technische Universität München, Physik-Department, Germany — [2]Institut für Physikalische Chemie, Leopold-Franzens-Universität Innsbruck, Austria — [3]Helmholtz Zentrum Dresden Rossendorf, Helmholtz-Institut Freiberg für Ressourcentechnologie, Germany

The importance of lithium in the modern industrial society is continuously increasing. Spatially resolved detection of tritium particles from ^{6}Li(n,α)^{3}H nuclear reactions is used to reconstruct microscopic lithium distributions. Samples are exposed to a flux of cold neutrons. Emitted charged particles are detected with a PSD. Introducing a pinhole aperture between target and detector, the experimental setup works like a "camera obscura", allowing to perform spatially resolved measurements. Tritium detection analysis was successfully used to reconstruct the lithium content in self-organized TiO_{2-x}-C and Si/TiO_{2-x}-C nanotubes electrochemically lithiated, for the first time. Titanium dioxide nanotubes are a candidate for a safe anode material in lithium-ion batteries. Also lithium distributions in geological samples, so called "pathfinder-minerals" containing lithium, like lepidolite from a pegmatite, were analyzed. With this development we present a new precision method using nuclear physics for material science.

Supported by the DFG (GE 2296/1-1).

HK 30.6 Di 18:00 S1/01 A3

BGO shields for the MINIBALL spectrometer — •Dawid Rosiak and Peter Reiter — Institut für Kernphysik, Universität zu Köln

An enhanced detection sensitivity of the high-resolution MINIBALL spectrometer is required for future experiments at the HIE-ISOLDE accelerator at CERN. These measurements will be based on direct reactions and fusion-evaporation reactions, populating excited nuclei at high excitation energies. Moreover, high angular-momentum transfer will cause higher γ-ray multiplicities. The existing MINIBALL spectrometer with its closely packed eight triple cluster detectors was designed for highest solid-angle coverage, causing best γ-ray efficiency for low-multiplicity events. Therefore the triple-cluster detectors will be surrounded with additional BGO Compton suppression detectors in order to cope with the scattering between detectors from high energetic γ-rays and double hits from higher γ-ray multiplicities. After extended Monte-Carlo studies with a newly developed MINIBALL simulation code based on GEANT4 a final Compton suppression detector geometry for the MINIBALL spectrometer was determined. This additional BGO detectors in combination with the MINIBALL array will improve the peak-to-total ratio up to 50% and cause just a slight reduction from 8.0% to 7.2% in efficiency. In collaboration with the IPN Orsay the first BGO prototype is under construction. The status of the project and first measurements with the newly developed BGO detector will be presented.

HK 31: Hauptvorträge I

Zeit: Mittwoch 11:00–12:30 Raum: S1/01 A1

Hauptvortrag HK 31.1 Mi 11:00 S1/01 A1

Extracting two- and three-particle resonances from the lattice — •Maxwell Hansen — Helmholtz Institut Mainz, Mainz, Germany

The theory of the strong force, QCD, is non-perturbative at low energies. For this reason, numerical techniques are needed to extract the low-lying resonance spectrum from the underlying theory. Lattice QCD offers a numerically tractable non-perturbative method that can be systematically improved to reach reliable physical predictions. However, numerical lattice calculations are necessarily performed in a finite volume and with Euclidean time coordinates. This greatly complicates the calculation of scattering amplitudes, which are needed to study resonances. In this talk I discuss formalism that circumvents these issues, allowing one to rigorously extract scattering observables and determine resonance widths and masses. The approach, based on early work from Martin Lüscher, is to us the finite-volume energy spectrum as the lattice observable, and then map it via non-perturbative formal relations to the desired scattering amplitudes. I will summarize the formal work of Lüscher and its modern extensions and also give examples of how the method has been applied in state-of-the-art calculations.

Hauptvortrag HK 31.2 Mi 11:30 S1/01 A1

Exploring the phase structure and dynamics of QCD — •Jan M. Pawlowski — Heidelberg University, Heidelberg, Germany

The past years have seen tremendous progress in the description of Quantum Chromodynamics at vanishing and finite temperature and density with functional approaches, such as the functional renormalisation group or Dyson-Schwinger equations. Within these approaches QCD correlation functions of quarks, gluon and hadrons are computed non-perturbatively from first principles.

In the present talk I will discuss results for the phase structure of QCD at finite temperature and density, as well as for thermodynamical obserables such as the pressure and the trace anomaly. The approach is also applied to baryon number fluctuations.

By now functional approaches also allow for a direct computation of transport coefficients in QCD. First results concern the temperature dependence of the shear viscosity over entropy ratio in Yang-Mills theory and QCD. The talk concludes with a discussion of the further prospects for our understanding of the phase structure and dynamics of QCD.

Hauptvortrag HK 31.3 Mi 12:00 S1/01 A1

Precision mass measurements and more at ISOLTRAP — •Frank Wienholtz for the ISOLTRAP-Collaboration — Ernst-Moritz-Arndt-Universität, Institut für Physik, Greifswald, Germany

Mass spectrometers at radioactive ion-beam facilities have to cope with ever-more demanding measurement conditions in order to succeed in gathering new data on the binding energy of exotic nuclei. These conditions are also quite diverse, ranging from cases in which the isotopes of interest are only produced in very low yields of some ions per second to others in which the ions of interests, although produced in reasonable quantities, are accompanied by isobaric contaminations several orders of magnitude more abundant. Furthermore, the purification and mass measurement processes have to be fast enough in order to reach exotic isotopes far away from the valley of stability, where half-lives drop well below hundred milliseconds.

The ISOLTRAP setup situated at the ISOLDE facility at CERN has been upgraded throughout the years to handle these extreme situations and determine further unknown binding energies on the way to an increased understanding of nuclear structures. This contribution will present the current status of the setup and with a focus on the most recent results. The topics range from the investigation of the N = 82 shell closure using neutron-rich cadmium masses, which are relevant for the rapid neutron capture process of nucleosynthesis, to nuclear structure studies around the double magic (Z=28, N=50) nucleus Ni-78 by probing exotic Cu isotopes. In addition, new measurements of rubidium, strontium and krypton isotopes in the mass A=100 region will be presented, which shed new light on a well-known shape-transition region of the nuclear chart. As an extension of the standard use of the ISOLTRAP setup, fast and highly selective single-ion counting techniques have been combined recently with the Resonant Ionization Laser Ion Source (RILIS) of ISOLDE. This combination allowed in-source laser-spectroscopy measurements for the study of shape coexistence. The new detection capabilities available at ISOLTRAP as well as recent on-line results will be presented.

HK 32: Hadron Structure and Spectroscopy V

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A4

Gruppenbericht HK 32.1 Mi 14:00 S1/01 A4

Hadron Spectroscopy with COMPASS — •Boris Grube — 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. Their spectrum is investigated in various final states produced in diffractive dissociation or in central-production reactions. The COMPASS data not only allow for measuring the properties of known resonances with high precision, but also for searching for new states. Among these is a new resonance-like signal, the $a_1(1420)$, with unusual properties. In addition, the resonance content of the partial wave with spin-exotic $J^{PC} = 1^{-+}$ quantum numbers, which are forbidden for quark-antiquark states, is of particular interest.

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.

HK 32.2 Mi 14:30 S1/01 A4

Extraction of resonance parameters of light mesons in diffractively produced $\pi^-\pi^+\pi^-$ final states at COMPASS — •Stefan Wallner[1] and Compass Collaboration[2] — [1]TU München E18 — [2]Cern

The COMPASS experiment studies the spectrum of hadrons and has acquired a large data sample of diffractively produced $\pi^-\pi^+\pi^-$ final states using a 190 GeV pion beam on a hydrogen target. The size of the data set permits us to perform a partial-wave analysis in bins of the squared four-momentum transfer t' from the beam to the target with the largest wave set used so far consisting of 88 waves.

Based on this partial-wave decomposition, resonance parameters are extracted by disentangling resonant and non-resonant parts of selected partial-wave amplitudes in resonance-model fits. The additional information obtained from the division of the data into bins of t', allows for a better separation of resonant and non-resonant parts, as they exhibit different t' dependences. Using this approach, the masses and widths of π_J- and a_J-like meson resonances have been extracted by simultaneously fitting a subset of selected partial waves. We will present this powerful analysis scheme and a selection of results.

HK 32.3 Mi 14:45 S1/01 A4

Light Meson Decays in `CLAS` and `CLAS12` — •Michael Kunkel — Forschungszentrum Jülich — CLAS Collaboration

Photoproduction experiments with the CEBAF Large Acceptance Spectrometer (`CLAS`) at the Thomas Jefferson National Facility produce data sets with competitive statistics of light mesons. With these data sets, measurements of transition form factors for η, ω, and η' mesons via conversion decays can be performed using the invariant mass distribution of the final state dileptons. Tests of fundamental symmetries and information on the light quark mass difference can be performed using a Dalitz plot analysis of the meson decay. An overview of preliminary results, from existing `CLAS` data, and future prospects within the newly upgraded `CLAS12` apparatus are given.

HK 32.4 Mi 15:00 S1/01 A4

Search for the rare π^0 decay into 3 photons at MAMI — •Jennifer Wettig and Wolfgang Gradl for the A2-Collaboration — Institut für Kernphysik, Universität Mainz

The rare decay of the neutral π^0 meson into 3 photons presents a unique possibility for a search of new, C-violating forces beyond the standard model. $\pi^0 \to 3\gamma$ is effectively forbidden by charge conjugation invariance and one SM estimate for this branching ratio is 10^{-31}.

This presentation will show a feasibility study for a future experiment at the tagged photon facility of MAMI (Glasgow Tagger) using Crystal Ball/TAPS detector setup together with particle identification detector (PID) and multi-wire proportional chambers (MWPCs). The CB detector is a high resolution spectrometer specifically designed to detect neutral final states and therefore well-suited for this task.

Supported by DFG under contract CRC1044 and excellence cluster PRISMA.

HK 32.5 Mi 15:15 S1/01 A4

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 $E_\gamma = 1.42 \ldots 1.58\,\text{GeV}$.

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.

This work is supported by DFG under contract SFB1044.

HK 32.6 Mi 15:30 S1/01 A4

Zeitabhängige Dalitz-Diagramm-Analyse des Zerfalls $D^0 \to K_S\pi^+\pi^-$ zur Messung von D^0–$\bar{D}^0$-Mischung am $\overline{\text{P}}$ANDA-Experiment — •Andreas Pitka[1] und Kai-Thomas Brinkmann[2] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]II. Physikalisches Institut, Justus-Liebig-Universität Gießen

Die derzeit genauesten Messungen von D^0–$\bar{D}^0$-Mischung verwenden eine zeitabhängige Dalitz-Diagramm-Analyse des Zerfalls $D^0 \to K_S\pi^+\pi^-$. Hierbei wird genutzt, dass der Flavorinhalt des physikalischen D^0-Zustandes aufgrund der Mischung im D^0–$\bar{D}^0$-System zeitlich oszilliert, was zu einer Variation der relativen Stärke doppelt Cabibbo-unterdrückter bzw. Cabibbo-bevorzugter Resonanzen innerhalb der Dreikörperamplitude führt. Mithilfe von Monte-Carlo-Daten des Simulationsframeworks PandaRoot wird die Anwendbarkeit dieses Verfahrens am $\overline{\text{P}}$ANDA-Experiment überprüft. Neben der Auflösbarkeit der Amplitudenstruktur des Dreikörperzerfalls wird gezeigt, mit welcher Genauigkeit die Mischungsparameter x und y nach 150 Tagen Datennahme extrahiert werden können. Zur Parametrisierung der Dreikörperamplitude dient hierbei ein realistisches Modell unter Verwendung des K-Matrix-Formalismus und der LASS-Amplitudenform zur Beschreibung der $\pi\pi$ bzw. Kπ S-Welle; die im Verhältnis zur mittleren D^0-Lebensdauer nicht vernachlässigbare Auflösung der Zerfallszeit wird durch eine analytische Faltung der Dreikörperamplitude mit der Auflösungsfunktion der Zerfallszeit berücksichtigt.

HK 32.7 Mi 15:45 S1/01 A4

Feasibility study of the $\bar{p}p \to D_s^- D_{s0}^*(2317)$ process with $\overline{\text{P}}$ANDA — •Elisabetta Prencipe[1], Albrecht Gillitzer[1], James Ritman[1], and Klaus Goetzen[2] — [1]Forschungszentrum Jülich IKP1, Jülich (DE) — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt (DE)

Charm spectroscopy has recently gained renewed attention, due to confirmations and new observations published by LHCb. Despite of the excellent performance of the CERN experiments, still limitations exist, that do not allow to perform the measurement of the width (Γ) of narrow states with $\Gamma \leq 1$ MeV. The measurement of the $D_{s0}^*(2317)$ and the $D_{s1}(2460)$ width is a crucial point to discriminate among theoretical models, and to reveal their nature. One of the major advantage of the future $\overline{\text{P}}$ANDA experiment at FAIR is the excellent momentum beam resolution of about $\Delta p/p{=}5{\times}10^{-5}$, allowing energy scans with an energy resolution down to $\Delta E \approx 26$ keV. We present a method to measure the width of the $D_{s0}^*(2317)$, and for the first time a complete full simulation performed with PandaRoot is shown. Feasibility studies for assumption of different signal cross sections are shown, to accommodate the incomplete experimental and theoretical knowledge of the corresponding process of interest. A proposal for a threshold scan for the production reaction $\bar{p}p \to D_s^- D_{s0}^*(2317)^+$ in 100-keV-steps is presented, together with an estimate of the competitiveness of $\overline{\text{P}}$ANDA in this field, assuming an average luminosity of $L{=}10^{31}$ cm^{-1}s^{-1}.

HK 33: Hadron Structure and Spectroscopy VI

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A5

Gruppenbericht HK 33.1 Mi 14:00 S1/01 A5

Complete Experiments in pseudoscalar meson photoproduction — •Yannick Wunderlich for the CBELSA/TAPS-Collaboration — HISKP, Universität Bonn

The understanding of the nucleon excitation spectrum poses a long lasting challenge on the way towards a precise picture on how QCD forms bound states. Many excited states that were predicted by phenomenological models have not shown up in the results of analyses for πN scattering data. Therefore, experiments on photoproduction of mesons have been planned and executed, in order to find resonances with a comparatively large photocoupling, which have escaped observation before. The reaction $\gamma N \rightarrow \pi N$ in particular allows for the extraction of 16 polarization observables.

An interesting mathematical problem associated with polarization measurements is the so called 'Complete Experiment'. Here, one investigates the content and size of a minimal subset of the 16 observables which still allows for an unambiguous determination of the underlying amplitudes. It can be shown that, at least in case numerically precise pseudo-data are investigated, 8 carefully selected observables can constitute a Complete Experiment. If a truncated partial wave analysis is done, fewer observables can be already sufficient.

The presentation will treat the Complete Experiment problem for truncated partial wave analyses and show preliminary results for an analysis of $\gamma p \rightarrow \pi^0 p$, which utilizes 7 polarization observables measured in the second resonance region. Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

Gruppenbericht HK 33.2 Mi 14:30 S1/01 A5

Strangeness photoproduction at the BGO-OD experiment — •Thomas Jude for the BGO-OD-Collaboration — Physikalisches Institut, Bonn University, Bonn, Germany

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.

Compared to constituent quark models (CQMs), models including psuedoscalar meson-baryon interactions have had improved success in describing baryon excitation spectra. For example, the $\Lambda(1405)$ appears to be dynamically generated from meson-baryon interactions at least to some extent. Vector-meson baryon interactions have also been predicted to dynamically generate states, which may have been observed in photoproduction reactions.

BGO-OD is ideal for investigating low momentum transfer processes due to the acceptance and high momentum resolution at forward angles. This enables the investigation of degrees of freedom not derived from CQMs, and in particular, strangeness photoproduction where t-channel exchange mechanisms play a dominant role.

With the first major data taking periods for BGO-OD complete, an extensive programme for the investigation of associated strangeness photoproduction has begun. Supported by DFG (SFB/TR-16).

HK 33.3 Mi 15:00 S1/01 A5

Measurement of double polarization observables in $2\pi^0$-photoproduction off the proton with the CBELSA/TAPS-experiment — •Philipp Mahlberg for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

In contrast to the atomic spectrum with its sharp and well defined excitation levels, the nucleon excitation spectrum is dominated by broad, overlapping resonances. Partial wave analyses are needed to extract the contributing resonances from the experimental data. In order to find an unambiguous solution, the measurement of polarization observables is indispensable.

The Crystal Barrel/TAPS experiment at the electron accelerator ELSA is, due to its high photon detection efficiency and its almost complete solid angle coverage, ideally suited to measure neutral mesons decaying into photons. The measurement with double polarization, i.e. a circularly polarized photon beam and a longitudinally polarized target provides access to single and double polarization observables. At higher energies, the cross sections show that multi-meson decay channels gain in importance compared e.g. to single pseudoscalar meson photoproduction.

In this talk, preliminary results for the helicity asymmetry E in $2\pi^0$-photoproduction measured with the CBELSA/TAPS experiment will be presented.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 33.4 Mi 15:15 S1/01 A5

Helicity asymmetry of the single π^0 photoproduction on neutron — •Federico Cividini for the A2-Collaboration — Institut für Kernphysik - Universität Mainz

During the pion production reaction, the nucleon is excited to an intermediate resonant state, and a systematic analysis of the experimental data allows a determination of the main properties of the baryon resonances. A detailed knowledge of the spectrum of nucleon excited states gives essential constraints on models of nucleon structure. The data for the observables accessible using a polarised photon beam and/or polarised nucleon targets are scarce in many channels, especially in those induced on the neutron. A measurement is performed at the Mainz Microtron, using a circularly polarised photon beam and longitudinally polarised proton and deuteron targets. The detector is the large acceptance Crystal Ball/TAPS setup.

The talk gives an overview of the status of the experiment and the preliminary results of the helicity asymmetry of the single π^0 photoproduction reaction from the deuteron target.

Supported by DFG under contract SFB1044

Supported by Carl-Zeiss-Stiftung

HK 33.5 Mi 15:30 S1/01 A5

Linearly polarised photons at the BGO-OD experiment* — •Andreas Bella — Physikalisches Institut, Universität Bonn

The BGO-OD experiment, located at the ELSA accelerator of the University of Bonn studies photoproduction reactions off the nucleon. A real, energy-tagged photon beam is produced via bremsstrahlung by exposing a thin radiator to the electron beam provided by ELSA.

Linear polarisation is obtained by coherent bremsstrahlung. To do this we use a 570 μm thick diamond radiator.

The degree of polarisation is obtained from the bremsstrahlung spectrum. A consistency check is performed by extracting the already well measured beam asymmetry Σ in π^0 photoproduction off the proton.

*Supported by DFG (SFB/TR-16)

HK 33.6 Mi 15:45 S1/01 A5

Commissioning of the new SciRi detector and reaction channel reconstruction at the BGO-OD experiment* — •Georg Scheluchin for the BGO-OD-Collaboration — Physikalisches Institut, D-53115 Bonn

The aim of the BGO-OD experiment is the investigation of non-strange and strange meson photoproduction. The setup combines a large aperture forward magnetic spectrometer covering the polar angles up to 12° and a central BGO crystal calorimeter with a 25° to 155° polar angle acceptance. The acceptance gap between these two apparatus is a region which requires covering, as many final states under investigation have charged particles in this region.

The Scintillating Ring detector (SciRi) is a segmented plastic scintillator detector with Avalanche Photodiode readout designed to cover the polar angles between 10 and 25 degrees. The detector is segmented into 96 pieces, each covering $\Delta\phi = 11.25°$ and $\Delta\theta = 5°$.

The increase in acceptance leads to a significantly increased detection efficiency of many photoproduction channels. The enhancement of meson identification such as ω, η and η' using this new detector complementing the BGO-OD setup will be presented.

*Supported by DFG (SFB/TR-16).

HK 34: Heavy Ion Collision and QCD Phases VIII

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A01

Gruppenbericht HK 34.1 Mi 14:00 S1/01 A01

QCD inspired determination of NJL-parameters — •Paul Springer[1], Jens Braun[2,3], Stefan Rechenberger[2], and Fabian Rennecke[3,4] — [1]Physik Department, Technische Universität München, 85747 Garching, Germany — [2]Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt, 64289 Darmstadt, Germany — [3]ExtreMe Matter Institute EMMI, GSI, 64291 Darmstadt, Germany — [4]Institut für Theoretische Physik, Universität Heidelberg, 69120 Heidelberg, Germany

Studies of the QCD phase diagram at finite temperature and quark chemical potential are currently one of the most discussed topics in theoretical physics and are of great importance to better our understanding of heavy-ion collision experiments. However, there is considerable uncertainty about the detailed structure of the QCD phase diagram at high baryon densities. Models provide some insight into the phase structure but usually rely on various parameters and therefore require validation from the point of view of the fundamental theory. We propose to apply nonperturbative functional Renormalization Group methods (FRG) to QCD in order to determine constraints on the parameters used in low-energy QCD models. In particular, this includes a determination of the dependence of these parameters on temperature and quark chemical potential. We present first results and argue that our findings can be used to improve the predictive power of model calculations.

HK 34.2 Mi 14:30 S1/01 A01

Stochastic Quantization with Colored Noise — •Felix Ziegler, Jan Martin Pawlowski, and Ion-Olimpiu Stamatescu — Institute for Theoretical Physics, Heidelberg University

Studying the topological properties of the QCD vacuum, observables obtained from lattice simulations are suffering from short-distance fluctuations. To solve this problem, smoothening methods such as cooling and the Wilson flow have been developed.

We present a method based on stochastic quantization with UV-regulated noise enabling a direct control of the quantum fluctuations at all lattice momentum scales. Smoothened configurations are generated from the beginning.

The method is tested on a scalar field theory in two and four dimensions as well as pure SU(2) gauge theory. Effects of colored noise on observables are analyzed. Moreover, we investigate the existence of a scale above which physical quantities become independent of UV fluctuations at larger scales.

We present and discuss our recent results.

HK 34.3 Mi 14:45 S1/01 A01

Yang-Mills correlation functions from functional methods — •Anton Konrad Cyrol[1], Leonard Fister[2], Mario Mitter[1], Jan Martin Pawlowski[1,3], and Nils Strodthoff[1] — [1]Institute for Theoretical Physics, Heidelberg University, Philosophenweg 16, 69120 Heidelberg, Germany — [2]Institut de Physique Theorique, CEA Saclay, F-91191 Gif-sur-Yvette, France — [3]ExtreMe Matter Institute EMMI, GSI, Planckstr. 1, D-64291 Darmstadt, Germany

We investigate SU(3)-Yang-Mills theory in a systematic vertex expansion scheme for the effective action. Particular focus is put on the dynamical creation of the gluon mass gap at non-perturbative momenta, and the consistent treatment of quadratic divergences. The gluon and ghost propagators as well as the momentum-dependent ghost-gluon, three-gluon and four-gluon vertices are calculated self-consistently. Furthermore, we calculate the two-ghost-two-gluon and the four-ghost vertices and back-couple them into the propagator equations. Apparent convergence of the expansion scheme is shown. The result for the gluon propagators is in quantitative agreement with the corresponding lattice results.

HK 34.4 Mi 15:00 S1/01 A01

Shear viscosity and entropy of a pion gas — •Jean-Bernard Rose, Dmytro Oliinychenko, Anna Schäfer, and Hannah Petersen — FIAS, Goethe University, Frankfurt, Germany

A model of microscopic non-equilibrium dynamics for classical point particles is used to calculate the transport coefficients of dense hadronic matter. Specifically, the shear viscosity to entropy density ratio is investigated, and the temperature dependence between 100 MeV and 300 MeV is explored. Calculations are made at corresponding particle densities going from 0.01 to 0.34 in a pion box simulating infinite matter. The results for the entropy and shear viscosity are then compared to analytic estimates. In addition, massless particles as well as ρ-meson resonance excitations are included. This will be the starting point for the calculation of more transport coefficients as functions of T and μ_B; expanding systems could also be considered.

HK 34.5 Mi 15:15 S1/01 A01

Non-perturbative dynamics in gauge and scalar systems - a challenge to kinetic theory — Jürgen Berges[1], •Kirill Boguslavski[1], Sören Schlichting[2], and Raju Venugopalan[1,2] — [1]Institut für Theoretische Physik, Universität Heidelberg, Heidelberg, Germany — [2]Brookhaven National Laboratory, Physics Department, Upton, NY, USA

We report of a universality class for longitudinally expanding systems, encompassing strongly correlated non-Abelian plasmas and scalar field theories in an intermediate range of momenta. This poses further challenges to our understanding of the thermalization process in the high-energy limit of heavy-ion collisions, like a puzzling evolution of the longitudinal to transverse pressure ratio in non-Abelian plasmas. In scalar theory, we show that the same behavior can be understood from non-trivial infrared dynamics related to a nonthermal fixed point.

HK 34.6 Mi 15:30 S1/01 A01

Inverse Monte Carlo Methoden für effektive SU(2)-Polyakovmodelle — •Bardiya Bahrampour — Institut für Theoretische Physik, JLU Gießen, Deutschland

Wir benutzen geometrische Ward-Identitäten der Eichgruppen einer effektiven Quantenfeldtheorie, um die Kopplungskonstanten mittels sogenannter inverser Monte Carlo Methoden an eine volle Theorie zu fitten. Dazu betrachten wir die Ward-Identitäten als Erwartungswerte einer Oberservablen in der vollen Theorie und bestimmen die Kopplungskonstanten numerisch, so dass die erhaltenen Gleichungen erfüllt sind. Mit dieser Methode untersuchen wir verschiedener effektive Theorien (resummierte und nicht-lokale Polyakov-Modelle) und das verhalten ihrer Kopplungskonstanten.

HK 34.7 Mi 15:45 S1/01 A01

Mesonic Spectral Functions from the Functional Renormalization Group — •Christopher Jung[1,2] and Lorenz von Smekal[1,2] — [1]JLU Giessen — [2]TU Darmstadt

We present a non-perturbative method to obtain spectral functions at finite temperature and density from the Functional Renormalization Group (FRG). This method is based on an analytic continuation on the level of the flow equations. In particular, we will use an effective QCD model, the Polyakov-quark-meson model, to calculate mesonic spectral functions along the phase diagram of the model.

HK 35: Astroparticle Physics I

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A02

Gruppenbericht HK 35.1 Mi 14:00 S1/01 A02

Status of the XENON experiment — •Teresa Marrodan Undagoitia for the XENON collaboration — Max-Planck-Institut für Kernphysik

The XENON100 detector at the Gran Sasso Underground Laboratory in Italy has been searching for dark matter during the last years. Its data has lead to some of the most constraining upper limits on the WIMP-nucleon interaction cross section. To improve the sensitivity by two orders of magnitude and hopefully measure interactions of dark matter, the larger XENON1T experiment has been constructed. It is

also a liquid xenon time-projection chamber containing a total mass of ~ 3.5 tons. The goal is to achieve a spin-independent cross section sensitivity at $\sim 2 \times 10^{47}\,\mathrm{cm}^2$ for a WIMP mass of $50\,\mathrm{GeV}/c^2$. To this end, in addition to an increased target mass, all background contributions have been reduced compared to XENON100. This talk will describe the design and commissioning of the XENON1T detector and its subsystems. First data is expected in 2016.

Gruppenbericht HK 35.2 Mi 14:30 S1/01 A02

Recent Edelweiss WIMP search results and perspectives — •Valentin Kozlov for the EDELWEISS-Collaboration — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe

EDELWEISS collaboration performs direct dark matter search by means of Germanium low-temperature detectors. A 20-kg array of advanced high-purity detectors is operated at 18 mK in the low-radioactivity environment of the Modane underground laboratory (LSM, France). The current phase of the experiment shows improved resolution and rejection performance relative to the results of the previous phase. A first low WIMP mass analysis of data acquired in a long-term campaign will be presented. To further explore the parameter space for low mass WIMPs (down to ∼1 GeV), the current R&D program concentrates on voltage-assisted heat amplification technique (so-called Neganov-Luke mode). Significant improvements in sensitivity can be realized with a moderate exposure of 350 kg.d within the next 2 years. Beyond 2017, the already existing cooperation with SuperCDMS should lead to a common experimental infrastructure in SNOLAB. Current R&D activities, sensitivity projections and the project towards the SNOLAB cryogenic facility will be discussed as well.

HK 35.3 Mi 15:00 S1/01 A02

Radon Screening for XENON1T — •Natascha Rupp — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

The radioactive isotope 222Rn is one of the most dominant intrinsic background sources for experiments dealing with a low event rate like the direct detection Dark Matter experiment XENON1T that starts data taking in 2016. As being part of the primordial decay chain of 238U the noble gas 222Rn permanently emanates from almost all materials. It is crucial to determine the radon emanation rate of those detector components that will be in contact with the xenon target. The technique of the radon emanation measurements, making use of ultra low background proportional counters is presented as well as selected results for XENON1T.

HK 35.4 Mi 15:15 S1/01 A02

Monitoring the Energy Scale of KATRIN with Conversion Electrons of a Solid ^{83m}Kr Source as Nuclear Standard — •Klaus Schloesser for the KATRIN-Collaboration — Karlsruher Institut fuer Technologie /IKP

For KATRIN* to be able to achieve the desired sensitivity of 200meV/c^2 for the effective electron neutrino mass, it is of crucial importance that the energy scale of the main spectrometer (18.6 keV) is under control within +/- 60 mV at any given time over the planned measurement time of approximately 5 years.

Besides conventional high voltage dividers and high precision volt meters, a nuclear standard will be deployed additionally in a separate spectrometer of MAC-E filter type. The filter electrodes of both spectrometers are connected galvanically.

For permanent and continuous monitoring an easy to use ion implanted source containing the noble gas ^{83m}Kr was developed and qualified for HV monitoring at the ppm level in the 30kV regime. This talk will present the methods applied and the achievements made.

Acknowledgements:

This work has been supported by the German BMBF (05A14VK2), the Czech GACR (contract P203/12/1896). We are grateful to the ISOLDE collaboration for the opportunity to carry out implantations of ^{83}Rb (I80, IS500) which was also supported by ENSAR founding (contract no. 262010).

*KArlsruhe TRItium Neutrino experiment

HK 35.5 Mi 15:30 S1/01 A02

Investigation of background processes in the KATRIN main spectrometer — •Axel Müller for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institut für Kernphysik (IKP)

The **KA**rlsruhe **TRI**tium **N**eutrino experiment aims to probe the mass of the electron antineutrino in a model-independent way with an unsurpassed sensitivity of $m_\nu = 200$ meV/c^2 (90% C.L.). In order to determine the neutrino mass, the energy spectrum of electrons from the tritium β-decay is analyzed by a high-resolution electrostatic spectrometer which is based on the MAC-E filter principle.

To keep the influence of the spectrometer background on the neutrino mass sensitivity small, KATRIN aims for a background level of 0.01 cps. For the investigation of different background components such as cosmic muons, external gamma radiation and the radioactive decay of isotopes in the volume of the spectrometer or on its surface, a series of dedicated measurements were performed with a combined system of main spectrometer and detector.

This talk will present the results of measurements focusing on the secondary electron production at the inner surface of the spectrometer and compare them with electro-magnetic elctron tracking simulations performed with the KATRIN developed simulation software KASSIOPEIA.

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

HK 35.6 Mi 15:45 S1/01 A02

Investigation of the reactor neutrino anomaly with STEREO — •Felix Kandzia — Institut Laue-Langevin, Grenoble

Nuclear reactors are strong sources of electron antineutrinos in the energy range from 1 to 10 MeV, originating from the beta decays of neutron rich fission fragments. Reactors therefore provide a good opportunity to study neutrino oscillations. Recently calculated corrections to the common model of emitted neutrino spectra prompted a re-evaluation of several experiments, resulting in a deficit of about 6% between the observed and predicted antineutrino flux at short distances. This so called 'reactor neutrino anomaly' has a statistical significance of 2.7 sigma. One possible explanation of the deficit could be a fourth neutrino state, which would only participate in the oscillations but not in weak interactions and is therefore called 'sterile'.

This hypothesis has triggered a number of experiments worldwide, searching for sterile neutrinos. One of which is STEREO, which will be presented in this talk. STEREO will investigate neutrino oscillations at a distance of only 10 m from the core of the research reactor of the Institute Laue-Langevin (ILL) in Grenoble, France. The very compact core is suitable for the investigation of the expected short oscillation length of the light sterile neutrinos. The sensitive volume of STEREO is 2000 l of a Gd doped liquid scintillator, detecting antineutrinos via inverse beta decay. The detector is currently under construction and is expected to deliver first results in 2016.

HK 36: Structure and Dynamics of Nuclei VIII

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A03

Gruppenbericht HK 36.1 Mi 14:00 S1/01 A03

Applications of chiral three-nucleon forces up to N^{3}LO to nuclear matter — •Christian Drischler[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

We have developed recently an improved method for including normal-ordered three-nucleon (3N) forces to many-body calculations of nuclear matter. Applying these density-dependent effective two-body forces to matter of arbitrary proton fractions we show results for the equation of state based on chiral N^{3}LO two- and N^{2}LO three-body forces up second order and study the symmetry energy including contributions beyond the quadratic expansion. As our method allows to incorporate also the recent developed matrix elements of the subleading three-body forces we show in addition results for consistent N^{3}LO calculations of pure neutron matter at zero temperature.

Furthermore, these advances in treating chiral 3N forces up to N^{3}LO can directly be used for advanced studies of properties of neutron matter, such as the equation of state based on the nonperturbative

approach of self-consistent Green's functions or the $^3PF_2$ BCS energy gap. We show first results for these.

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

HK 36.2 Mi 14:30 S1/01 A03

Towards chiral three-nucleon forces in heavy nuclei — •Victoria Durant[1,2], Kai Hebeler[1,2], Johannes Simonis[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

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 approximations for calculating 3N matrix elements. We benchmark these in few-nucleon systems and for normal-ordered matrix elements in calculations of medium-mass nuclei.

This work was supported by the TU Darmstadt - GSI Cooperation, HIC for FAIR, and the ERC Grant No. 307986 STRONGINT.

HK 36.3 Mi 14:45 S1/01 A03

Three-nucleon forces: From oxygen to calcium* — •Johannes Simonis[1,2], Kai Hebeler[1,2], Jason D. Holt[3], Javier Menéndez[4], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]TRIUMF, Vancouver, Canada — [4]The University of Tokyo, Japan

We study ground- and excited-state properties of medium-mass nuclei based on chiral two- and three-nucleon interactions. Our results are based on a many-body perturbation theory approach combined with large-scale diagonalizations. In particular, we will focus on theoretical uncertainty estimates by considering Hamiltonians at different resolution and different sets of low-energy constants.

*This work was supported by ERC Grant No. 307986 STRONGINT.

HK 36.4 Mi 15:00 S1/01 A03

Two- and Three-Nucleon Chiral Interactions in Quantum Monte Carlo Calculations for Nuclear Physics — •Joel Lynn[1], Ingo Tews[2], Joseph Carlson[3], Stefano Gandolfi[3], Alexandros Gezerlis[4], Kevin Schmidt[5], and Achim Schwenk[1,6] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Institute for Nuclear Theory, University of Washington, Seattle, Washington 98195, USA — [3]Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA — [4]Department of Physics, University of Guelph, Guelph, Ontario, N1G 2W1, Canada — [5]Department of Physics, Arizona State University, Tempe, Arizona 85287, USA — [6]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

I present our recent work on Green's function Monte Carlo calculations of light nuclei using local two- and three-nucleon interactions derived from chiral effective field theory up to next-to-next-to-leading order (N^2LO). I discuss the choice of observables we make to fit the two low-energy constants which enter in the three-nucleon sector at N^2LO: the ^{4}He binding energy and n–α elastic scattering P-wave phase shifts. I then show some results for light nuclei. I also show our results for the energy per neutron in pure neutron matter using the auxiliary-field diffusion Monte Carlo method and discuss regulator choices. Finally I discuss some exciting future projects which are now possible.

HK 36.5 Mi 15:15 S1/01 A03

Initial Four-Body Forces in Many-Body Calculations — •Stefan Schulz and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt

For the ab-initio description of light and medium-mass nuclei, chiral effective field theory is used successfully. Improving the precision and uncertainty estimation of chiral forces, especially an improved description of medium-mass nuclei, requires consistent order-by-order calculations. Starting at N^3LO, chiral four-body forces play a role and their impact on nuclei beyond few-body systems is currently unknown. Even without initial four-body forces, transformations such as the similarity renormalization group induce many-body forces.

We model the four-body forces using a simple contact interaction and investigate its effect on nuclear many-body observables, especially ground-state energies and radii, as well as correlations between them. The four-body forces are evaluated in a Jacobi harmonic oscillator (HO) basis and subsequently used in no-core shell model and Hartree-Fock calculations for light- and medium mass nuclei. Handling of chiral forces is identical to a contact interaction, once they are evaluated in a HO basis.

* Supported by GSI, DFG (SFB 1245), HIC for FAIR, and BMBF (05P15RDFN1)

HK 36.6 Mi 15:30 S1/01 A03

Quantum Monte Carlo calculations of two neutrons in finite volume with chiral effective field theory interactions* — •Philipp Klos[1,2], Martin Hoferichter[3], Joel Lynn[1,2], Ingo Tews[1,3], Stefano Gandolfi[4], Hans-Werner Hammer[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Institute for Nuclear Theory, University of Washington, Seattle — [4]Theoretical Division, Los Alamos National Laboratory

Few nucleon systems provide a unique testing ground for nuclear forces. We present auxiliary-field diffusion Monte Carlo simulations of the two-neutron system in finite volume with chiral effective field theory potentials. Both ground-state and excited-state energies in the S-wave channel are compared to results from the Lüscher formula, which provides exact solutions based on scattering data. Future calculations of few-body systems will help to constrain many-body forces, which are crucial for the description of nuclei and nuclear matter, and allow for comparisons with lattice QCD calculations that have approached the physical parameter space in the last years.

⋆This work was supported in part by the ERC Grant No. 307986 STRONGINT, the BMBF under contract 05P15RDFN1, the Helmholtz Association under contract HA216/EMMI and the DOE (Grant No. DE-FG02-00ER41132).

HK 36.7 Mi 15:45 S1/01 A03

Fitting a chiral interaction to nuclear properties in the sd-shell — •Lukas Huth[1,2], Johannes Simonis[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

The nuclear shell model is a powerful tool to investigate medium-mass regions of the nuclear chart. Its main ingredient is an effective valence-space Hamiltonian. This Hamiltonian consists of single-particle energies, two-body matrix elements and additional many-body contributions. We construct a family of effective Hamiltonians in the sd-shell. The considered interactions are motivated by chiral effective field theory. Thus they incorporate basic QCD symmetry principles by default, allow to study an order-by-order convergence behavior, and come with a theoretically motivated error estimate for missing higher-order contributions.

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

HK 37: Instrumentation IX

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 37.1 Mi 14:00 S1/01 A3

New developments of the Recoil Distance Doppler-Shift method — •Christoph Fransen, Andrey Blazhev, Thomas Braunroth, Alfred Dewald, Alina Goldkuhle, Jan Jolie, Julia Litzinger, Claus Mueller-Gatermann, Dorothea Woelk, and Karl-Oskar Zell — Institut für Kernphysik, Universität zu Köln

The recoil distance Doppler-shift (RDDS) method is a very valuable technique for measuring lifetimes of excited nuclear states in the picosecond range to deduce absolute transition strengths between nuclear excitations independent on the reaction mechanism. Dedicated plunger devices were built by our group for measurements with this method for a broad range of beam energies ranging from few MeV/u up to relativistic energies of the order of 100 MeV/u. Those were designed to match the constraints defined by state-of-the art γ-ray spectrometers

like AGATA, Galileo, Gammasphere. Here we give an overview about recent experiments of our group to determine transition strengths from level lifetimes in exotic nuclei where also recoil separators or mass spectrographs were used for an identification of the recoiling reaction products. The aim is to learn about phenomena like shape phase coexistence in exotic regions and the evolution of the shell structure far from the valley of stability. We will also review new plunger devices that are developed by our group for future experimental campaigns with stable and radioactive beams in different energy regimes, e.g., a plunger for HIE-ISOLDE. Supported by the BMBF, Grant No. 05P15PKFNA and 05P15PKCIA and the DFG, Grant No. DE 1516/3-1.

HK 37.2 Mi 14:30 S1/01 A3

A versatile cold pulsed neutron beam facility for particle physics at the ESS: ANNI — •Camille Theroine[1], Hartmut Abele[2], Gertrud Konrad[2,3], Bastian Märkisch[1], Ulrich Schmidt[4], and Torsten Soldner[5] — [1]Physik Department, TU München, Germany — [2]Atominstitut, TU Wien, Austria — [3]Stefan Meyer Institute, Wien, Austria — [4]Physikalisches Institut, Universität Heidelberg, Germany — [5]Institut Laue-Langevin, Grenoble, France

Particle Physics with neutrons performs sensitive tests of the Standard Model and searches for new interactions and symmetries. State-of-the-art high precision measurements require to combine well-designed instrumentation with a powerful neutron source.

In this prospect, the unique capabilities of the European Spallation Source (Lund, Sweden), namely the high peak flux and the inherent time structure of the neutron beam, will permit to push the frontiers of precision experiments. For instance, this source offers the possibility to resolve and separate beam-related systematic effects at full statistics, in parallel to data taking.

In order to exploit these possibilities we propose a new facility as part of the ESS instrument suite: ANNI. ANNI is optimized to study neutron decay, hadronic parity violation, and electromagnetic properties of the neutron and will outperform existing facilities by at least one order of magnitude. In this presentation, the scientific case, the concept and the expected performance of ANNI will be discussed.

HK 37.3 Mi 14:45 S1/01 A3

Extending direct mass measurements in the region of the heaviest elements at SHIPTRAP — •Francesca Giacoppo for the SHIPTRAP-Collaboration — GSI, Darmstadt — Helmholtz Institut Mainz

Penning-trap mass spectrometry allows direct measurements of atomic masses with high precision. This technique is especially suitable to investigate the nuclear structure evolution of radioactive nuclides through binding energies.

The heaviest elements investigated so far in pioneering experiments with the SHIPTRAP setup at GSI, Darmstadt, have been nobelium and lawrencium [1,2]. The existence of such heavy nuclei is closely connected to the nuclear shell effects that stabilize them against spontaneous fission. The direct measurement of the masses of $^{252-255}$No and ^{255,256}Lr has allowed mapping the evolution of the deformed subshell closure along N=152. In order to extend such studies to heavier and more exotic nuclides, the efficiency and sensitivity of the SHIPTRAP setup has to be further increased.

In this talk, an overview of the related developments will be presented. In particular, the online commissioning of a cryogenic buffer gas-stopping cell with improved efficiency will be reported [3].

[1] M. Block et al.,Nature 463 (2010) 785.
[2] E. Minaya Ramirez et al., Science 337 (6099) (2012) 1207.
[3] C. Droese et al., Nucl. Instr. Meth. Sec. B 338 (2014) 126.

HK 37.4 Mi 15:00 S1/01 A3

ALIVE - Collinear Laser Spectroscopy as a tool to measure high voltages with ppm accuracy — Phillip Imgram, Kristian König, •Jörg Krämer, Bernhard Maass, Ratajczyk Tim, Johannes Ullmann, and Wilfried Nörtershäuser — Institut für Kernphysik, Technische Universität Darmstadt

Whenever beams of charged particles are involved in a nuclear physics experiment, also high voltages are involved. In some cases the limited accuracy of high voltage measurements directly spoils the relevance of experimental data. Measuring high voltages with the best-possible accuracy is therefore essential. Collinear laser spectroscopy has become a standard technique for the determination of nuclear charge radii, spins, and magnetic moments. While this technique involves the Doppler shift of the incident laser frequency in the ion's rest frame it is sensitive to the ion velocity and hence, the high voltage applied to accelerate the ions. We want to make use of this feature by determining the high voltage with very high accuracy employing a well-known atomic system and a pump/probe scheme. Accuracies of the order of 1 ppm are feasible. We will present the current status of the setup and the results of test measurements with Ca^+ ions.

HK 37.5 Mi 15:15 S1/01 A3

Detector of the BGO-OD experiment* — •Jürgen Hannappel — Physikalisches Institut, Universität Bonn

In the framework of an international collaboration the BGO-OD experiment is set up at the accelerator facility ELSA in Bonn.

It aims at systematic investigation of nonstrange and strange meson photoproduction, in particular t-channel processes at low momentum transfer. The setup uniquely combines a central almost 4π acceptance BGO crystal calorimeter with a large aperture forward magnetic spectrometer providing good detection of both neutral and charged particles, complementary to other setups like CB, LEPS or CLAS.

In the previous year (2015) substantial data sets have been taken. The performance of the various detectors is discussed based on these data.

* Supported by the DFG (SFB/TR-16)

HK 37.6 Mi 15:30 S1/01 A3

Further development of NEPTUN photon tagging facility — •Dmytro Symochko, Michaela Arnould, Thomas Aumann, Martin Baumann, Norbert Pietralla, Heiko Scheit, Diego Semmler, and Christopher Walz — Institut für Kernphysik, Darmstadt, Germany

The low-energy photon tagging facility NEPTUN at the superconducting Darmstadt linear accelerator (SDALINAC) has been constructed with the aim to study

the photoabsorption cross section of the nuclei in the energy regions of Pygmy Dipole and Giant Dipole Resonances. Recently it went through the series of commissioning runs, which proved the concept and the ability of NEPTUN to tag the discreet nuclear states. Also, based on the results of the commissioning, major upgrade was developed to optimize the setup. Upgraded tagger will be able to operate with 60 MeV electron beam and will have extended focal plane with energy bite of more than 10 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 only 2-3 settings of the spectrometer. Presentation will focus on the analysis results of commissioning runs and details of the proposed upgrade plan.

Supported by DFG (SFB 634).

HK 37.7 Mi 15:45 S1/01 A3

Bestimmung der Elektronenpolarisation für das A4-Experiment — •Yoshio Imai[1], David Balaguer Ríos[1], Sebastian Baunack[1], Luigi Capozza[1], Jürgen Diefenbach[1], Boris Gläser[1], Jeong-Han Lee[1,2], Frank Maas[1,3,4], Maria Carmen Mora Espí[1], Ernst Schilling[1], Dietrich von Harrach[1] und Christoph Weinrich[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Johann-Joachim-Becher-Weg 45, 55128 Mainz — [2]jetzt Institute for Basic Science, Yuseong-daero 1689-gil, Yuseong-gu, Daejeon, Korea, 305-811 — [3]Helmholtz-Institut Mainz, Johann-Joachim-Becher-Weg 36, 55128 Mainz — [4]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität, 55099 Mainz

Das A4-Experiment am MAMI-Elektronenbeschleuniger der Universität Mainz untersucht die Nukleonstruktur durch Messung von Einzelspinasymmetrien in der elastischen Elektron-Nukleon-Streuung unter Verwendung polarisierter Elektronenstrahlen. Da somit eine genaue Kenntnis der Strahlpolarisation für die Interpretation der Meßergebnisse erforderlich ist, wurde ein Compton-Rückstreu-Polarimeter aufgebaut, mit dem erstmals das internal-cavity-Konzept zur Erhöhung der Luminosität trotz geringer Strahlströme umgesetzt wurde. Hiermit ist eine deutliche Reduktion des Polarisationsbeitrags zur Gesamtunsicherheit der A4-Meßergebnisse gelungen. Dieser Beitrag wird auf die spezifischen Herausforderungen dieser Bauweise eingehen und die damit erzielten Resultate vorstellen.

HK 38: Instrumentation X

Zeit: Mittwoch 14:00–16:00 Raum: S1/01 A2

Gruppenbericht HK 38.1 Mi 14:00 S1/01 A2

The CBM Time-of-Flight wall — •Ingo Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut der Universität 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 in CBM 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 will be presented. We will show various MRPC prototypes developed by the CBM-Tof group. 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 performance test results regarding time resolution, efficiency, cluster size and rate capability for several counter types. Work was supported partially by BMBF 05P12VHFC7 and by EU/FP7-HadronPhysics3/WP19.

HK 38.2 Mi 14:30 S1/01 A2

Untersuchungen zur Lebensdauer von neuen langlebigen Microchannel-Plate Photomultipliern — •Markus Pfaffinger, Merlin Böhm, Albert Lehmann und Fred Uhlig — Physikalisches Institut , Universität Erlangen-Nürnberg

Das PANDA-Experiment an der FAIR Beschleunigeranlage plant den Einsatz von 2 DIRC Detektoren zur Teilchenidentifikation. Aufgrund der hohen Magnetfelder von bis zu 2 Tesla müssen hier Microchannel-Plate Photomultiplier (MCP-PMTs) verbaut werden. Die MCP-PMTs sollen während des ganzen Experiments nicht getauscht werden, deshalb muss deren Lebensdauer bestimmt und optimiert werden. Die Quanteneffizienz (QE) eines Photomultipliers ist ein Maß für dessen Lebensdauer. Mit zunehmender Alterung geht die QE immer weiter zurück, bis der Sensor schließlich quasi "blind" ist. Diese Alterung kommt u.a. von positiven Ionen, die von den Photoelektronen an den Microchannelplates ausgelöst werden und von dort durch die Spannungsdifferenz auf die Photokathode beschleunigt werden. Diese wird beim Auftreffen der Ionen beschädigt. Die Beschädigung der Photokathode hängt also mit der vom Sensor gesehenen Gesamtladung zusammen. Im vorliegenden Aufbau werden neue MCP-PMTs bestrahlt und deren integrierte Anodenladung gemessen. Dabei werden in kurzen Intervallen Messungen der spektralen QE sowie QE-Scans über die gesamte Oberfläche der Sensoren durchgeführt, um den Verlauf der Alterung zu protokollieren. Im Rahmen des Vortrags werden der Messaufbau und die Ergebnisse der Lebensdauermessungen präsentiert.

HK 38.3 Mi 14:45 S1/01 A2

Untersuchung von 2x2 Zoll MCP-PMT Prototypen mit sehr feiner Anodenpixelierung — •Fred Uhlig, Merlin Böhm, Albert Lehmann und Markus Pfaffinger — Universität Erlangen-Nürnberg, physikalisches Institut

Für das PANDA-Experiment am HESR/FAIR-Komplex der GSI in Darmstadt ist der Einsatz von zwei DIRC (Detection of Internally Reflected Cherenkov Light) Detektoren zur Teilchenidentifikation geplant. Dazu werden die Öffnungswinkel des beim Durchlauf eines relativistischen Teilchens durch einen Radiator emittierten Cherenkov-Kegels bestimmt. Um den Wechselwirkungspunkt wird ein Barrel-DIRC zum Einsatz kommen, in Vorwärtsrichtung wird dies durch einen Scheiben-DIRC erfolgen.

Zur Detektion der Cherenkov-Photonen sind Photosensoren notwendig, die eine sehr gute Zeitauflösung von $<$ 100 ps für einzelne Photonen in Magnetfeldern über 1 Tesla, eine niedrige Dunkelrate und eine hohe Ratenstabilität haben. Desweiteren wird zur Rekonstruktion des Cherenkov-Winkels am Scheiben-DIRC in einer Dimension eine Anodenbreite von maximal 0,5 mm benötigt. Eine gute Oberflächenuniformität bezüglich der Verstärkung und der Quanteneffizienz, sowie ein geringes Pixelübersprechen ist insbesondere bei der feinen Pixellierung notwendig.

Als Kandidaten wurden hierzu neue MCP-PMT Prototypen von Hamamatsu mit einer Fläche von 2x2 Zoll und einer Anodenpixelierung von 8x8 und 6x128 Pixeln untersucht.

- Gefördert durch BMBF und GSI -

HK 38.4 Mi 15:00 S1/01 A2

Concept and design of an alignment monitoring system for the CBM RICH mirrors* — •Jordan Bendarouach for the CBM-Collaboration — Justus Liebig University, Germany

The Compressed Baryonic Matter (CBM) experiment at the future FAIR (Facility for Antiproton and Ion Research) 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) beam energy. One of the key detector components required for this CBM physics program is the RICH (Ring Imaging CHerenkov) detector, developed for efficient and clean electron identification and pion suppression. The detector consists of about 80 spherical glass mirror tiles, distributed over two sphere parts.

An important aspect to guarantee a stable operation of the RICH detector is the alignment of the mirrors. A method originally developed and inspired by the HERA-B experiment uses recorded data to assess mirror alignment of the RICH mirror system. Measurements of Cherenkov distances and angles on the PMT plane may reveal potential misalignments of the considered tile. If mirror misalignment is revealed, it can be subsequently included and rectified by correction routines, which should mostly increase ring reconstruction as well as ring-track matching efficiencies. Results of this alignment method based on simulated events, reproducing potential mirror misalignments, its limits and first correction routines will be presented.

(*Supported by BMBF(05P15RGFCA), HIC for FAIR and HGS-HIRe)

HK 38.5 Mi 15:15 S1/01 A2

High Resolution Time-of-Flight (TOF) Detector for Particle Identification — •Merlin Böhm, Albert Lehmann, Markus Pfaffinger, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

Several prototype tests were performed with the PANDA DIRC detectors at the CERN T9 beam line. A mixed hadron beam with pions, kaons and protons was used at momenta from 2 to 10 GeV/c. For these tests a good particle identification was mandatory.

We report about a high resolution TOF detector built especially for this purpose. It consists of two stations each consisting of a Cherenkov radiator read out by a Microchannel-Plate Photomultiplier (MCP-PMT) and a Scintillating Tile (SciTil) counter read out by silicon photomulipliers (SiPMs). With a flight path of 29 m a pion/kaon separation up to 5 GeV/c and a pion/proton separation up to 10 GeV/c was obtained. From the TOF resolutions of different counter combinations the time resolution (sigma) of the individual MCP-PMTs and SciTils was determined. The best counter reached a time resolution of 50 ps.

- Gefördert durch BMBF und GSI -

HK 38.6 Mi 15:30 S1/01 A2

Testbeam results of the PANDA Endcap Disc Dirc — •Erik Etzelmüller, Klim Biguenko, Michael Düren, Avetik Hayrapetyan, Julian Rieke, and Mustafa Schmidt for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland

The physics program of the PANDA detector at the future FAIR facility at GSI requires excellent particle identification. For the PANDA forward endcap region a novel detector type called "Disc DIRC" has been designed. It covers the angular range between 5 and 22 degrees and uses internally reflected Cherenkov light in order to separate pions, kaons and protons up to a momentum of 4 GeV/c.

A new prototype was tested at the PS East Area at CERN in May 2015. For the first time all optical components consisted of fused silica and different MCP-PMT sensors were used for the photon detection. A summary of the analysis will be presented along with results from in-house tests for the individual components.

HK 38.7 Mi 15:45 S1/01 A2

The Crystal Zero Degree Detector for ISR tagging at BES III — Achim Denig[1], •Leonard Koch[2], Wolfgang Kühn[2], Sören Lange[2], Yutie Liang[2], Christoph Redmer[1], and Milan Wagner[2] for the BESIII-Collaboration — [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 region. The crystals will be read out by SiPMs and the signal will be digitized by a feature extracting flash ADC. This data stream is correlated with the BESIII trigger in realtime on FPGA based hardware.

The detectors response has been simulated using GEANT4 and the energy resolution has been obtained. A beam test of a prototype has demonstrated the stably running of the DAQ

This work is supported by grant DFG research group 2359.

HK 39: Hadron Structure and Spectroscopy VII

Zeit: Mittwoch 16:30–18:30 Raum: S1/01 A5

Gruppenbericht HK 39.1 Mi 16:30 S1/01 A5

Chiral extrapolation of D meson masses — •Xiao-Yu Guo and Matthias F. M. Lutz — GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany

We consider the quark-mass dependence of open-charm meson masses. The chiral Lagrangian formulated with the ground-state mesons with $J^P = 0^-$ and $J^P = 1^-$ quantum numbers is applied at the one loop level. The implications of the heavy-quark spin symmetry are worked out. We scrutinize the results from various QCD lattice simulations for the masses of the charmed meson ground-states. Finite volume effects are considered systematically.

HK 39.2 Mi 17:00 S1/01 A5

The Low-Energy Constants of the extended Linear Sigma Model — •Florian Divotgey, Francesco Giacosa, Peter Kovacs, and Dirk H. Rischke — Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main

The low-energy dynamics of Quantum Chromodynamics (QCD) is fully determined by the interactions of the (pseudo-) Nambu-Goldstone bosons of spontaneous chiral symmetry breaking, i.e., for two quark flavors, the pions. Pion dynamics is described by the low-energy effective theory of QCD, chiral perturbation theory (ChPT), which is based on the nonlinear realization of chiral symmetry [1]. An alternative description is provided by the Linear Sigma Model, where chiral symmetry is linearly realized. An extended version of this model, the so-called extended Linear Sigma Model (eLSM) was recently developed [2,3] which incorporates all $J^P = 0^\pm, 1^\pm$ $\bar{q}q$ mesons up to 2 GeV in mass. A fit of the coupling constants of this model to experimentally measured masses and decay widths has a surprisingly good quality [3]. In this talk, it is demonstrated that the low-energy limit of the eLSM, obtained by integrating out all fields which are heavier than the pions, assumes the same form as ChPT. Moreover, the low-energy constants (LECs) of the eLSM agree with those of ChPT.

[1] J. Gasser and H. Leutwyler, Annals Phys. **158**, 142 (1984).
[2] D. Parganlija, F. Giacosa and D. H. Rischke, Phys. Rev. D **82**, 054024 (2010).
[3] D. Parganlija, P. Kovacs, G. Wolf, F. Giacosa and D. H. Rischke, Phys. Rev. D **87**, no. 1, 014011 (2013).

HK 39.3 Mi 17:15 S1/01 A5

Tetraquarks in a Dyson-Schwinger Approach — •Paul Christian Wallbott, Gernot Eichmann, Christian S. Fischer, and Walter Heupel — Justus Liebig university, Giessen, Germany

We present numerical solutions of the four-quark Bethe-Salpeter equation for ground-state scalar tetraquarks with $J^{PC} = 0^{++}$. In a recent work [1] it was shown, that the four-body equation dynamically generates pseudoscalar-meson poles in the Bethe-Salpeter amplitude. The resulting tetraquarks are genuine four-quark states, dominated by pseudoscalar meson-meson correlations. These lead to an isoscalar tetraquark mass $M_\sigma \sim 350$ MeV which is comparable to that of the $\sigma/f_0(500)$. Based on these findings we present a second solution of the equation, with the pseudoscalar meson poles explicitly built in the Bethe-Salpeter amplitude.
[1] G. Eichmann, C. S. Fischer and W. Heupel, accepted by PLB, arXiv:1508.07178 [hep-ph]

HK 39.4 Mi 17:30 S1/01 A5

The $X(3872)$ as a $D^0\bar{D}^0\pi^0$ bound state — •Marcel Schmidt, Maximilian Jansen, and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

Three-body physics may play a crucial role for the exotic charmonium state $X(3872)$ which can be interpreted as a hadronic molecule. We propose a new effective field theory with D^0, $\bar{D}^0$ and π^0 fields, considering Galilean invariance to be an exact symmetry of the problem. Moreover, heavy D^{0*} ($\bar{D}^{0*}$) mesons implicitly enter as p-wave resonances in the $D^0\pi^0$ ($\bar{D}^0\pi^0$) system. They are treated using dimeson auxiliary fields in the respective channels. In this talk, we first discuss the underlying Lagrangian. Afterwards, we construct the nonperturbative three-body amplitude for the $X(3872)$ and elucidate its relation to the $D^0\bar{D}^{0*}$ scattering length.

HK 39.5 Mi 17:45 S1/01 A5

Investigation of neutral pion decays using the nonperturbative Dyson-Schwinger formalism — •Esther Weil, Gernot Eichmann, Christian Fischer, and Richard Williams — Justus-Liebig Universität Giessen, Deutschland

In this talk we present an investigation of neutral pion decays within this framework of Dyson-Schiwnger and Bethe-Salpeter equations. Our main objective is to determine the off-shell pion form factor ($\pi^0 \to \gamma\gamma$), which serves as an important ingredient for calculations of other π^0 decays. Examples include the three-body decay ($\pi^0 \to \gamma e^+ e^-$) or the rare decay ($\pi^0 \to e^+e^-$). The pion form factor is also an important part in the hadronic light-by-light contribution to g-2. By systematically comparing with other approaches, we aim to improve the precision of the theory prediction within the Standard Model. This, together with improved experimental results, will lead to stronger constraints on various beyond-the-Standard-Model theories.

HK 39.6 Mi 18:00 S1/01 A5

$K_0^*(800)$ (or κ) as a companion pole of $K_0^*(1430)$ — •Thomas Wolkanowski[1], Milena Sołtysiak[2], Francesco Giacosa[1,2], and Dirk H. Rischke[1] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt am Main, Deutschland — [2]Institute of Physics, Jan Kochanowski University Kielce, Poland

We study the light scalar meson sector up to 1.8 GeV in mass using a model Lagrangian which features a single kaonic state (the resonance $K_0^*(1430)$) coupled to kaons and pions. By performing a fit of the parameters of the Lagrangian to πK phase shift data in the $I = 1/2$, $J = 0$ channel, we show that $K_0^*(800)$ (or κ) emerges as a dynamically generated companion pole of $K_0^*(1430)$. This is a result of resumming quantum fluctuations to one-loop order (with one kaon and one pion running in the loop) in the self-energy of $K_0^*(1430)$. We determine the position of the poles in the complex plane. A large-N_c study confirms that $K_0^*(1430)$ is predominantly a quarkonium and that $K_0^*(800)$ is a molecular-like dynamically generated state.

HK 39.7 Mi 18:15 S1/01 A5

Coupled-channel analysis of the omega-meson photoproduction in the resonance energy region — •Vitaly Shklyar, Horst Lenske, and Ulrich Mosel — Institut für Theoretische Physik I, Giessen Universität

Omega-meson photoproduction is studied to explore the nucleon resonance couplings to the final omega-nucleon system. The production amplitude is obtained within a coupled-channel unitary Lagrangian model which allows for the simultaneous analysis of pion- and photon-induced reactions. The resonance parameters are constrained by direct

comparison with the available experimental data. The present study extends our previous results by including all available experimental data on the omega photoproduction off the proton and neutron.

HK 40: Heavy Ion Collision and QCD Phases IX

Zeit: Mittwoch 16:30–18:30 Raum: S1/01 A01

Gruppenbericht HK 40.1 Mi 16:30 S1/01 A01

J/ψ production in p–Pb collisions with ALICE at the LHC — •Michael Winn for the ALICE-Collaboration — Physikalisches Institut, Universitaet Heidelberg

Charmonia are a key observable for deconfinement in nucleus–nucleus collisions at LHC energies. Measurements in proton–nucleus collisions and their comparison with proton–proton collision results provide crucial information on nuclear effects which are also present in the absence of the Quark–Gluon Plasma.

Charmonium production has been measured by ALICE in proton–proton, proton–lead and lead–lead collisions down to $p_{\mathrm{T}} = 0$ both via the dielectron decay channel in the central barrel and via the dimuon decay channel in the forward spectrometer.

In this talk, results on inclusive J/ψ production in proton–lead collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV at midrapidity as function of transverse momentum, centrality and multiplicity will be shown. Comparisons with results at forward and backward rapidity measured by ALICE and with theoretical models will be carried out. Implications of the results for the interpretation of lead–lead results on charmonium at the LHC as well as further prospects will be discussed.

HK 40.2 Mi 17:00 S1/01 A01

Beauty-jet tagging using the track counting method in pp collisions with ALICE at the LHC — •Linus Feldkamp for the ALICE-Collaboration — 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, of B-meson decay products to identify beauty-jets. The signed rϕ-impact parameter, $d_0 = sign(\vec{d_0} \cdot \vec{p}_{\mathrm{jet}}) d_0$, 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 d_0 in a jet is sensitive to the flavor 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 that will serve as baseline reference for future energy loss studies.

HK 40.3 Mi 17:15 S1/01 A01

Ratios of differential cross sections of heavy-flavour hadron production with ALICE — •Sebastian Hornung for the ALICE-Collaboration — Physikalisches Institut, Heidelberg, Deutschland

Measurements of heavy-flavour hadrons in pp collisions are important to test pertubative Quantum ChromoDynamics and as a reference for measurements in heavy-ion collisions. ALICE has measured several observables in this sector, e.g. p_T-differential cross-sections of prompt D mesons and semi-electronic decays of beauty and charm hadrons at different energies. These measurements are compared to theoretical calculations, like General-Mass Variable Flavour Number Scheme (GM-VFNS) and Fixed-Order plus Next-to-Leading-Logarithms (FONLL), which are affected by large uncertainties caused by renormalisation scale, factorization scale and the heavy quark mass. Because of low statistics, the pp reference spectra for PbPb data are often obtained by extrapolation of data taken at different centre-of-mass energies. This procedure is guided by theory and also affected by large systematic uncertainties. The FONLL authors proposed to consider ratios of cross-sections at different centre-of-mass energies for a substantial reduction of the systematic uncertainties. Therefore, ratios of p_T-differential cross-sections were studied to investigate the possibility to reduce theoretical uncertainties. Such ratios could benefit from the possibility to cancel some systematic errors on the measured data. Simulations with POWHEG are performed to provide an additional theory-based reference. By comparing calculated and measured ratios, sensitivity to the gluon distribution function may be obtained.

HK 40.4 Mi 17:30 S1/01 A01

J/ψ production in Pb-Pb collisions with ALICE at the LHC — •RAUL TONATIUH JIMENEZ BUSTAMANTE[1,2], PASCAL DILLENSEGER[3], and DENNIS WEISER[2] for the ALICE-Collaboration — [1]Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Physikalisches Institut, Heidelberg Universität, Heidelberg, Germany — [3]Institut für Kernphysik, Goethe-Universität Frankfurt, Frankfurt, Germany

Charmonium production provides insights into and hottest stages of nucleus-nucleus collisions where the formation of a Quark-Gluon Plasma is expected. The ALICE experiment at the CERN LHC has measured charmonium at low transverse momentum (p_{T}). At central rapidity ($|y| < 0.9$) J/ψ is reconstructed via its e^+e^- decay channel, whereas at forward rapidity ($2.5 < y < 4$) J/ψ is reconstructed into $\mu^+\mu^-$ pairs. In this talk the ALICE results in Pb-Pb collisions on the inclusive J/ψ at $\sqrt{s_{NN}}$=2.76 TeV and comparisons to theoretical model calculations will be presented. A first look on the J/ψ analysis in the recent data acquired at $\sqrt{s_{NN}}$=5.02 TeV will be also shown.

HK 40.5 Mi 17:45 S1/01 A01

J/ψ production in pp collisions at $\sqrt{s} = 13$ TeV with ALICE at the LHC — •Steffen Weber for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt

Charmonium production is a unique probe for the hot and dense deconfined medium created in ultrarelativistic heavy-ion collisions. Produced in the initial hard collisions, the charm and anticharm quarks maintain their identity throughout the lifetime of the medium, whereas the subsequent creation of charmonium states is subject to the influence of the hot medium.

The measurement of J/ψ in pp collisions serves as a baseline for the quantification of hot and dense medium effects in heavy-ion collisions, but it is also an important probe for perturbative and non-perturbative aspects of quantum chromo dynamics, the theory of strong interactions.

The ALICE experiment at CERN has unique capabilities to measure J/ψ production down zero transverse momentum both at midrapidity in the dielectron decay channel and at forward rapidities in the dimuon decay channel.

In this talk a first analysis of J/ψ production at midrapidity in pp collisions at $\sqrt{s} = 13$ TeV will be presented. A comparison to production at $\sqrt{s} = 7$ TeV and prospects on further measurements will be provided.

HK 40.6 Mi 18:00 S1/01 A01

Separation of the Charm- and Beauty Production in p–Pb and Pb–Pb Collisions With ALICE — •Martin Völkl for the ALICE-Collaboration — Physikalisches Institut, Heidelberg

In heavy-ion collisions the energy loss of heavy quarks is an interesting quantity for the investigation of the roperties of the Quark-Gluon Plasma (QGP). Heavy quarks are produced almost exclusively in the initial hard interactions. Thus, they can interact with the surrounding matter throughout its evolution. A comparison of measurements in Pb–Pb and p–Pb collisions helps to separate initial- and final-state effects. The excellent particle identification properties of the ALICE detector and the large branching ratio ($\approx 10\%$) to a final state containing electrons suggest a measurement using semileptonic decay channels. In the analyses presented here, the contributions from charm and beauty are

separated statistically using their different impact parameter distributions and empirical estimations of the background. The impact parameter for electrons from hadrons containing a beauty quark is typically larger due to the larger decay length ($c\tau \approx 500\mu$m) of these hadrons. Here, the current results of the analyses of p–Pb at $\sqrt{s_{NN}} = 5.02$ TeV and Pb–Pb at $\sqrt{s_{NN}} = 2.76$ TeV are presented.

HK 40.7 Mi 18:15 S1/01 A01

Influence of parton shadowing on J/psi-to-Drell-Yan ratio at SPS and FAIR — •Partha Pratim Bhaduri — CBM Department, GSI, Planck Str. 1, 64291 Darmstadt, Germany — Variable Energy Cyclotron Centre, 1/AF Bidhan Nagar, Kolkata - 700064, India

In relativistic heavy-ion collision experiments, J/psi suppression has long been considered as a direct signature of the onset of deconfinement transition leading to the formation of quark-gluon plasma (QGP). In the present work, we have employed a two component model for calculation of J/psi production cross section in nuclear collision. We report our analysis of the available data on J/psi-to-Drell-Yan production cross section ratio in proton-nucleus (p+A) and nucleus-nucleus (A+A) collisions, at SPS energies. For both J/psi and Drell-Yan production, nuclear modifications to the free nucleon structure functions are taken into account. Differences in quark and gluon shadowing leads to a new source of impact parameter dependence of the production ratio. For J/psi, once the final state interaction of the produced cc-bar pairs with the nuclear medium is incorporated, a satisfactory description of the data in both p+A and A+A collisions is obtained. Model calculations are extrapolated to predict the centrality dependence of J/psi-to-Drell-Yan ratio in the FAIR energy domain.

HK 41: Astroparticle Physics II

Zeit: Mittwoch 16:30–18:15 Raum: S1/01 A02

Gruppenbericht HK 41.1 Mi 16:30 S1/01 A02

Status and Prospects of the COBRA $0\nu\beta\beta$ Experiment — •Robert Temminghoff for the COBRA-Collaboration — TU Dortmund, Exp. Physik IV

COBRA is a next-generation low-background experiment aiming to search for neutrinoless double beta-decay ($0\nu\beta\beta$) based on commercially available CdZnTe semiconductor detectors operated at room temperature.

COBRA is currently in its demonstrator phase. 64 coplanar-grid (CPG) detectors with a total mass of about 400 g are in operation at the LNGS underground laboratory. To reduce the background as much as possible, COBRA relies on passive shielding, the use of radio-pure materials and pulse-shape analysis techniques.

While in principle a total of nine $0\nu\beta\beta$ candidates can be observed in CdZnTe, the main isotope of interest is ^{116}Cd with a Q-value of 2814 keV which is well above the highest naturally occurring γ-line. A high precision measurement of the fourfold forbidden non-unique beta-decay of ^{113}Cd is also possible with the COBRA demonstrator.

This talk will give an overview of the current status and latest results of the COBRA experiment. These include new half-life limits of several candidate isotopes and investigations on the long-term stability of CdZnTe detectors. Plans for using larger detectors in the near future will also be discussed.

Gruppenbericht HK 41.2 Mi 17:00 S1/01 A02

Status of the Gerda Phase II experiment — •Andrea Lazzaro for the GERDA-Collaboration — Physik-Department and Excellence Cluster Universe, Technische Universität München, Germany

The Gerda experiment searches for the neutrinoless double beta decay ($0\nu\beta\beta$) in ^{76}Ge. The first phase of the experiment collected 21.6 kg· yr of exposure with a background index (BI) of 0.01 cts/(keV· kg · yr). No signal was observed and a lower limit for the $0\nu\beta\beta$ half-life was set to $T_{1/2}^{0\nu\beta\beta} < 2.1 \cdot 10^{25}$ yr (90% C.L).

The apparatus has now been upgraded to the Phase II configuration. In Phase II 38 kg of HPGe detectors will be operated to reach an exposure of 100 kg· yr. The goal of Gerda Phase II is to lower the BI to 10^{-3} cts/(keV·kg·y), in order to reach the sensitivity for $T_{1/2}^{0\nu\beta\beta} = \mathcal{O}(10^{26})$ yr.

The additional target mass is constituted of 30 custom made BEGe detectors with higher energy resolution and better pulse shape discrimination performance. The detectors are operated in new radio-pure low-mass holders. The liquid argon surrounding the detectors has been instrumented to veto the background events which produce scintillation light.

In this talk the current status and the performance of the Gerda Phase II will be presented.

This work has been partially funded by BMBF.

HK 41.3 Mi 17:30 S1/01 A02

Search for neutrinoless double beta decay beyond GERDA — •Stefan Schönert — Physik-Department, E15, Technische Universität München

The observation of neutrinoless double beta decay (NLDBD) would be an explicit violation of lepton number conservation and indicate that neutrinos are their own antiparticles (Majorana particles). The study of NLDBD is therefore viewed as addressing one of the key questions in neutrino physics today. NLDBD of Ge-76 is being studied with the ongoing experiment GERDA, which has the lowest background of all experiments in the field. The proposed experimental program beyond GERDA is presented.

HK 41.4 Mi 17:45 S1/01 A02

Performance of the LAr scintillation veto of Gerda Phase II — •Mark Heisel for the GERDA-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg

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

HK 41.5 Mi 18:00 S1/01 A02

Characterization of large volume CdZnTe detectors with a quad-grid structure for the COBRA experiment — •Katja Rohatsch for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik, 01069 Dresden, D

The COBRA experiment uses room temperature semiconductor detectors made of Cadmium-Zinc-Telluride, which contains several double beta isotopes, to search for neutrinoless double beta-decay. To compensate for poor hole transport in CdZnTe the detectors are equipped with a coplanar grid (CPG) instead of a planar anode.

Currently, a demonstrator setup consisting of 64 1 cm^3 CPG-detectors is in operation at the LNGS in Italy to prove the concept and to determine the long-term stability of the detectors and the instrumentation. For a future large scale experiment it is planned to use larger CdZnTe detectors with a volume of 6 cm^3, because of the better surface-to-volume ratio and the higher full energy detection efficiency. This will also reduce the background contribution of surface contaminations.

Before the installation at the LNGS the new detector design is validated and studied in detail. This talk presents a laboratory experiment for the characterization with γ-radiation of 6 cm^3 CdZnTe quad-grid detectors. The anode of such a detector is divided into four sub-CPGs. The characterization routine consists of the determination of the optimal working point and two-dimensional spatially resolved scans with a highly collimated γ-source.

HK 42: Structure and Dynamics of Nuclei IX

Zeit: Mittwoch 16:30–18:30 Raum: S1/01 A03

HK 42.1 Mi 16:30 S1/01 A03

Ab Initio Spectroscopy of Open-Shell Medium-Mass Nuclei: Merging Configuration Interaction and In-Medium Similarity Renormalization Group — •Eskendr Gebrerufael[1], Robert Roth[1], Klaus Vobig[1], and Heiko Hergert[2] — [1]IKP, TU Darmstadt, Germany — [2]NSCL, Michigan State University, USA

In the past years there has been rapid progress in the ab initio description of medium-mass closed-shell nuclei. One of the most flexible and efficient approaches is the In-Medium Similarity Renormalization Group (IM-SRG). The initial formulation of the IM-SRG is limited to ground states of closed-shell nuclei, but first extensions to open-shell systems and spectra have been proposed through multi-reference or valence-space formulations.

Building and extending these ideas, we present a novel ab initio approach for the structure and spectroscopy of all open-shell nuclei in the medium-mass regime. An initial Configuration-Interaction (CI) calculation in a limited model space is used to define a reference state for the multi-reference IM-SRG evolution of the Hamiltonian for the target nucleus. The resulting IM-SRG evolved Hamiltonian is employed in a second no-core CI calculation to extract ground and excited states as well as spectroscopic observables. We present first applications to the spectroscopy of carbon, oxygen and neon isotopes and compare to ab initio no-core shell model calculations.

Supported by DFG (SFB 1245), HIC for FAIR, BMBF (05P15RDFN1)

HK 42.2 Mi 16:45 S1/01 A03

Block Generators for the Similarity Renormalization Group — •Thomas Hüther and Robert Roth — TU Darmstadt

The Similarity Renormalization Group (SRG) is a powerful tool to improve convergence behavior of many-body calculations using NN and 3N interactions from chiral effective field theory. The SRG method decouples high and low-energy physics, through a continuous unitary transformation implemented via a flow equation approach.

The flow is determined by a generator of choice. This generator governs the decoupling pattern and, thus, the improvement of convergence, but it also induces many-body interactions. Through the design of the generator we can optimize the balance between convergence and induced forces.

We explore a new class of block generators that restrict the decoupling to the high-energy sector and leave the diagonalization in the low-energy sector to the many-body method. In this way one expects a suppression of induced forces. We analyze the induced many-body forces and the convergence behavior in light and medium-mass nuclei in No-Core Shell Model and In-Medium SRG calculations.

Supported by DFG (SFB 1245), HIC for FAIR, and BMBF (05P15RDFN1)

HK 42.3 Mi 17:00 S1/01 A03

Importance-Truncated Shell Model for Multi-Shell Valence Spaces — •Christina Stumpf, Klaus Vobig, and Robert Roth — Institut für Kernphysik, TU Darmstadt

The valence-space shell model is one of the work horses in nuclear structure theory. In traditional applications, shell-model calculations are carried out using effective interactions constructed in a phenomenological framework for rather small valence spaces, typically spanned by one major shell. We improve on this traditional approach addressing two main aspects. First, we use new effective interactions derived in an ab initio approach and, thus, establish a connection to the underlying nuclear interaction providing access to single- and multi-shell valence spaces. Second, we extend the shell model to larger valence spaces by applying an importance-truncation scheme based on a perturbative importance measure. In this way, we reduce the model space to the relevant basis states for the description of a few target eigenstates and solve the eigenvalue problem in this physics-driven truncated model space. In particular multi-shell valence spaces are not tractable otherwise. We combine the importance-truncated shell model with refined extrapolation schemes to approximately recover the exact result. We present first results obtained in the importance-truncated shell model with the newly derived ab initio effective interactions for multi-shell valence spaces, e.g., the *sdpf* shell.

Supported by DFG (SFB 1245), HIC for FAIR, and BMBF (05P15RDFN1).

HK 42.4 Mi 17:15 S1/01 A03

Non-perturbative renormalization of the two-dipole system — •Maximilian Jansen and Hans-Werner Hammer — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

The dipole-dipole interaction is an example for an anisotropic and singular potential. Its similarity to the one pion exchange potential in the chiral limit establishes an interesting tie between nuclear and atomic physics. Of particular interest is its tunability, employing electric or magnetic fields in table-top experiments. We investigate a system of two oriented, bosonic dipoles by solving the Lippmann-Schwinger equation numerically. We treat ultraviolet divergences utilizing a cutoff regularization prescription. Cutoff dependence has to be removed subsequently in the procedure of renormalization. We show that in order to do so, anisotropic operators are required besides an isotropic, short-range s-wave interaction. We propose operators for which cutoff independence is obtained in the limit of an infinite ultraviolet cutoff and present our results for the binding energy. Possible consequences for the renormalization of nuclear forces are commented on.

HK 42.5 Mi 17:30 S1/01 A03

Renormalization Group Approach to Density Functional Theory — •Sandra Kemler, Jens Braun, and Martin Pospiech — Institut für Kernphysik, TU Darmstadt

We study specific types of 1+1-dimensional field theories which allow us to study the ground-state properties of self-bound systems of spinless fermions which can also be viewed as toy models of nuclei. To this end, we apply our recently developed renormalization group (RG) approach to Density Functional Theory (DFT) to these systems. Our approach indeed relates to conventional DFT in a simple manner and can in principle be used to study ground-state properties of non-relativistic many-body systems from microscopic interactions. Although the basic RG equation underlying our approach is exact, its solution requires approximations. To construct the latter, we employ the exact solution for the two-body system. In this talk, we present our results for ground-state properties, such as ground-state energies, densities, and pair-correlation functions, from this RG approach to DFT for self-bound systems with many fermions interacting via a short-range repulsive and long-range attractive interaction.

HK 42.6 Mi 17:45 S1/01 A03

Effective Field Theory for the Λnn System — •Fabian Hildenbrand and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

Because of the recent results from the HypHI collaboration at GSI, the question of whether the Λnn system is bound or not has received considerable interest recently. We construct an effective field theory for the Λnn system without explicit pions. An asymptotic analysis of the resulting scattering equations reveals that a Λnn three-body force is required for consistent renormalization. In this talk, we present first results of our analysis with a special focus on the sensitivity on the neutron-neutron-scattering length.

*This work has been supported by the BMBF under grant 05P15 RDFN1.

HK 42.7 Mi 18:00 S1/01 A03

Induced Hyperon-Nucleon-Nucleon Interactions and the Hyperon Puzzle — •Roland Wirth and Robert Roth — Institut für Kernphysik, TU Darmstadt, Germany

There is a strong experimental and theoretical interest in determining the structure of hypernuclei and the effect of strangeness in strongly interacting many-body systems. Recently, we presented the first calculations of hypernuclei in the p shell from first principles. However, these calculations showed either slow convergence with respect to model-space size or, when the hyperon-nucleon potential is transformed via the Similarity Renormalization Group, strong induced three-body terms.

By including these induced hyperon-nucleon-nucleon (YNN) terms explicitly, we get precise binding and excitation energies. We present first results for p-shell hypernuclei and discuss the origin of the YNN terms, which are mainly driven by the evolution of the Λ–Σ conversion terms. We find that they are tightly connected to the hyperon puzzle,

a long-standing issue where the appearance of hyperons in models of neutron star matter lowers the predicted maximum neutron star mass below the bound set by the heaviest observed objects.

* Supported by DFG (SFB 1245), HIC for FAIR and BMBF (05P15RDFN1).

HK 42.8 Mi 18:15 S1/01 A03

Electric properties of one-neutron halo nuclei in Halo EFT — •Jonas Braun and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

We exploit the separation of scales in weakly-bound nuclei to compute E2 transitions and electric radii in a Halo EFT framework. The relevant degrees of freedom are the core and the halo neutron. The EFT expansion is carried out in powers of R_{core}/R_{halo}, where R_{core} and R_{halo} denote the core and halo radius, respectively. We include the strong s-wave and d-wave interactions by introducing dimer fields. The dimer propagators are regulated by employing the power-law divergence subtraction scheme and matched to the effective-range expansion in the respective channel. Electromagnetic interactions are included via minimal substitution in the Lagrangian. We demonstrate that, depending on the observable and respective partial wave, additional local gauge-invariant operators contribute in LO, NLO and higher orders. We present the modifications needed for the extension of our work to higher partial-wave bound states and discuss the consequences for universality in such systems.

∗ This work has been supported by Deutsche Forschungsgemeinschaft (SFB 1245).

HK 43: Instrumentation XI

Zeit: Mittwoch 16:30–18:30 Raum: S1/01 A3

Gruppenbericht HK 43.1 Mi 16:30 S1/01 A3

Reactions with Relativistic Radioactive Beams — •Heiko Scheit for the R3B-Collaboration — TU Darmstadt

The experiment Reactions with Relativistic Radioactive Beams (R^3B) is currently being constructed at GSI. It will be commissioned and operated at GSI in the next years before being installed at the high-energy cave after the Super Fragment Separator (SuperFRS) of the future FAIR facility.

The R3B experiment allows for kinematically complete nuclear reaction studies of short-lived radioactive ion beams in inverse kinematics up to beam energies of 1 GeV/u. Various detection systems are employed to detect beam-velocity charge particles and neutrons. Furthermore light charged particles are detected around the target region as well as γ rays.

I will shortly introduce the setup and give an overview of the status of the different subsystems.

Support by BMBF project 05P15RDFN1 is acknowledged.

HK 43.2 Mi 17:00 S1/01 A3

The Dortmund Low Background Facility — Current Status and Recent Developments — Claus Gössling, Kevin Kröninger, and •Christian Nitsch — Experimentelle Physik IV, TU Dortmund, 44221 Dortmund

The Dortmund Low Background Facility (DLB) is a low-background gamma ray spectrometry system with an artificial overburden. The overburden of ten meters of water equivalent, in combination with a multi-layer lead castle and an active muon veto are shielding a high-purity germanium detector of 60 % relative efficiency. The background level is remarkably low compared to a conventional spectrometer system without special shielding and enables sensitivities well below 1 Bq/kg. Thus, material screening measurements as well as environmental monitoring measurements are possible on an easy-accessible location above ground at the campus of the Technische Universität Dortmund. The integral background count rate between 40 keV and 2700 keV is 2.528±0.004 counts/kg/min, which is comparable to systems that are situated below ground.

In the talk, an overview of the current status of the DLB is given and recent developments are presented.

HK 43.3 Mi 17:15 S1/01 A3

The Muon Veto of the Dortmund Low-Background Facility — •Marcel Gerhardt, Claus Gössling, Kevin Kröninger, and Christian Nitsch — TU Dortmund, Physik EIV, D-44221 Dortmund

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

The remarkably lowered background of the DLB compared to an unshielded spectrometer, allows radio-purity screening measurements for material preselection with sensitivities better than 1 Bq/kg.

This talk focusses on the muon veto of the DLB. Its basic concept and its benefits for low-background operation will be described. Also its current status of development and future upgrade plans will be presented.

HK 43.4 Mi 17:30 S1/01 A3

Half-life and Mass Measurement of the short-lived ^{215}Po Isotope (1.78ms) at the FRS Ion Catcher — •Ann-Kathrin Rink[1], Samuel Ayet San Andres[1,2], Julian Bergmann[1], Timo Dickel[1,2], Jens Ebert[1], Hans Geissel[2], Christine Hornung[1], Ivan Miskun[1], Wolfgang R. Plass[1,2], Sivaji Purushothaman[2], Moritz P. Reiter[1], and Christoph Scheidenberger[1,2] — [1]Justus-Liebig Universität Gießen — [2]GSI, Darmstadt

At the Low-Energy Branch (LEB) of the Super-FRS at FAIR, precision experiments with exotic nuclei will be performed using ion traps and lasers. The nuclei will be produced at relativistic energies, slowed down, thermalised in a cryogenic stopping cell (CSC) and made available to various experiments. The thermalisation is a challenging task because of the large energy straggling of the nuclei after production, which requires a stopping cell with large areal densities. Also, the process needs to be performed on a millisecond time scale in order to give access to short-lived nuclides. This method has already been successfully applied at the FRS Ion Catcher at GSI using a prototype CSC. Recently the potential of the method has been demonstrated by the mass and half-life measurement of the ^{215}Po nuclide with a half-life of 1.78 ms only. The multiple-reflection time-of-flight mass spectrometer at the FRS Ion Catcher has been used to determine the mass to a sub-ppm accuracy and to provide a mass-selected beam for alpha spectroscopy. Furthermore, experiments have been performed with the prototype CSC in order to test novel concepts to be used with the final version of the CSC for the LEB.

HK 43.5 Mi 17:45 S1/01 A3

Vakuumeigenschaften des AGATA-Cluster-Detektors — •Marcel Hahn, Peter Reiter, Jürgen Eberth, Herbert Hess, Benedikt Birkenbach, David Schneiders und Lars Lewandowski für die AGATA-Kollaboration — Institut für Kernphysik, Universität zu Köln, Deutschland

Drei großvolumige, hochsegmentierte HPGe-Detektoren werden gemeinsam als AGATA-Tripel-Cluster-Detektor in einem gemeinsamen Kryostaten unter Vakuum bei Temperaturen von flüssigem Stickstoff betrieben. Der Langzeiteinsatz der Detektoren im AGATA-Spektrometer erfordert hohe Anforderungen an die Qualität des Vakuums, die ohne aktive Pumpen durch den Einsatz von Gettermaterial gewährleistet sein muss. Der Einsatz verschiedener Kombinationen dieser Gettermaterialien und ihre Positionierung innerhalb des Kryostaten wurde in einer Reihe von Messungen mit einem Quadrupolmassenspektrometer für verschiedene Operationsbedingungen der Detektoren über einen großen Temperaturbereich von 77 K bis 300 K untersucht und optimiert. Detaillierte Restgasanalysen wurden mit verschiedenen Systemkonfigurationen durchgeführt. Die Ergebnisse tragen zur Langzeitstabilität der AGATA-Detekoren bei.

HK 43.6 Mi 18:00 S1/01 A3

Efficiency measurement of the NeuLAND detector — •Hans Toernqvist[1], Leyla Atar[1], Thomas Aumann[1], Konstanze

Boretzky[2], Christoph Caesar[2], Igor Gasparic[3], Matthias Holl[1], Andrea Horvat[1], Julian Kahlbow[1], Kenjiro Miki[1], Dominic Rossi[1], Heiko Scheit[1], Fabia Schindler[1], and Haik Simon[2] for the R3B-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Gesellschaft für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Ruđer Bošković Institute, Zagreb, Croatia

NeuLAND is the next-generation high-energy and high-efficiency neutron detector currently under construction at GSI/FAIR by the R^{3}B collaboration. This detector will be used in a wide variety of experiments, ranging from nuclear-structure measurements of neutron-rich species to the investigation of the equation-of-state of asymmetric nuclear matter. The design goals of the full NeuLAND detector are a >95% detection efficiency for single neutrons, a time resolution of $\sigma_t \leq 150$ ps and a position resolution of $\sigma_{x,y,z} \leq 1.5$ cm, with a detection volume of $250 \times 250 \times 300$ cm^3. While still under construction, a set of 4 of the 30 planned NeuLAND double-planes were used for a series of experiments at the SAMURAI setup at RIKEN. In particular, the time resolution and one-neutron efficiency were measured using neutrons from the ^{7}Li(p,n)^{7}Be reaction. The test setup at RIKEN will be described and the resolution and efficiency results will be discussed.

This work was supported in part by HIC for FAIR, BMBF contract 05P15RDFN1 and the GSI-TU Darmstadt cooperation agreement.

HK 43.7 Mi 18:15 S1/01 A3

Hochauflösende Spektroskopie von Betastrahlung mit PIPS Detektoren — •Alexander Robert Domula, Jan Thurn und Kai Zuber — Institut für Kern- und Teilchenphysik / TU-Dresden

In der modernen Physik treten oft Fragestellungen auf, die einer zunehmend genauen Kenntniss der Emissionspektren von Betastrahlung bedürfen. Insbesondere bei verbotenen Betazerfällen ist die Datenlage nicht ausreichend, so dass neue Experimente erforderlich sind. Das IKTP der TU-Dresden betreibt einen Detektoraufbau mit PIPS (Passivated Implanted Planar Silicon) Detektoren zur präziesen Vermessung von Betaspektren. Zur Charakterisierung der Detektoren im Energiebereich 10 keV..1 MeV mit Konversionselektronen wurde ein Satz verschiedener Nuklid-Standards etabliert. Erste Ergebnisse zur Bestimmung von Betaspektren werden vorgestellt.

HK 44: Instrumentation XII

Zeit: Mittwoch 16:30–18:15 Raum: S1/01 A2

Gruppenbericht HK 44.1 Mi 16:30 S1/01 A2

The Transition Radiation Detector of the CBM Experiment at FAIR — •Cyrano Bergmann — 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 above momenta of 1 GeV/c and charged particle tracking. Due its capability to identify charged particles via their specific energy loss, the TRD in addition will provide valuable information for the measurement of fragments. These requirements can be fulfilled with a $XeCO_2$ based Multi-Wire Proportional Counter (MWPC) detector in combination with an adequate radiator. The default MWPC is composed of a symmetric amplification area of 7 mm thickness, followed by a 5 mm drift region to enhance the TR-photon absorption probability in the active gas volume. This geometry provides also efficient and fast signal creation, as well as read-out, of the order of 200 μs per charged particle track. The performance of this detector is maximized by reducing the material budget between the radiator and gas volume to a minimum. The full detector at SIS100 will be composed of 200 modules in 2 sizes. To limit cost and production time the number of various module types is limited to 6 types and 4 types of Front End Board (FEB) flavors are required.

An overview of the design and performance of the TRD detector will be given.

*Supported by HydronPhysics3 and BMBF

HK 44.2 Mi 17:00 S1/01 A2

Detector performance tests for the CBM TRD — •Martin Kohn — 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. With the construction phase of the detector nearing, we will present results of the detector obtained with a close to final prototype. These results were achieved in measurements at CERN PS in 2014 and SPS in 2015.

HK 44.3 Mi 17:15 S1/01 A2

Design and Test of the Real Size Prototypes for the CBM-TRD in Frankfurt — •milad tanha for the CBM-Collaboration — Institut für Kernphysik, Frankfurt, Germany

The Compressed Baryonic Matter (CBM) experiment is planned to explore the QCD phase diagram in the region of high net-baryon densities using high-energy nucleus-nucleus collisions at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt. The Transition Radiation Detector (TRD) will be used to track charged particle and identify electrons.

At the Institute for Nuclear Physics in Frankfurt (IKF), we design, develop and test real size TRD prototypes with different thicknesses and structures e.g. alternating wire-planes. In this talk, we will present the research and development of TRD prototypes and using realistic readout chain. We will show some results from tests at the CERN-PS and the corresponding results (e.g. pad response function and rate stability of the chamber) will be discussed.

HK 44.4 Mi 17:30 S1/01 A2

A fast high-voltage current-peak detection system for the ALICE Transition Radiation Detector — •Robert Verclas for the ALICE-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg

During LHC operation in run 1, the gaseous detectors of ALICE occasionally experienced simultaneous trips in their high voltage which affected the majority of the high voltage channels. These trips are caused by large anode currents in the detector and are potentially related to LHC machine operations. We developed and installed a fast current-peak detection system for the ALICE Transition Radiation Detector. This system is based on FPGA technology and monitors 144 out 522 high voltage channels minimally invasively at a maximum readout rate of 2 MHz. It is an integral part of the LHC beam monitoring system. We report on the latest status.

HK 44.5 Mi 17:45 S1/01 A2

Electron identification performance of the now completely installed ALICE TRD and its potential for J/ψ measurements in Run 2 — •Pascal Dillenseger, Christoph Blume, and Julian Book for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The study of J/ψ production in ultrarelativistic heavy-ion collisions provides information about deconfinement in matter under extreme conditions. The ALICE experiment at the LHC is able to measure the e^+e^- J/ψ decay channel at mid-rapidity ($|y| < 0.9$) and down to $p_T = 0$. One of the main challenges in this channel is the hadronic background in the sample of electron candidates. The excellent PID performance of ALICE during Run 1, mainly by the measurement of dE/dx in the large TPC, will be further improved by the Transition Radiation Detector (TRD) in Run 2, which has recently started. This has become possible after the completion of the TRD during the Long Shutdown 1. In this presentation, the PID methods and the performance of the full TRD and its impact on the J/ψ measurement in Run 2 will be discussed.

HK 44.6 Mi 18:00 S1/01 A2

Bau eines Teststandes für MAPMT-Serientests* — •Jörg Förtsch für die CBM-Kollaboration — Bergische Universität Wuppertal

Eine wesentliche Komponente des CBM-Detektors am FAIR ist ein Ring-abbildender Cherenkov-Detektor (RICH). Im RICH-Detektor sollen die Cherenkov-Photonen ortsaufgelöst mittels MAPMTs des Typs HAMAMATSU H12700-03 detektiert werden. Diese MAPMTs

verbinden einen klar differenzierbaren Single-Photon-Peak (PV ca. 1.5:1) mit einer guten Effizienz im UV-Bereich (QE @300nm ca. 30%). Die insgesamt 1000 MAPMTs müssen zur späteren bestmöglichen Positionierung auf der Detektorfläche charakterisiert werden. Hierzu wird ein dedizierter Teststand aufgebaut, mit dem mittels positionsaufgelöster Beleuchtung der MAPMTs mit "einzelnen" Photonen verschiedene Eigenschaften der MAPMTs untersucht werden können. Die Kombination aus einem LED-Pulser, einer selbstgetriggerter Datenauslese (mittels eines nXYter ASIC) und einem automatisierten XY-Tisch erlaubt eine Erfassung vieler Charakteristika in nur einem Messdurchlauf. Zu diesen Messgrößen gehören z.B. Verstärkung (pro Pixel), effiziente Fläche, Dunkelrate und Afterpulsing. Weitere Messungen, die unabhängig von diesem Teststand durchgeführt werden sollen, umfassen sowohl die Quanteneffizienz als auch den Dunkelstrom der Photokathode. Der Aufbau, die Charakteristika und erste Ergebnisse werden in diesem Vortrag dargestellt.

*gefördert durch BMBF 05P15PXFCA, und GSI

HK 45: Postersession

Zeit: Mittwoch 18:30–20:30 Raum: S1/05 22-24

HK 45.1 Mi 18:30 S1/05 22-24

Coincidence studies of bremsstrahlung during electron-nucleus collisions — •Doris Jakubassa-Amundsen — LMU Muenchen, Germany

A precise knowledge of electron-nucleus bremsstrahlung is important for estimating its influence in the electron spectra from nuclear excitation. A photon recorded simultaneously with the inelastically scattered electron may thus result from elementary bremsstrahlung induced by an inert nucleus, in particular at angles where the probability for radiative decay into the nuclear ground state is small. In order to obtain reliable estimates for heavy nuclei the relativistic partial-wave bremsstrahlung code has been optimized to cover collision energies up to 30 MeV. For spin-polarized electrons the polarization transfer to the photon is also considered. For 208Pb nuclear size effects are found to be quite large at backward angles, exceeding 10 percent even at a collision energy of 5 MeV. Although such effects are included in the conventionally used Born approximation, the PWBA gives at most a qualitative prescription for bremsstrahlung intensities and polarization correlations when heavy nuclei are involved.

HK 45.2 Mi 18:30 S1/05 22-24

The energy dependence of photon-flux and efficiency in the NRF measurement* — •Osman Agar[1,2], Udo Gayer[1], Laura Merter[1], Haridas Pai[1], Norbert Pietralla[1], Philipp Ries[1], Christopher Romig[1], Volker Werner[1], Marcel Schillling[1], and Markus Zweidinger[1] — [1]nstitut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Karamanoglu Mehmetbey University, Department of Physics, 70100 Karaman, Turkey

The calibration of the detector efficiency and the photon-flux distribution play an important role during the analysis of nuclear resonance fluorescence (NRF) measurements. The nucleus ^{11}B is a frequently used calibration target with well-known photo-excitation cross sections. The product of photon flux and efficiency is determined exploiting γ-ray transitions of the ^{11}B monitoring target. Photon-flux calibrations from numerous measurements at the superconducting Darmstadt electron linear accelerator (S-DALINAC) are carried out up to the neutron separation threshold, in order to obtain a system check of influences of absorbers on the flux, and to check against different GEANT models as well as parametrizations of the Schiff formula.

*Supported by the TUBITAK-BIDEB 2214/A Program and DFG under contract No. SFB 634

HK 45.3 Mi 18:30 S1/05 22-24

Zehn-Spalt Modell eines neuen Alvarez DTL bei GSI — •Anja Seibel[1], Xiaonan Du[2], Lars Groening[2], Oliver Kester[1,2] und Sascha Mickat[2] — [1]IAP Universität Frankfurt, Deutschland — [2]GSI, Darmstadt, Deutschland

Um den Anforderungen des geplanten FAIR-Projektes (hohe Strahlintensitäten) an der GSI gerecht zu werden, ist ein Upgrade des bestehenden Universal Linear Accelerators (UNILAC) geplant. Die fünf bestehenden Alvarez-Kavitäten, die bei einer Resonanzfrequenz von 108 MHz arbeiten, sollen durch neue HF-Strukturen gleicher Frequenz ersetzt werden. Dazu wurden Simulationen durchgeführt, um die HF-Eigenschaften zu optimieren. Die Geometrie der Driftröhren erhält eine rundlichere Form, damit eine homogenere Oberflächenfeldverteilung und höhere Shuntimpedanzen erreicht werden. Um die Notwendigkeit und Platzierung von Kühlkanälen zu überprüfen, wurden Simulationen zur Temperaturverteilung an der Kavität durchgeführt. Ein Teststand mit einem kalten zehn-Spalt Aluminium Modell (Maßstab 1:3) wurde für erste HF-Messungen angefertigt. Der modulare mechanische Aufbau des Modells ermöglicht eine breite experimentelle Palette an unterschiedlichen Driftröhren- und Stem-Geometrien. Mit der Störkörpermessmethode wird die elektrische Feldverteilung sowie die Feldstabilität in Bezug auf parasitäre Moden bestimmt. Zusätzlich sind entlang der Kavität HF-Tuner platziert, um für jede gewählte Geometrie die Resonanzfrequenz einstellen zu können. Die Ergebnisse von Simulation und Messung werden vorgestellt.

HK 45.4 Mi 18:30 S1/05 22-24

TILDA - fast experiment control and data acquisition in collinear laser spectroscopy experiments. — •Simon Kaufmann for the TRIGA-SPEC-Collaboration — Inst. für Kernphysik, TU Darmstadt — Inst. für Kernchemie, Johannes Gutenberg-Universität Mainz

The TRIGA-Laser Data Acqusition (TILDA) is a custom development for the collinear laser spectroscopy (CLS) experiment TRIGA-Laser. Situated at the research reactor TRIGA Mainz, the TRIGA-Laser experiment benefits from the possibility to create short-lived nuclides by neutron-induced fission of a heavy actinide target, e.g. ^{249}Cf. The beam-line is equipped with a radio-frequency cooler and buncher emitting bunches with lengths in the order of 500 ns to 10 μs, which allows a drastical reduction of the background in CLS. In order to benefit from this bunched beam structure a time resolved data acquisition system is essential. The real time computing in TILDA is realized by field programmable gate arrays (FPGAs), which are synchronized via the backplane of a PXI-crate. This gives the user a great flexibility in adapting to different measurement schemes. This flexibility in hardware must therefore be given in equivalent way to the user in software. Due to that, high level programming languages were chosen (Labview and Python) and TILDA will provide the user with a solid framework around it. TILDAs main features, specifications, programming schematics and status will be presented.

HK 45.5 Mi 18:30 S1/05 22-24

Approaching unums — •Cora S. Lüdde and Udo Kebschull — Infrastructure and Computer Systems in Data Processing (IRI), Goethe-University Frankfurt, 60629 Frankfurt am Main, Germany

A new format for numbers has been proposed by John L. Gustafson with the aim to replace the IEEE standard. The new format called unums will be presented and its advantages over the IEEE format will be illustrated.

The use of unums is supposed to save energy, to support parallelism and to prevent rounding errors. This is possible due to a specific extension of the IEEE Format and the introduction of a special arithmetic.

First application of unums has been realised with Mathematica by Gustafson.

One of our aims is to implement this new format on FPGAs, to verify the statements Gustafson made and to reproduce and hopefully improve results of preceeding calculations. Finally we expect to use the new concept for a faster processing of large quantities of data which are accumulated in high energy experiments.

HK 45.6 Mi 18:30 S1/05 22-24

Identification of deuterons in $pd \to dX$ reactions at ANKE* — •Marcel Rump, Christopher Fritzsch, Alfons Khoukaz, and Daniel Schröer for the ANKE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität, 48149 Münster, Germany

The collisions of protons and deuterons open up many interesting hadron physics topics, e.g., the interaction between pseudoscalar mesons and hadrons. In this regard a measurement of $pd \to d\eta p_{\mathrm{sp}}$

has been realized at the ANKE spectrometer at the COSY accelerator of the Forschungszentrum Jülich to investigate the production mechanism of η mesons as well as their interaction with nuclear matter. Another reaction that can be studied with the same dataset is the two-pion production $pd \to d\pi^+\pi^- p_{\mathrm{sp}}$. In both cases the deuteron acts as an effective neutron target while the proton is handled as a spectator particle. The Fermi motion of these particles combined with the two different beam momenta ($p_1 = 2.09$ GeV/c and $p_2 = 2.25$ GeV/c) allow to study the low and high-mass enhancement in isoscalar $M_{\pi\pi}$ spectra corresponding to the ABC effect as well as total and differential cross sections. To analyze these reactions an identification of the final deuteron is of high relevance. Recent results of the identification and detector calibration procedure will be presented and discussed.

*Supported by the FFE program of the Forschungszentrum Jülich

HK 45.7 Mi 18:30 S1/05 22-24

Lattice QCD Dslash Operator with Dataflow Computing — •Thomas Janson and Udo Kebschull — Infrastructure and Computer Systems for Data Processing, Goethe University Frankfurt

We investigate new methods in computational particle physics and high performance computing for applications in the field of Quantum Chromodynamic simulation with Dataflow Engines. We describe an algorithm as a directed graph using the high-level dataflow programming language openSPL from Maxeler and others. Such a graph models the parallel flow of data and operations on an algorithmic abstraction level and exposes the highest possible parallelism and locality of a given algorithm in a natural way. In this concept, the data flows through pipelines of an FPGA with many arithmetic units which are all connected to perform the massive parallel computation of an algorithm.

We have shown and verified by simulation that we can describe the naive Dslash operator fully as a dataflow graph. Here, all multiplication and addition to update one spinor are computed in one clock cycle. The data flows over six DDR3 channels into the FPGA.

HK 45.8 Mi 18:30 S1/05 22-24

In-beam measurement of the ^{85}Rb(p,γ)^{86}Sr reaction cross section for the astrophysical γ process — •Lars Netterdon, Felix Heim, Jan Mayer, Philipp Scholz, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The majority of the neutron-deficient p nuclei is believed to be produced during the so-called γ process. Other mechanisms for the production of these nuclei have been proposed, such as the rapid proton-capture process or the νp process. All processes have in common, that the involved reaction rates are calculated within the scope of the Hauser-Feshbach statistical model, as experimental data are rare. The quality of reaction rate predictions strongly depends on the underlying models for the nuclear-physics input parameters, such as particle+nucleus optical model potentials (OMP) or the γ-ray strength function. These models are tested and improved by comparing experimental total and partial cross sections with theoretical predictions.

In this contribution, first results of a cross-section measurement of the ^{85}Rb(p,γ)^{86}Sr reaction using in-beam γ-ray spectroscopy will be presented. The experiment was performed using the high-efficiency γ-ray spectrometer HORUS in Cologne. The experimental setup and preliminary data will be discussed and compared to statistical model predictions in order to test various models of the proton+nucleus OMP and the γ-ray strength functions.

Supported by the ULDETIS project within the UoC Excellence Initiative institutional strategy. P.S. and J.M. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.

HK 45.9 Mi 18:30 S1/05 22-24

The workflow of CBM-STS silicon strip sensor module-assembly — •Carmen Simons, Daniel Soyk, and Robert Visinka for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The Compressed Baryonic Matter Experiment at FAIR is designed to explore the QCD phase diagram of strongly interacting matter. The Silicon Tracking system (STS) is the core detector that provides track reconstruction and momentum determination of charged particles from beam-target interactions. The STS will consist of eight planar tracking stations that are built from different types of basic functional modules consisting of a double-sided silicon microstrip sensor that is connected via microcables to two front-end-electronics boards.

All in all 32 polyimide microcables, each with 64 aluminum traces, have to be connected on one side to 16-STS-XYTER-chips and on the other side to the P- and N-side of the sensor in two staggered layers with TAB-bonding. Additionally, the chips have to be wire-bonded to the front-end-electronics-boards, and shielding layers have to be fixed. This contribution will show the workflow of the module-assembly.

*Supported by EU-Horizon2020 CREMLIN.

HK 45.10 Mi 18:30 S1/05 22-24

Prospects for an energy determination of the ^{229m}Th nuclear isomer via IC electrons — •B. Seiferle[1], L. v.d. Wense[1], M. Laatiaoui[2,3], and P. G. Thirolf[1] — [1]LMU München, Garching. — [2]GSI, Darmstadt. — [3]Helmholtz Institut Mainz, Mainz.

Of all known nuclear excited states, the isomeric first excited state of ^{229}Th possesses the lowest excitation energy reported to be E*=7.6(5) eV ($\hat{=}$163(11) nm). This opens up the possibility to drive the transition with a laser and makes ^{229m}Th an interesting candidate for future developments linking nuclear and atomic physics, such as a nuclear optical clock or a nuclear γ-ray laser. Still, for a direct laser excitation, the knowledge on the energy and half-life of the isomer is not precise enough. In this work and for the expected transition energy, neutral ^{229}Th decays via the emission internal conversion (IC) electrons with an energy of 1.2 eV (*i.e.* difference between E* and the 1^{st} ionization potential). A ^{233}U α-recoil source is placed in a buffer-gas stopping cell. ^{229}Th ions, of which 2% are in the isomeric state are recoiled out of the source. RF- and DC electrode structures form an ion beam out of all the recoil ions. Afterwards, $^{229(m)}$Th ions are separated from other short-lived daughter isotopes with a quadrupole mass separator and can be prepared for further experiments. The poster gives prospects for an energy determination of the IC electrons emitted during the decay of the isomer and for a corresponding half-life determination with this experimental setup.

This work was supported by DFG grant (Th956/3-1) and by the EU Horizon 2020 grant agreement No. 664732 "nuClock".

HK 45.11 Mi 18:30 S1/05 22-24

γ-Zerfallsverhalten von J=1 Zuständen von ^{76}Ge — •Malte Cordts[1], Tobias Beck[1], Vera Derya[2], Udo Gayer[1], Bastian Löher[3], Norbert Pietralla[1], Christopher Romig[1], Deniz Savran[3], Werner Tornow[4], Henry R. Weller[4], Volker Werner[1] und Markus Zweidinger[1] — [1]IKP, TU Darmstadt — [2]IKP, Universität zu Köln — [3]GSI, Darmstadt — [4]Duke University, Durham, USA

Die Erforschung des neutrinolosen doppelten Betazerfalls ($0\nu\beta\beta$) ist eine der wichtigsten offenen Fragen der Teilchenphysik, da dieser im Standardmodell verboten ist und mit seiner Existenz das Neutrino den Majoranateilchen zuordnen würde. Im Rahmen dieser Forschung dient ^{76}Ge als Basisisotop. Mittels eines Kernresonanzfluoreszenzexperiments unter Verwendung des γ^3 Messaufbaus [1] wurde an der High Intensity γ-Ray Source (HIγS) in Durham, NC, USA, die Scherenmode in ^{76}Ge untersucht. Unter Nutzung der $\gamma\gamma$-Koinzidenzmethode wurde das Zerfallsverhalten von dipol-angeregten Zuständen, wie z.B. der Scherenmodenzustände analysiert. Dies ist von Bedeutung in Bezug auf möglichen Untergrund in ($0\nu\beta\beta$) Experimenten, wie etwa GERDA, sowie auch zum Test von relevanten Kernstrukturmodellen. Es werden die bisherigen Schritte der Analyse und erste Ergebnisse präsentiert.

[1] Löher *et al.*, Nucl. Instr. Meth. Phys. Res. A 723 (2013) 136.

⋆ Unterstützt durch die DFG (SFB 634 und ZI 510/7-1) und durch HA216/EMMI).

HK 45.12 Mi 18:30 S1/05 22-24

Lifetimes in ^{94}Zr extracted via the Doppler-shift attenuation method using pγ coincidences — •Sarah Prill[1], Vera Derya[1], Andreas Hennig[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)

Lifetimes of excited states in ^{94}Zr were previously measured applying the Doppler-shift attenuation method (DSAM) following the (n,n$'\gamma$) reaction [1,2]. Since the two measurements were in conflict with each other, we remeasured 14 lifetimes of excited states in ^{94}Zr in a (p,p$'\gamma$) experiment utilizing the DSAM technique [3]. Centroid-energy shifts were extracted from proton-gated γ-ray spectra, yielding lifetime values that are independent of feeding contributions. The results were compared to the previously measured lifetimes and found to be in good agreement with the values reported in Ref. [2], thus confirming the correction procedure introduced in Ref. [2] for the (n,n$'\gamma$) data.

This contribution will feature our new results and introduce the (p,p′γ) DSAM technique, which is now available in Cologne.
Supported by the DFG (ZI-510/7-1). S.P., S.G.P., M.S. and J.W. are supported by the Bonn-Cologne Graduate School of Physics and Astronomy. [1] E. Elhami et al., Phys. Rev. C **88** (2013) 024317, [2] E.E. Peters et al., Phys. Rev. C **78** (2008) 064303, [3] A. Hennig et al., NIM A **758**, 171 (2015)

HK 45.13 Mi 18:30 S1/05 22-24

Sensitive lifetime measurement of excited states of ^{98}Ru via the (p,p′γ) reaction — •Vera Vielmetter[1], Andreas Hennig[1], Vera Derya[1], Pavel Petkov[1,2,3], Simon G. Pickstone[1], Sarah Prill[1], Mark Spieker[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]INRNE, Bulgarian Academy of Sciences, Sofia — [3]National Institute for Physics and Nuclear Engineering, Bucharest-Magurele

The one-phonon mixed-symmetry quadrupole excitation 2^+_{ms} is a well established excitation mode in near-spherical nuclei, especially in the $A \approx 100$ mass region [1]. However, it is largely unknown how mixed-symmetry states evolve along shape-transitional paths, e.g. from spherical to deformed shapes. The chain of stable ruthenium isotopes is well suited for this study since it exhibits a smooth transition from spherical (^{96,98}Ru) to deformed shapes (^{104}Ru). To identify the 2^+_{ms} state of ^{98}Ru on the basis of absolute $M1$ and $E2$ transition strengths, we performed a proton-scattering experiment on ^{98}Ru using the SONIC@HORUS setup at the University of Cologne. Lifetimes of excited states were measured via the Doppler-shift attenuation method (DSAM), which benefits from the acquired pγ-coincidence data [2]. First results of this experiment are presented and compared to the neighbouring nuclei ^{96}Ru and ^{100}Ru. Supported by the DFG (ZI-510/7-1). S.G.P., S.P., M.S. are supported by the Bonn-Cologne Graduate School for Physics and Astronomy.
[1] N. Pietralla *et al.*, Prog. Part. Nucl. Phys. **60** (2008) 225.
[2] A. Hennig *et al.*, Nucl. Instr. and Meth. A **794** (2015) 717.

HK 45.14 Mi 18:30 S1/05 22-24

Precision high voltage divider for the electron cooler at CRYRING — I. Denesjuk[1], 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]Institut für Kernchemie, Uni Mainz — [3]GSI, Darmstadt

The heavy ion storage ring CRYRING at GSI provides a unique possibility to test atomic structure calculations with slow exotic ion beams at energies in the range of 0.3 MeV/u up to 15 MeV/u. In order to cool the ions and thus achieve a low momentum spread of the stored beam, CRYRING features an electron cooler, where the ion beam is superimposed with a monoenergetic electron beam. In earlier measurements of hyperfine transitions in hydrogen- and lithiumlike ions at Experimental Storage Ring (ESR), the limiting uncertainty was the voltage measurement of the electron cooler which determines the velocity of the ions. That uncertainty could be removed by an in-situ precision measurement of the cooler voltage using a high voltage divider provided by PTB on a temporary basis. We therefore plan to construct a high-precision divider for voltages up to 35 kV which will be similar to the ultrahigh-precision voltage dividers which have been constructed for use at the KATRIN experiment. The precision of the divider will be in the low ppm range and will allow for measurement uncertainties in the $< 10^{-5}$ region. The concept and first characterization measurements of the precision components will be presented. This work is supported by BMBF under contract number 05P15PMFAA. Daniel Winzen thanks HGS-HIRe for FAIR for funding his scholarship.

HK 45.15 Mi 18:30 S1/05 22-24

Monte Carlo studies for direct photon measurement with the ALICE EMCAL detector — •Dominik Herzig for the ALICE-Collaboration — Institur für Kernphysik Frankfurt

Since direct photons are produced during all stages of a heavy-ion collision, they can probe the space-time evolution of the medium. Direct photons sources include hard scattering processes, thermal emission and interactions of fast partons with the medium. In proton-proton collisions, direct photons are a vital tool to test pQCD calculations of hard processes. Furthermore, the pp-measurement is needed as a baseline for interpreting the heavy-ion data.

In the ALICE experiment the EMCAL detector is used to measure high energetic photons. In this poster, we present Monte Carlo studies for the analysis of direct photon production using the ALICE EMCAL. The poster focuses on improving photon identification cuts that are studied in such Monte Carlo simulations in order to test their effects on the photon measurement.

HK 45.16 Mi 18:30 S1/05 22-24

Experimental access to Transition Distribution Amplitudes with the PANDA experiment at FAIR — •Manuel Zambrana[1,2], María Carmen Mora Espí[2], Frank Maas[1,2,3], Heybat Ahmadi[2], Samer Ahmed[1,2], Luigi Capozza[2], Alaa Dbeyssi[2], Malte Deiseroth[1,2], Bertold Fröhlich[1,2], Dmitry Khaneft[1,2], Dexu Lin[1,2], Cristina Morales[2], Oliver Noll[1,2], David Rodríguez Piñeiro[2], Roserio Valente[1,2], and Iris Zimmermann[1,2] 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

We address the feasibility of accessing proton to pion Transition Distribution Amplitudes with the future PANDA detector at the FAIR facility. Assuming a factorized cross section, feasibility studies of measuring $\bar{p}p \to e^+e^-\pi^0$ with PANDA have been performed at the center of mass energy squared $s = 5$ GeV^2 and $s = 10$ GeV^2, in the kinematic region of four-momentum transfer $3.0 < q^2 < 4.3$ GeV^2 and $5 < q^2 < 9$ GeV^2, respectively,with a neutral pion scattered in the forward or backward cone $|\cos\theta_{\pi^0}| > 0.5$ in the $\bar{p}p$ center of mass frame. These include detailed simulations on signal reconstruction efficiency, rejection of the most severe background channel, i.e. $\bar{p}p \to \pi^+\pi^-\pi^0$, and the feasibility of the measurement using a sample of 2 fb^{-1} of integrated luminosity. The cross sections obtained with the simulations are used to test QCD factorization at the leading order by measuring scaling laws and fitting angular distributions.

HK 45.17 Mi 18:30 S1/05 22-24

Measurement of the $e^+e^- \to \bar{p}p$ cross section at BESIII using the untagged-initial state radiation technique — •Alaa Dbeyssi[1], Samer Ali Nasher Ahmed[1,2], Paul Larin[1,2], Dexu Lin[1,2], Christoph Rosner[1,2], Frank Maas[1,2,3], Cristina Morales[1], and Yadi Wang[1,2] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg-Universität Mainz, Germany — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz, Germany

Electromagnetic form factors (FFs) are fundamental quantities which parametrise the electric and magnetic structure of hadrons. In the time-like region, proton FFs can be accessed through the annihilation process $e^+e^- \to \bar{p}p$, assuming that the interaction takes place through the exchange of one virtual photon. Initial state radiation (ISR) is an effective tool to measure hadronic cross section at high luminosity e^+e^- storage rings, such as the Beijing Electron-Positron Collider II (BEPC-II). This contribution reports on the analysis of $e^+e^- \to \bar{p}p\gamma$ for proton FF measurements at the Beijing Spectrometer III (BESIII/BEPC- II). Data collected at 7 beam energies between 3.773 and 4.6 GeV, with a total luminosity of 7.408 fb^{-1}, are analysed. The case of untagged ISR photon in $e^+e^- \to \bar{p}p\gamma$ is presented.

HK 45.18 Mi 18:30 S1/05 22-24

Performance of the Cluster-Jet Target for P̄ANDA — •Ann-Katrin Hergemöller, Daniel Bonaventura, Silke Grieser, Benjamin Hetz, Esperanza Köhler, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The success of storage ring experiments strongly depends on the choice of the target. For this purpose, a very appropriate internal target for such an experiment is a cluster-jet target, which will be the first operated target at the P̄ANDA experiment at FAIR. In this kind of target the cluster beam itself is formed due to the expansion of pre-cooled gases within a Laval nozzle and is prepared afterwards via two orifices, the skimmer and the collimator. The target prototype, operating successfully for years at the University of Münster, provides routinely target thicknesses of more than 2×10^{15} $\frac{\text{atoms}}{\text{cm}^2}$ in a distance of 2.1 m behind the nozzle. Based on the results of the performance of the cluster target prototype the final cluster-jet target source was designed and set into operation in Münster as well. Besides the monitoring of the cluster beam itself and the thickness with two different monitoring systems at this target, investigations on the cluster mass via Mie scattering will be performed. In this presentation an overview of the cluster target design, its performance and the Mie scattering method will be presented and discussed. Supported by BMBF, HGS HIRe and GSI F+E.

HK 45.19 Mi 18:30 S1/05 22-24

Laval Nozzles for Cluster-Jet Targets — •Silke Grieser, Daniel Bonaventura, Ann-Katrin Hergemöller, Benjamin Hetz, Esperanza Köhler, Lukas Lessmann, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

Cluster-jet targets are highly suited for storage ring experiments due to the fact that they provide high and constant beam densities. Therefore, a cluster-jet target is planned to be the first internal target for the $\bar{\text{P}}$ANDA experiment at FAIR. A cluster source generates a continuous flow of cryogenic solid clusters by the expansion of pre-cooled gases within fine Laval nozzles. For the production of clusters the geometry of the nozzle is crucial. The production of such nozzles with their complex inner geometry represents a major technical challenge. The possibility to produce new fine Laval nozzles ensures the operation of cluster-jet targets, e.g. for the $\bar{\text{P}}$ANDA experiment, and opens the way for future investigations on the cluster production process to match the required targets performance. Optimizations on the recently developed production process and the fabrication of new glass nozzles were done. Initial measurements of these nozzles at the $\bar{\text{P}}$ANDA cluster-jet target prototype and the investigation of the cluster beam origin within the nozzle will be presented and discussed.

Supported by BMBF, HGS-Hire and GSI F+E.

HK 45.20 Mi 18:30 S1/05 22-24

Bi-Phase CO_2 cooling of the CBM STS detector — •Evgeny Lavrik for the CBM-Collaboration — Physikalisches Institut der Universität Tübingen, Deutschland

The Compressed Baryonic Matter (CBM) experiment aims to study the properties of nuclear matter at high net-baryon densities. The Silicon Tracking System (STS) is the key detector to reconstruct charged particle tracks created in heavy-ion interactions. The foreseen interaction rate of up to 10 MHz requires radiation hard detectors as well as efficient cooling of the silicon sensors. To avoid thermal runaway the system must be kept at -5° C or below all the time. This is rather challenging because the overall thermal load in the $2m^3$ STS enclosure is up to 40 kW.

Because of these requirements liquid CO_2 is used as a cooling agent as it is superior in terms of volumetric heat transfer coefficient compared to other agents. This contribution shows the thermal simulations and measurement results of the STS front-end electronic boxes as well as an overview of 1kW TRACI-XL cooling plant developed at GSI and its use to perform thermal measurements of a fully heat loaded STS quarter station.

Work supported by BMBF under grant 05P12VTFCE.

HK 45.21 Mi 18:30 S1/05 22-24

Particle dependent tracking efficiency of the measurement of charged hadrons in ALICE — •Patrick Huhn for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to study the properties of the Quark-Gluon-Plasma (QGP) based on high energy pp, p-Pb and Pb-Pb collisions. Certain properties of these collisions can be studied by measuring the production of charged hadrons. In ALICE charged hadrons are measured with the Time Projection Chamber (TPC) and are corrected for the tracking efficiency of the detector.

Here, tracking efficiencies are calculated based on two simulations: A Monte Carlo generator for the particle production and GEANT, to simulate the detector response. As the particle abundancies in Monte Carlo simulations differ from the measured yields of identified particles, the composition of the inclusive tracking efficiency has to be tuned.

We present a systematic study of the particle dependent tracking efficiency of the measurement of charged hadrons, especially in pp collisions at $\sqrt{s} = 13$ TeV.

Supported by BMBF and the Helmholtz Association.

HK 45.22 Mi 18:30 S1/05 22-24

Extraction of the $0_1^+ \rightarrow 0_2^+$ monopole matrix element in ^{150}Nd with high-resolution electron scattering at the S-DALINAC* — •Andreas Krugmann, Simela Aslanidou, Sergej Bassauer, Andreas Ebert, Michaela Hilcker, Tobias Klaus, Christoph Kremer, Peter von Neumann-Cosel, Norbert Pietralla, Vladimir Yu. Ponomarev, Maxim Singer, and Gerhart Steinhilber — IKP, TU Darmstadt

A high resolution electron scattering experiment on the deformed nucleus ^{150}Nd has been performed at the 169° spectrometer at the S-DALINAC. The aim of this investigation was the determination of the $\rho^2(E0; 0_1^+ \rightarrow 0_2^+)$ transition strength, which is a key signature of an IBM phase-shape transition. Spectra have been taken at various scattering angles with beam energies of 46 MeV and 73 MeV and a very good energy resolution of $4{\cdot}10^{-4}$ has been achieved, which was crucial for this experiment. The experimental form factor of this particular transition has been compared to a theoretical form factor, constructed by an effective density operator on a microscopic level with the help of the generator coordinate method. The required collective wave functions have been calculated in the Confined β soft rotor model. With this model-dependent analysis the $E0$ transition strength could be determined for the first time.

* Supported by the DFG under contract SFB 634.

HK 45.23 Mi 18:30 S1/05 22-24

Ein neuer Photonendetektor für den HADES RICH* — Mike Faul[3], •Jürgen Friese[1], Claudia Höhne[4], Tobias Kunz[1], Semen Lebedev[4], Christian Pauly[2], Dennis Pfeifer[2] und Michael Traxler für die HADES-Kollaboration[3] — [1]Technische Universität München, 85748 Garching — [2]Bergische Universität Wuppertal, 42119 Wuppertal — [3]GSI Helmholtzzentrum, 64291 Darmstadt — [4]Justus-Liebig-Universität Gießen, 35390 Gießen

Für den e^+e^-- Paarnachweis in Pionen- und Schwerionen-induzierten Kernreaktionen wird im HADES Experiment ein hadronenblinder RICH-Detektor verwendet. Der bisherige Photonendetektor weist das Cherenkovlicht mit einem photosensitiven Gasdetektor (CsI Kathode) nach. In Zusammnenarbeit mit der CBM Kollaboration wird z.Zt. ein neuer Photonendetektor (RICH700) mit Multianoden-Photomultipliern (MAPMT) aufgebaut. Die $2m^2$ große neue Kamera hat insgesamt 27904 Pixel ($\simeq 6 \cdot 6mm^2$) und wird mit bis zu 200 kHz/pixel Einzelphotonenrate bei einem Datenstrom bis zu 1 GB/s ausgelesen. Simulationen zeigen, daß eine Nachweiswahrscheinlichkeit bis zu $\simeq$ 90% auch für e^+e^--Paare mit sehr kleinen Öffnungswinkeln erreicht wird. Konzept und Status des Detektoraufbaus werden neben Simulationsergebnissen vorgestellt.

* Unterstützt durch DFG Exc. Cluster Universe, BMBF 05P15RGFCA

HK 45.24 Mi 18:30 S1/05 22-24

Zeitsynchronisierung zwischen NeuLAND Modulen mit der Messung von kosmischen Strahlen — •Vadim Wagner[1,2] und Dmytro Kresan[2] für die R3B-Kollaboration — [1]TU Darmstadt - Institut für Kernphysik — [2]GSI Helmholtzzentrum für Schwerionenforschung

R3B (Reactions with Relativistic Radioactive Beams) ist ein zukünftiges Experiment bei der Facility for Antiproton and Ion Research (FAIR) zur Untersuchung von Struktur und Dynamik seltener Isotope in inverser Kinematik. Ein Schlüsselelement im Detektorsystem von R3B ist der New Large Area Neutron Detector (NeuLAND).

NeuLAND ist aus 60 Ebenen mit je 50 Szintillator-Modulen aufgebaut. An beiden Enden der 250 cm x 5 cm x 5 cm großen Module befindet sich jeweils ein Photomultiplier. Diese messen sowohl die im Modul deponierte Energie als auch den Zeitpunkt und die Koordinaten des Ereignisses. Die Energieauflösung hängt wesentlich von der Genauigkeit der Zeit- und Positionsmessungen ab. Um die angestrebte Genauigkeit der Flugzeitmessung von $\sigma < 150$ ps zu erreichen, müssen die 6000 Kanäle synchronisiert werden.

Die Durchführung der Synchronisierung mit kosmischer Strahlung und die Prüfung der Kalibrierung mit den experimentellen Daten werden präsentiert.

Teilweise unterstützt durch das LOEWE-Zentrum HIC for FAIR, den TU-Darmstadt-GSI-Kooperationsvertrag, und das BMBF (05P15RDFN1).

HK 45.25 Mi 18:30 S1/05 22-24

Studies on an Automated Gain Stabilisation for the new APD Read-Out of the Crystal Barrel Calorimeter — •Peter Pauli for the CBELSA/TAPS-Collaboration — HISKP Bonn, Germany

For the investigation of the nucleon spectrum it is not enough to measure only cross sections because of the large overlap of resonances. To disentangle these resonances, a partial wave analysis is needed. To find unambiguous solutions it is necessary to measure (double) polarisation observables. The CBELSA/TAPS experiment is an important tool to measure these observables in meson photoproduction off nucleons. To achieve a high efficiency in purely neutral reactions it is important to implement the main calorimeter into the first level trigger. To do so it is necessary to replace the current PIN photo diodes with new

avalanche photo diodes (APDs). The new read-out is able to provide a timing signal that is fast enough to use it as a trigger while it does not impair the energy resolution of the calorimeter compared to the previous system. A drawback of APDs is their temperature dependency. To provide a stable gain throughout varying running conditions it is vital to monitor the temperature change and correct it if necessary.

The poster shows an approach to ensure temperature stability where the temperature is monitored via a temperature sensitive NTC thermistor and the gain is adjusted via changes of the high voltage supply of the APDs. This method proved successful while it is easy to implement in all 1320 CsI(Tl) crystals of the calorimeter.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16) and Schweizerischer Nationalfonds.

HK 45.26 Mi 18:30 S1/05 22-24

Measurement of Time-Like Baryon Electro-Magnetic Form Factors in BESIII — •Cristina Morales Morales[1], Samer Ali Nasher Ahmed[1,2], Alaa Dbeyssi[1], Dexu Lin[1,2], Frank Maas[1,2,3], Christoph Rosner[1,2], and Yadi Wang[1,2] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz — [2]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany

BEPCII is a symmetric electron-positron collider located in Beijing running at center-of-mass energies between 2.0 and 4.6 GeV. This energy range allows BESIII experiment to measure baryon form factors both from direct electron-positron annihilation and from initial state radiation processes. We present results on direct electron-positron annihilation into proton anti-proton and preliminary results on direct electron-positron annihilation into lambda anti-lambda based on data collected by BESIII in 2011 and 2012. Finally, expectations on the measurement of nucleon and hyperon electro-magnetic form factors from the BESIII high luminosity energy scan in 2015 and from initial state radiation processes at different center-of-mass energies are also shown.

HK 45.27 Mi 18:30 S1/05 22-24

Measurement of Neutral Pions in pp collisions at 8 TeV with the ALICE EMCAL — •Adrian Mechler — 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 center-of-mass 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 EMCAL calorimeter is used to measure the position and energy of these photons.

We will present the status of an ongoing π^0 analysis in pp collisions at $\sqrt{s}$=8 TeV. Different analysis steps such as the yield extraction and corrections for the detector response will be discussed.

HK 45.28 Mi 18:30 S1/05 22-24

Centrality Determination in Au-Au Collisions at 1.23 AGeV with HADES — •Maximilian Zuschke for the HADES-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

An important characterization of events in heavy-ion physics is the centrality. It classifies events by considering the collision's cross section relative to the total cross section of the system. This characteristics is needed for many analyses, as it provides indirect information about the initial geometrical reaction properties. As the production rate of particles is a function of the deposited energy, which itself depends on the centrality, quantities based on measured multiplicities allow to draw conclusions about the centrality of a collision.

Estimators used to determine the centrality for Au-Au collisions at 1.23 AGeV recorded with HADES include the charged particle multiplicity and hit multiplicities measured with various detectors, such as the TOF/RPC or forward wall.

Calibration methods accounting for variations in the acceptance of the detectors are introduced and verified by comparison with the theoretical expectations, as obtained by calculations with the Glauber-Model.

This work has been supported by BMBF (05P12RFGHJ,05P15RFFCA), GSI and HIC for FAIR.

HK 45.29 Mi 18:30 S1/05 22-24

P2 - A fused silica Cherenkov detector for the high precision determination of the weak mixing angle — •Kathrin Gerz[1], Dominik Becker[1], Thomas Jennewein[1], Sebastian Baunack[1], Krishna Kumar[3], and Frank Maas[1,2] — [1]Johannes Gutenberg Universität Mainz — [2]Helmholtz Institut Mainz — [3]Department of Physics and Astronomy, Stony Brook University, Stony Brook, USA

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 $sin^2(\Theta_W)$ 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 both by simulations and by beam tests at the MAMI accelerator.

HK 45.30 Mi 18:30 S1/05 22-24

Calibration of the precision high voltage dividers of the KATRIN experiment — •Oliver Rest for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The KATRIN (KArlsruhe TRItium Neutrino) 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 type spectrometer. The retarding potential of the MAC-E-filter (up to −35 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 and constructed in cooperation with the Physikalisch-Technische Bundesanstalt Braunschweig.
In order to determine the absolute values and the stability of the scale factors of the voltage dividers, regular calibration measurements are essential. Such measurements have been performed during the last years using several different methods.
The poster will give an overview of the methods and results of the calibration of the precision high voltage dividers.

This project is supported by BMBF under contract number 05A11PM2.

HK 45.31 Mi 18:30 S1/05 22-24

Meson production in pd fusion to ^{3}HeX at proton beam momenta between p_p = 1.60 GeV/c and p_p = 1.74 GeV/c with WASA-at-COSY* — •Nils Hüsken, Florian Bergmann, Kay Demmich, Alfons Khoukaz, Karsten Sitterberg, Juliane Von Wrangel, and Lisa Wölfer for the WASA-at-COSY collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Deutschland

The production of pseudoscalar mesons in pd fusion to ^{3}HeX adresses a wide range of interesting hadron physics topics.
While the reaction $pd \rightarrow {}^3\text{He}\eta$ has been studied in great detail in the near threshold region, there still remain open questions regarding the underlying production mechanism as well as recently observed unexpected cross section structures at higher excess energies. As the WASA-at-COSY experiment is perfectly suited to study the energy dependence of both total and differential cross sections, a beam time was realized in May 2014 in order to investigate the excess energy region of interest, covering 15 excess energies ranging from $Q \approx 13.6$ MeV to $Q \approx 80.9$ MeV. This dataset also allows the investigation of the energy dependence of various other $pd \rightarrow {}^3\text{He}X$ reactions, like the one-, two- and three-pion production with high statistics. An overview of the possibilities this new dataset provides will be given as well as the current status of the analyses regarding these reactions.
*Supported by FFE program of the Forschungszentrum Jülich and the European Union Seventh Framework Programme (FP7/2007-2013) un-

der grant agreement n 283286.

HK 45.32 Mi 18:30 S1/05 22-24

Simulation der Detektionssignaturen von Neutroneneinfangsreaktionen an ^{83}Kr und ^{85}Kr — •Ashkan Taremi Zadeh[1], Stefan Fiebiger[1], Milan Krtička[2], René Reifarth[1], Mario Weigand[1] und Clemens Wolf[1] — [1]Goethe-Universität Frankfurt — [2]Charles University in Prague

^{85}Kr ist ein wichtiger Verzweigungspunkt des s-Prozesspfades. Deswegen ist die Kenntnis seines Neutroneneinfangsquerschnitts für die nukleare Astrophysik von großer Bedeutung. ^{85}Kr ist gasförmig und instabil mit einer Halbwertszeit von ca. 10,8 Jahren. Dies macht die Messung des Neutroneneinfangsquerschnittes von ^{85}Kr sehr schwierig, da zunächst eine möglichst reine und ausreichend große Probe hergestellt werden muss. Für ein geplantes Time-of-Flight-Experiment wird reaktorproduziertes Kr verwendet. Dieses besteht neben ^{85}Kr, auch aus anderen Kr-Isotopen, welche in der späteren Messung unerwünschten Untergrund verursachen könnten. Dabei ist das Isotop ^{83}Kr im Vergleich zu ^{85}Kr aufgrund seines größeren Q-Werts bei der (n,γ)-Messung die größte Herausforderung. Für eine Analyse wurden Zunächst γ-Kaskaden mit DICEBOX erzeugt. Anschließende Simulationen der kalorimetrischen Messung mit eine 4π-Detektoraufbau mit GEANT3 sollen zeigen ob es möglich ist, diese beiden Isotope in einer (n,γ)-Messung voneinander zu unterscheiden.
Dieses Projekt wird unterstützt vom ERC Grant Agreement n. 615126.

HK 45.33 Mi 18:30 S1/05 22-24

Study of the spatial resolution of methods for photon interaction position determination in a monolithic scintillator — •A. Miani[1,2], S. Liprandi[1], S. Aldawood[1,3], T. Marinšek[1], L. Maier[4], C. Lang[1], H. van der Kolff[1,5], R. Lutter[1], R. Gernhäuser[4], D. R. Schaart[5], G. Dedes[1], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Germany — [2]Università degli Studi di Milano, Italy — [3]King Saud University, Riyadh, Saudi Arabia — [4]TU Munich, Germany — [5]Delft University of Technology, The Netherlands

At LMU Munich, a Compton camera prototype is being developed as a promising tool for ion-beam range verification for hadron therapy by detecting prompt γ rays induced by nuclear reactions between the particle beam and organic tissues. The camera is composed of a scatterer, consisting of six layers of double-sided Si-strip detectors, and an absorber, a monolithic $LaBr_3$:Ce crystal (50x50x30 mm^3) read out by a 256-segments multianode PMT. Key ingredient of the photon source reconstruction process is the determination of the γ ray interaction position in the monolithic scintillator. It has been determined by applying the k-Nearest Neighbor (k-NN) algorithm (van Dam et al., IEEE TNS 58 (2011)), which requires a large reference library of 2D scintillation light amplitude distributions, determined by scanning the scintillator with a 1 mm collimated ^{137}Cs source and a fine step size (0.5mm). The characterization of the spatial resolution of the k-NN method will be presented.
This work was supported by the DFG Cluster of Excellence Munich Centre for Advanced Photonics (MAP) and KSU, Saudi Arabia.

HK 45.34 Mi 18:30 S1/05 22-24

Studien zum Y(2175) bei BES III — •Jiaqi Li für die BESIII-Kollaboration — Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44780 Bochum

Das BES III-Experiment am Elektron-Positron-Speicherring BEPCII des Institute of High Energy Physics (IHEP) in Peking zeichnet seit 2009 Elektron-Positron-Kollisionen bei einer Schwerpunktsenergie zwischen 2 und 4,6 GeV auf. Mit etwa 1,3 Millarden aufgezeichneten J/ψ-Ereignissen verfügt die BES III-Kollaboration über den weltweit größten Datensatz. Zerfälle des J/ψ stellen eine reichhaltige Quelle für die Erzeugung leichter Hadronen dar.

So konnte 2015 im Zerfallskanal $J/\psi \to \eta\phi f_0(980)$ vom BES-III Experiment das durch BaBar entdeckte Y(2175)-Meson mit hoher Statistik bestätigt werden. Um die Eigenschaften des $Y(2175)$-Mesons besser zu verstehen, wird dies im Rahmen der hier vorgestellten Analyse weiter studiert. Die Selektionsschritte sowie erste Ergebnisse der Analyse werden hier präsentiert.

Unterstützt durch die DFG.

HK 45.35 Mi 18:30 S1/05 22-24

Entwicklung eines neuen Datenaufnahmesystems für das QClam-Spektrometer * — •Maxim Singer, Antonio D'Alessio und Peter von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

Am supraleitenden Elektronenbeschleuniger S-DALINAC wird für das hochauflösende Magnetspektrometer QClam eine neue Datenaufnahme für Elektronenstreu- und insbesondere (e,e'x)-Experimente entwickelt. Durch eine Verdopplung der Zähldrähte in den neuen Driftkammern auf 896 und eine Zeitauflösung von 100 ps, soll eine Energieauflösung von 10^{-4} erreicht werden. Hierfür muss das bestehende Datenaufnahmesystem durch eine flexiblere Lösung ersetzt werden.
Um eine hohe Energieauflösung in (e,e')-Experimenten zu erreichen, muss der Durchstoßpunkt der Elektronenspur durch die Fokalebene möglichst genau bestimmt werden. Hierzu dienen die Driftzeiten der Sekundärelektronen in den drei Driftkammern und die Zeitinformation des Trigger-Szintillators als Datengrundlage. Ein Algorithmus, der aus diesen Informationen die Elektronenbahn rekonstruiert, wird vorgestellt. Der Einfluss von fehlerhaften Kanälen und zufälligen Ereignissen wird beleuchtet. Präsentiert wird auch ein Konzept des Aufbaus bestehend aus 19 TDC Modulen und deren zeitliche Synchronisation über mehrere VME-Crates, sowie eine Möglichkeit das System für Koinzidenzexperimente zu erweitern.
* Gefördert durch die DFG im Rahmen des SFB 1245.

HK 45.36 Mi 18:30 S1/05 22-24

Correlated random-phase approximation from densities and in-medium matrix elements — •Richard Trippel and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt

The random-phase approximation (RPA) as well as the second RPA (SRPA) are established tools for the study of collective excitations in nuclei. Addressing the well known lack of correlations, we derived a universal framework for a fully correlated RPA based on the use of one- and two-body densities. We apply densities from coupled cluster theory and investigate the impact of correlations. As an alternative approach to correlations we use matrix elements transformed via in-medium similarity renormalization group (IM-SRG) in combination with RPA and SRPA. We find that within SRPA the use of IM-SRG matrix elements leads to the disappearance of instabilities of low-lying states. For the calculations we use normal-ordered two- plus three-body interactions derived from chiral effective field theory. We apply different Hamiltonians to a number of doubly-magic nuclei and calculate electric transition strengths. Supported by DFG (SFB 1245), HIC for FAIR and BMBF (06DA7047I)

HK 45.37 Mi 18:30 S1/05 22-24

Position sensitive plastic scintillating fibre-detectors for heavy ion detection — •Sebastian Scholl, Joachim Tscheuschner, Stefanos Paschalis, Thomas Aumann, and Heiko Scheit — Institut für Kernphysik, Technische Universität, 64289 Darmstadt, Germany

The R^{3}B (**R**eactions with **R**elativistic **R**adioactive **B**eams) experiment at FAIR will be able to perform kinematically complete measurements of reactions with relativistic heavy-ion beams up to 1 AGeV. In order to track the beam before the target and to determine the mass number of the scattered nucleus after the reaction, five fibre detectors with sizes between 10.24 x 10.24 cm^2 and 120 x 80 cm^2 are going to be built for the R^{3}B setup. These fibre detectors will provide $x-y$-position of the trajectory of charged particles after the reaction target. The light from the fibre detector is sensed using MPPCs (Multi Pixel Photon Counter). For the readout of the MPPCs we will test different electronics. In this contribution we present results obtained using an α-source and a LED light source to generate light in the fibre and use the PADI-VFTX for readout. This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

HK 45.38 Mi 18:30 S1/05 22-24

Design eines Kollimators zur Charakterisierung des Gammastrahls von ELI-NP* — •Matthias Nicolay[1], Catalin Matei[2], Norbert Pietralla[1], Philipp Ries[1], Calin A. Ur[2], and Volker Werner[1] — [1]Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt — [2]ELI-NP, 077125, Magurele, Rumänien

Die im Aufbau befindliche internationale Großforschungsanlage "Extreme Light Infrastructure - Nuclear Physics" (ELI-NP) umfasst u.a. einen hochbrillanten Niederenergiegammastrahl (ca. 0.5 - 3 MeV), der ab 2017 zur Verfügung stehen soll. Die geringe Bandbreite von ca. 1% seiner Energie wird neue Experimente und Anwendungen in der Kern-, Strahlungs-, Kernstruktur- und nuklearen Astrophysik ermöglichen. So soll in einem der ersten Experimente nach neuen Doorway-Zuständen zur elektromagnetischen Entvölkerung des seltensten natürlich vorkommenden Nuklids ^{180m}Ta geforscht und deren Eigenschaften vermessen werden. Dazu wird es nötig sein, den Strahl mit hoher Präzision

in Echtzeit zu analysieren, was über Comptonstreuung des Strahls an einem Kupfertarget mit anschließender Aufnahme des Energiespektrums unter einem sehr kleinen Raumwinkel erfolgen soll. Der zur Raumwinkelfilterung verwendete Kollimator muss dabei so beschaffen sein, dass er das Energieprofil so wenig wie möglich verzerrt. Um zu einem optimalen Kollimatoraufbau zu finden, werden verschiedene Designs mit dem Programm Geant4 simuliert und anschließend real getestet. Erste Ergebnisse und Optimierungsmöglichkeiten werden vorgestellt.

* Gefördert vom BMBF unter 05P15RDENA

HK 45.39 Mi 18:30 S1/05 22-24

The new FPGA based discriminator board for the CBELSA/TAPS Experiment — •Eugenia Fix for the CBELSA/TAPS-Collaboration — HISKP, Universität Bonn

The Crystal Barrel calorimeter at ELSA, which consists of 1320 CsI(Tl) crystals has been upgraded by a new Avalanche Photo Diode (APD) crystal readout.The APD readout electronics will provide a fast trigger signal down to 10 MeV energy deposit per single crystal. The processing of these trigger signals requires the development of a previously not existent timing branch of the readout chain of the Crystal Barrel calorimeter. Core component of the timing branch is a newly developed, FPGA based discriminator board. Its firmware contains modules for time to digital conversion, rise time compensation and parts of a cluster finder. In addition the reference voltages and discriminator thresholds are controlled and monitored. This poster presents the design and the achievable accuracy of the new discriminator.

Supported by the Deutsche Forschungsgemeischaft (SFB/TR16) and Schweizerischer Nationalfonds.

HK 45.40 Mi 18:30 S1/05 22-24

Detection system for forward emitted XUV photons from relativistic ion beams at the ESR — •C. Egelkamp[1], V. Hannen[1], Th. Kühl[2,3,4], W. Nörtershäuser[2,3], H.-W. Ortjohann[1], R. Sánchez[3], Th. Stöhlker[3,4,5], J. Vollbrecht[1], Ch. Weinheimer[1], D. Winters[3], and D. Winzen[1] — [1]Institut für Kernphysik, Uni Münster — [2]Institut für Kernchemie, Uni Mainz — [3]GSI, Darmstadt — [4]Helmholtz Institut Jena — [5]Uni Jena

Highly charged heavy ions stored at relativistic velocities provide a unique possibility to test atomic structure calculations. A possibility to investigate electron-electron correlations is the study of the $^3P_0 \rightarrow ^3P_1$ fine structure transition in Be-like Krypton ($^{84}Kr^{32+}$) in laser spectroscopy experiments. For this purpose Be-like krypton ions are stored in the experimental storage ring (ESR) at GSI at a velocity of $\beta = 0.69$. Through an anticollinear arrangement of the excitation laser and the ions the wavelength in the rest frame of the ions can be matched. After the excitation to the $^3P_1$ level the ions immediately decay to the ground state, emitting $\lambda \approx 17$ nm photons. Due to the Lorentz boost, the photons are emitted mainly in the forward direction and experience a Doppler shift to wavelengths < 10 nm. To collect these photons a moveable cathode plate with a central slit is brought into the beam line. The XUV photons mostly produce low energy secondary electrons on the plate which are electromagnetically guided onto a MCP detector. The design and working principle, as well as simulations and test measurements of the detector will be presented. This work is supported by BMBF under contract number 05P15PMFAA.

HK 45.41 Mi 18:30 S1/05 22-24

Calibration of the proton detector used for the neutron life time experiment τSPECT — •Kim Ross[1], Marcus Beck[1,2], Jan Haack[1], Werner Heil[1], and Jan Karch[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz

In order to measure the lifetime of free neutrons, a decay curve will be measured by detecting the decay products proton and electron. Their energies range up to 750 eV (protons) respectively 780 keV (electrons). The protons are accelerated onto 15 keV, in order to pass the dead layer of the detector and to be distinguishable from electronic noise. For the measurement a silicon drift detector is used which needs to be calibrated. This is achieved with a ^{133}Ba source mounted on three source holders of different materials in a vacuum chamber. Thus not only four of the characteristic lines of the ^{133}Ba source were measured but also the characteristic lines of the three source holders which yield four more calibration lines in the area of the proton energy in the spectrum. We report the implementation and results of the calibration of the silicon drift detector used for the neutron lifetime measurement τSPECT.

HK 45.42 Mi 18:30 S1/05 22-24

Particle Tracking Simulation des QCLAM-Spektrometers — •Gerhart Steinhilber, Christoph Kremer und Peter von Neumann-Cosel — IKP TU Darmstadt

Am supraleitenden Darmstädter Elektronen-Linearbeschleuniger S-DALINC am Institut für Kernphysik der Technischen Universität Darmstadt werden Experimente zur Untersuchung der Kernstruktur durchgeführt. Es stehen verschiedene Experimentierplätze zur Verfügung, an denen Photonen- bzw. Elektronenstreuexperimente realisiert werden können. An einem der Experimentierplätze befindet sich das QCLAM-Spektrometer, welches über eine große Impuls- und Raumwinkelakzeptanz verfügt, wodurch eine vergleichsweise hohe Zählrate erreicht wird. Dadurch können auch Experimente mit kleinen Wirkungsquerschnitten wie etwa Koinzidenzexperimente und 180°-Streuung durchgeführt werden.

Es wird eine Simulation des QLCAM-Spektrometers inklusive des Separationsmagneten für die 180°-Streuung mit CST-Studio durchgeführt um die Abbildungseigenschaften untersuchen zu können. Das Gesamtsystem setzt sich aus drei Magneten - dem Separationsmagneten, einem Pentapol und einem Dipol - zusammen. Simuliert werden die Magnetfelder sowie die Trajektorien der gestreuten Elektronen. Dadurch wird in Zukunft ein Werkzeug zur Analyse unterschiedlicher Experimenttypen am QCLAM-Spektrometer zur Verfügung stehen.

HK 45.43 Mi 18:30 S1/05 22-24

Implementation of a control system for FRS in LSA — •Jan-Paul Alexander Hucka[1], Joachim Enders[1], Stephane Pietri[2], Helmut Weick[2], David Ondreka[2], Hanno Huether[2], Holger Liebermann[2], Raphael Mueller[2], and Jutta Fitzek[2] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholzzentrum 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 to be included into the code of the LSA framework. The implemented control system will be later 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 45.44 Mi 18:30 S1/05 22-24

Neutron Time-Like Electromagnetic Form Factor Measurement with Direct Scan Method at BESIII — •Paul Larin[1,2], Samer Ali Nasher Ahmed[1,2], Alaa Dbeyssi[1], Dexu Lin[1,2], Frank Maas[1,2,3], Cristina Morales[1], Christoph Rosner[1,2], and Yadi Wang[1,2] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz, 55099 Mainz, Germany

The internal structure and dynamics of the neutron can be understood through the study of its electromagnetic (EM) form factors (FF). In comparison to proton FF measurements, less data on the neutron is available in the space-like as well as in the time-like region. None of the previous experiments were able to measure the ratio of the electric and the magnetic FF in the time-like region so far. The BESIII (Beijing Spectrometer III) experiment at BEPCII (Beijing Electron Positron Collider II) collected in 2014/15 a large sample of e^+e^- scan data in the region between 2.0 and 3.08 GeV with a total luminosity of 523.5 pb^{-1}. With this poster we show our efforts to measure the effective FF of the neutron in a large energy region and the possibility to measure for the first time the ratio of the neutron form factors in the time-like region.

HK 45.45 Mi 18:30 S1/05 22-24

Measurement of ppbar FFs at BESIII — •Yadi Wang[1,2], Christoph Rosner[1,2], Cristina Morales[1], Samer Ali Nasher

Ahmed[1,2], Alaa Dbeyssi[1], Dexu Lin[1,2], and Frank Maas[1,2,3] for the BESIII-Collaboration — [1]Helmholtz Institute Mainz, 55128 Mainz, Germany — [2]Institute for Nuclear Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany — [3]PRISMA Cluster of Excellence, Johannes Gutenberg University, Mainz, 55099 Mainz, Germany

The structure of the proton can be understood through the study of its electromagnetic (EM) form factors. Due to the low luminosity achieved up to now, few data exist on the proton form factors in the time-like region and only a very coarse determination of the individual electric and magnetic form factors (or its ratio) has been possible so far. BESIII (Beijing Spectrometer III) at BEPCII (Beijing Electron Positron Collider II) has a better performance in detecting ppbar, nnbar, ΛΛbar and so on. We studied the feasibility of measurement of form factors of proton at BESIII. In 2014 and 2015, BESIII has collected large e+e* scanning data samples with a total luminosity of 525.5 pb*1. With these data samples, the renovation of the status of proton form factors is foreseen.

HK 45.46 Mi 18:30 S1/05 22-24

Electron Identification and Hadron Contamination Studies in Proton-Proton Collisions with ALICE — •Anisa Dashi for the ALICE-Collaboration — Technische Universität München

The continuum of electron-positron pairs, produced in heavy-ion collisions, provides an excellent probe of the quark-gluon plasma and a possible chiral symmetry restoration, since these particles do not undergo strong final state interactions and hence carry information about the in-medium properties of hadrons to the detectors. To extract possible signatures, it is important to work with an electron sample of high purity, i.e. not contaminated by other particles. Dielectrons are also studied in proton-proton collisions to provide a crucial reference for the measurement in heavy-ion collisions.

This poster presents an analysis performed on a data set of pp collisions at $\sqrt{s} = 7$ TeV measured with the ALICE detector at the Large Hadron Collider. The aim of this work is to optimize the electron identification and to reduce the hadron contamination. For that, three different combinations of particle identification (PID) criteria are compared regarding the statistical significance S/σ_S of their dielectron signals and their electron purities. The analysis shows that one can achieve good electron identification efficiencies and high electron purities by combining the specific energy loss signals measured in the Inner Tracking System and the Time Projection Chamber with the information of the Time of Flight detector. With such a PID selection one obtains a dielectron signal with a purity higher than 82% reaching up to 96%, depending on the invariant mass.

HK 45.47 Mi 18:30 S1/05 22-24

Like sign pion femtoscopy with HADES — •Barbara Schweisshelm for the HADES-Collaboration — Physik Department, TUM, Garching, Germany — Excellence Cluster "Universe", Garching, Germany

The results of a three dimensional correlation analysis for like sign pion pairs, which are produced in π- + W reactions at 1.7GeV/c at HADES, are presented. Different PID cuts allow the identification of like sign pion pairs, which are used to investigate the correlation between these pairs. In particular the size of the source of the pair can be determined after applying some corrections, which take e.g. the resolution of the detector into account. The analysis was performed in a longitudinally co-moving system to reveal differences of the source size for different emission directions.

HK 45.48 Mi 18:30 S1/05 22-24

Collective flow in heavy-ion collisions at $E_{\mathrm{lab}} = 1 - 2A$ GeV — •Markus Mayer[1,2], Longgang Pang[2], Dmytro Oliinychenko[1,3], and Hannah Petersen[1,2,4] — [1]Frankfurt Institute for Advanced Studies — [2]Goethe Universität Frankfurt — [3]Bogolyubov Institute for Theoretical Physics — [4]GSI Helmholtzzentrum für Schwerionenforschung

Collective flow represents an important opportunity to gain information about the characteristics of the fireball and insights about the equation of state. Flow can be analyzed by considering the momentum distribution of the particles which are emitted from the fireball. Collective flow is composed of radial flow and an azimuthally asymmetric expansion, the latter is corresponding to the anisotropic flow. In non-central collisions the fireball corresponds to an almond-shaped overlap area of the participants, which results in the anisotropic flow. The largest contributions to this anisotropic flow are provided by the elliptic and the directed flow. When the speed of the spectators is lower than the rate of expansion of the fireball, they block the emission of particles from the fireball. Hence the particles are squeezed out of the almond shape. In central collisions the fireball is circular resulting in a radial flow of matter. These flow-effects can be analyzed by investigating v_1 and v_2 as a function of the transverse momentum or the rapidity. In this work, the collective flow of nucleons and pions is studied within a hadronic transport approach at beam energies of $1 - 2A$ GeV.

HK 45.49 Mi 18:30 S1/05 22-24

Strahlenschäden in dotiertem Silizium aufgrund Neutroneneinfangs Bor als Erweiterung des NIEL-Modells* — •Tobias Bus für die CBM-MVD-Kollaboration — Goethe-Universität, Frankfurt

CMOS Monolithic Active Pixel Sensoren werden für die Vertexdetektoren der Schwerionenexperimente STAR, ALICE und CBM entwickelt. Die Verbesserung der Strahlenhärte dieser Sensoren ist das Ziel eines Forschungsprojektes des IKF Frankfurt und IPHC Straßburg.
In diesem Beitrag werden nicht-ionisierende Strahlenschäden in dotiertem Silizium untersucht. Ihnen liegt das NIEL-Modell zu Grunde, das quantitativ Strahlenschäden von Teilchen in Silizium beschreibt. Auf der Basis zwei bereits durchgeführter Studien langsamer Neutronen lässt sich vermuten, dass das NIEL-Modell im niederenergetischen Bereich für CMOS-Sensoren nicht vollständig ist. Das im dotiertem Silizium enthaltene Fremdatom Bor kann durch einen Neutroneneinfang zerfallen, wodurch langsame Neutronen zusätzliche Strahlenschäden generieren können. Deswegen wird eine Formel entwickelt, die diese Strahlenschäden berücksichtigt, um Aussagen bezüglich der Relevanz des Borzerfalls treffen zu können. Daran anknüpfend wird geprüft, ob das NIEL-Modell durch diesen zusätzlichen Beitrag ergänzt werden kann. Schließlich kann man zu der Schlussfolgerung kommen, dass der Borzerfalls nicht zu vernachlässigende Strahlenschadeneffekte hat und deswegen eine Ergänzung des NIEL-Modells im niederenergetischen Bereich sein kann.
*gefördert durch das BMBF (05P12RFFC7), HIC for FAIR und GSI.

HK 45.50 Mi 18:30 S1/05 22-24

Research and Development for the PANDA Backward End-Cap of the Electromagnetic Calorimeter — •David Rodríguez Piñeiro[1], Oliver Noll[1,2], Luigi Capozza[1], Samer Ahmed[1,2], Alaa Dbeyssi[1], Frank Maas[1,2], Heybat Ahmadi[2], and Alexander Aycock[2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz — [2]Institut für Kernphysik Mainz

For the construction of the Backward End-Cap (BWEC) of the PANDA Electromagnetic Calorimeter (EMC) various tests regarding the mechanics and the monitoring system are necessary and will be discussed. In addition, a full prototype of the supporting system is under construction, comprising insertion rails, alignment feet, base and test arm supports, test mounting plates and basalt feet. This will allow testing the moving trajectory and insertion of the whole detector, including the specifications for the alignment. A customized solution for the monitoring and positioning of optical fibers for calibration and the insertion in the cold volume will be carried out. The status and the prospects of this development work will be shown and discussed.

HK 45.51 Mi 18:30 S1/05 22-24

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

The new in-flight separator Super-FRS is under construction at the Facility for Antiproton and Ion Research (FAIR, Darmstadt). Ion rates up to 3×10^{11} ^{238}U/spill demand an adaption of detectors to a high radiation enviroment. 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 62 MeV/u and intensities of up to 1.5 pnA. The setup consisted of pcCVD strip detectors to measure the beam profile, a single crytal diamond detector to calibrate the ionisation chamber 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 total

measured counts on the sample were 8.25×10^{11} counts/mm^2 over a period of 60 hours. Digital waveforms of the pcCVD signals were taken with an oscilloscope and analysed. The results showed no change of the pcCVD signal proprerties during the entire irradiation.

HK 45.52 Mi 18:30 S1/05 22-24

Efficiency Calculation for π^- + C and π^- + H_2 Reactions at HADES — •Steffen Maurus[1], Laura Fabbietti[1], Joana Wirth[1], and Alessandro Scordo[2] — [1]Technische Universität München, Germany — [2]Istituto nazionale di fisica nucleare, Italy

The study of strangeness production in hadronic matter is a major topic in the field of experimental nuclear physics, which requires modern and capable detector systems like the HADES detector. At SIS 18 at GSI Darmstadt this spectrometer provides excellent conditions to study rare states of matter like $\Phi, K^-, K^+, \bar{\omega}, \bar{K}^0_s$ in a precise way.

For the reconstruction of these states the detection efficiencies of all sub-detectors of the HADES setup has to be determined in an precise way. To do so, an correction procedure based on full physical quantities for the HADES detector was developed, using a secondary π^- beam in the momentum region of 690 MeV/c impinging on a Carbon and Polyethylen (C_2H_4) target. Explicitly the kinematic characteristics of elastic scattering of this system was used to obtain a correction map in Φ, Θ and momentum, which allows to extract corrected cross sections and yields of the studied reactions in the target. In this poster the detailed procedure as well as the results are illustrated. This work is supported by a joint project of BMBF 05P2015 and 05P15WOFCA.

HK 45.53 Mi 18:30 S1/05 22-24

Full magnetic storage of ultra-cold neutrons in τSPECT — •Jan Haack[1], Marcus Beck[1,2], Klaus Eberhardt[1], Christopher Geppert[1], Werner Heil[1], Jan Kahlenberg[1], Jan Karch[1], Sergey Karpuk[1], Fabian Kories[1], Kim Ross[1], Christian Siemensen[1], Yuri Sobolev[1], and Norbert Trautmann[1] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz

τSPECT aims to measure the lifetime of free neutrons. This lifetime factors into the CKM-Matrix and thus a precise measurement allows for a test of the standard model as well as conclusions regarding the genesis of matter. To eliminate losses during the storage due to neutron capture in materials, a full magnetic storage is set up. The longitudinal magnetic reservoir field is provided by super conducting magnets previously used in the aSPECT experiment and several added correction coils. Radial magnetic storage is realized with a permanent magnet multipole Halbach array. So far neutrons with radial kinetic energies of up to roughly 60neV are projected to be storable. On this poster the multipole-array and its storage capabilities for ultra-cold neutrons will be presented.

HK 45.54 Mi 18:30 S1/05 22-24

P2 - A fused silica Cherenkov detector for the high precision determination of the weak mixing angle — •Kathrin Gerz[1], Dominik Becker[1], Thomas Jennewein[1], Sebastian Baunack[1], Krishna Kumar[3], and Frank Maas[1,2] — [1]Johannes Gutenberg Universität Mainz — [2]Helmholtz Institut Mainz — [3]Department of Physics and Astronomy, Stony Brook University, Stony Brook, USA

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 $sin^2(\Theta_W)$ to a relative precision of 0.15%. Since the weak charge of the proton is small compared to its electric charge, the measurable asymmetry is in the order of only 30ppb, requiring a challenging measurement to a precision of only 0.5ppb or below. 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 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 both by simulations and by beam tests at the MAMI accelerator.

HK 45.55 Mi 18:30 S1/05 22-24

Aufbau eines GEM-Kalibrationsstandes für das MAGIX-Experiment an MESA — •Mirco Christmann — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Am Institut für Kernphysik der Johannes Gutenberg-Universität Mainz wird bald der neue Teilchenbeschleuniger MESA (Mainz Energy-Recovering Superconducting Accelerator) in Betrieb gehen. Im energierückgewinnenden Arm von MESA (105 MeV | 10 mA) soll das MAGIX-Experiment eingebaut werden. Ein Teil der beschleunigten Elektronen kollidiert dort mit einem Gasstrom und 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 x 0,30 m und einer Ortsauflösung besser als 50 μm benötigt. Geplant sind auf GEMs (Gaseous Electron Multipliers) basierende Detektoren, um mit einer geringen Strahlungslänge der niedrigen Strahlenergie zu entgegnen. Dieses Poster zeigt die Entwicklung eines Prototypen mit einer aktiven Fläche von 100 cm^2 und dessen Kalibration. Eine konventionelle Bestimmung der Ortsauflösung soll mit einer Röntgenquelle und einem Aufbau aus Referenzdetektoren realisiert werden. Des Weiteren soll eine innovative Methode zur Bestimmung der Ortsauflösung mit Hilfe von UV-Licht entwickelt werden, mit welcher eine Kalibration während des laufenden Experiments möglich wäre.

HK 45.56 Mi 18:30 S1/05 22-24

Performance studies of ionisation chambers for photon-induced fisson experiments — •Marius Peck[1], Joachim Enders[1], Martin Freundenberger[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]Fundamental Fysik, Chalmers teknsika högskola, Göteborg, Sweden

Angular and mass distributions as well as total kinetic energy of fission fragments in photon-induced fisson of ^{232}Th were obtained using a twin Frisch-grid ionization chamber at the superconducting Darmstadt electron accelerator S-DALINAC.
To improve the experimental luminosity, e.g. for future energy-resolved experiments at ELI-NP, while maintaining the overall resolution we are studying a multi-stack ionisation chamber.
We present investigations on the suitability of different gas-mixtures for optimizing the electrode design of said multi-stack chamber.
Supported in part by BMBF (05P15RDENA).

HK 45.57 Mi 18:30 S1/05 22-24

Erforschung eines neuartigen Injektionssystems für einen toroidalen Hochstromspeicherring — •Heiko Niebuhr, Adem Ates, Martin Droba, Oliver Meusel, Daniel Noll, Ulrich Ratzinger und Joschka Wagner — Institut für Angewandte Physik, Goethe-Universität Frankfurt

Zur Realisierung des angedachten supraleitenden magnetostatischen Speicherrings (F8SR) zur Speicherung hoher Ionenströme (bis zu 10 A) wird an der Universität Frankfurt ein herunterskaliertes Strahlexperiment mit zwei normalleitenden Toroidsegmenten (0,6 T) durchgeführt. Nachdem die Dynamik beim Transport eines Ionenstrahls durch einen solchen toroidalen Kanal erforscht wurde, wird im nächsten Schritt die seitliche Injektion mittels einer Injektionsspule bei gleichzeitigem Transport des Ringstrahls untersucht. Die niederenergetischen Wasserstoffionen werden dazu mittels zweier Volumenionenquellen bereitgestellt und dann mit Hilfe zweier Filterkanäle gefiltert, um Ionenstrahlen bestehend aus einer Spezies zu erhalten. Der eine Strahl wird in das erste Toroidsegment und der andere mittels einer Injektionsspule zwischen die beiden Toroidsegmente injiziert. Zur Untersuchung stehen verschiedene Strahldiagnosesysteme zur Verfügung. Zur Umsetzung des angedachten Experiments werden neben theoretischen und experimentellen Befunden auch Simulationen mit dem am IAP in Entwicklung befindlichen 3D-Simulationsprogramm bender genutzt. Dabei wird das aufzubauende Experiment und der Parameterraum zuvor mittels Simulationen weitläufig untersucht, um den optimalen Injektions- und Transportkanal für das Experiment zu finden.

HK 45.58 Mi 18:30 S1/05 22-24

Multiconfigurational Many-Body Perturbation Theory for Ab Initio Nuclear Structure — •Alexander Tichai and Robert Roth — Institut für Kernphysik, TU Darmstadt

Many-body perturbation theory provides a simple yet effective tool for ab initio calculations of nuclear observables. In the case of closed-shell systems the Hartree-Fock wave function defines an adequate starting point for the calculation of perturbative corrections. We have shown that the perturbation series converges exponentially fast and third-order partial sums yield a good approximation to the ground-state

energy over the whole mass range up to ^{132}Sn. However, when proceeding to open-shell systems the ground-state wave function is no longer dominated by a single determinant. Therefore, we choose a multiconfigurational reference state arising from a diagonalization in a small model space. A recursive treatment allows for the calculation of energy corrections up to order 30 for small systems. Furthermore, we present second-order energy corrections for ground-state energies of the oxygen chain. We use two- and three-body interactions constructed from chiral effective field theory which are evolved via a similarity renormalization group transformation. All results are compared to configuration interaction and recent multireference in-medium similarity renormalization group calculations.

Supported by GSI, DFG (SFB 1245), HIC for FAIR, and BMBF (05P15RDFN1)

HK 45.59 Mi 18:30 S1/05 22-24

Das Kühlsystem für den PANDA-Luminositätsdetektor — •Heinrich Leithoff[1], Florian Feldbauer[1], Roman Klasen[1], Stephan Maldaner[1], Mathias Michel[1,2], Christof Motzko[1,2], Stefan Pflüger[1], Tobias Weber[2] und Miriam Fritsch[1,2] für die PANDA-Kollaboration — [1]Helmholtz-Institut Mainz — [2]Institut für Kernphysik, Johannes Gutenberg Universität Mainz

Der Luminositätsdetektor für das PANDA-Experiment, das als Teil der FAIR-Beschleunigeranlage in Darmstadt entsteht, wird die Luminosität anhand der Winkelverteilung elastisch gestreuter Antiprotonen bei sehr kleinen Winkeln bestimmen. Um die gewünschte Genauigkeit in der Spurbestimmung zu erreichen, werden die Spuren mit vier Lagen Silizium-Pixelsensoren (HV-MAPS) vermessen. Ausserdem müssen störende Einflüsse wie Vielfachstreuung minimiert werden. Dazu befindet sich das Detektorsystem im Vakuum. Da HV-MAPS aktive Sensoren sind und im Vakuum keine Kühlung über Konvektion möglich ist, muss aktiv gekühlt werden. Gleichzeitg musste darauf geachtet werden, dass für das Kühlsystem die Massenbelegung minimiert wird. Somit werden Kühlsystem und mechanische Halterung der Sensoren kombiniert und bestehen aus 200*m dünnen Diamantscheibchen, auf die die Sensoren aufgeklebt werden, sowie einer Aluminiumstruktur, in die für einen guten thermischen Übergang ein Edelstahlrohr für Kühlflüssigkeit eingeschmolzen wurde. Präsentiert wird ein Überblick über den Status des Kühlsystems und seine erwartete Leistungsfähigkeit.

HK 45.60 Mi 18:30 S1/05 22-24

In-Medium Similarity Renormalization Group for Nuclear Structure—Applications and Extensions — •Klaus Vobig and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt

The In-Medium Similarity Renormalization Group (IM-SRG) is a very flexible ab initio many-body method for the calculation of nuclear structure observables over a wide mass range.

We employ the IM-SRG for the study of a new generation of consistent interactions derived from chiral effective field theory within the LENPIC collaboration. Focussing on ground-state energies and charge radii for medium-mass nuclei, we study the order-by-order behavior of the chiral expansion.

Furthermore, we present a novel ab initio many-body approach that combines the IM-SRG with Configuration Interaction methods for targeting excited states and open-shell nuclei.

Supported by DFG (SFB1245), HIC for FAIR and BMBF (05P15RDFN1).

HK 45.61 Mi 18:30 S1/05 22-24

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. 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 45.62 Mi 18:30 S1/05 22-24

$\eta \to \pi^0 e^+ e^-$ with WASA-at-COSY: C-violation in electromagnetic meson decays* — •Kay Demmich, Florian Bergmann, Nils Hüsken, Karsten Sitterberg, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The C-symmetry and the invariance of the electromagnetic and the strong interaction under a charge conjugation transformation are basic concepts of the standard model. The electromagnetic decay $\eta \to \pi^0 e^+ e^-$ via a virtual photon violates the C-parity and alternative C-conserving processes are strongly suppressed. Hence, studies on this η-decay are of high interest in order to test the conservation of the C-parity within the standard model and to search for physics beyond the standard model, e.g., for dark bosons. Since this decay has not yet been observed, only an upper limit of the branching ratio of 4×10^{-5} is quoted by the PDG. A huge data set of $\approx 5 \times 10^8$ η mesons dedicated for studies on rare and forbidden η-decays has been measured with the WASA-at-COSY setup, which allows for a determination of the relative branching ratio more sensitively than the recent upper limit. The current status of the analysis will be presented and discussed.

*Supported by FFE program of the Forschungszentrum Jülich.

HK 45.63 Mi 18:30 S1/05 22-24

Mechanical integration of the detector components for the CBM Silicon Tracking System — •Oleg Vasylyev and Wolfgang Niebur for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to explore the QCD phase diagram in the region of high net-baryon densities. The central detector component, the Silicon Tracking System (STS) is based on double-sided micro-strip sensors. In order to achieve the physics performance, the detector mechanical structures should be developed taking into account the requirements of the CBM experiments: low material budget, high radiation environment, interaction rates, aperture for the silicon tracking, detector segmentation and mounting precision. A functional plan of the STS and its surrounding structural components is being worked out from which the STS system shape is derived and the power and cooling needs, the connector space requirements, life span of components and installation/repair aspects are determined.

The mechanical integration is at the point of finalizing the design stage and moving towards production readiness. This contribution shows the current processing state of the following engineering tasks: construction space definition, carbon ladder shape and manufacturability, beam-pipe feedthrough structure, prototype construction, cable routing and modeling of the electronic components. *Supported by EU-Horizon2020 CREMLIN.

HK 45.64 Mi 18:30 S1/05 22-24

Entwicklung des Slow Control Systems für das MAGIX-Experiment am MESA. — •Stefan Lunkenheimer für die Magix/MESA-Kollaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, germany

Das MAGIX-Experiment hat das Ziel hochpräzise Messungen bei niedrigen Energien und hohen Strahlintensitäten am Elektronenbeschleuniger MESA durchzuführen. MESA soll in wenigen Jahren in Mainz in Betrieb genommen werden und ermöglicht es, mit Hilfe der Energierückgewinnung, einen sehr hohen Teilchenstrom zu erreichen. Mit der Verwendung eines Gas-Targets kann nun eine hohe Luminosität erreicht werden, sofern dieses fensterlos aufgebaut ist und die Elektronen nur mit dem Gas interagieren können. Hierbei beschäftigen wir uns mit dem Jet Target, wobei Gas durch eine Laval Düse beschleunigt und mit einer hohen Geschwindigkeit durch das Vakuum der Streukammer in einen „catcher“ bewegt wird, um dort direkt abgepumpt zu werden. Für das MAGIX-Experiment bedarf es eines komplexen Slow Control Systems.

Ziel ist es die Vielzahl an Messgeräten und Steuerelementen, welche zum Betrieb des Jet Targets benötigt werden, zu steuern und zu überwachen. Der generelle Aufbau sowie die Funktionsweise des Slow Controls soll auf diesem Poster veranschaulicht werden. Zusätzlich werden wir hier näher auf den Aufbau des Prototyp-Systems eingehen, welches

für den Teststand des Jet Targets entwickelt wird.

HK 45.65 Mi 18:30 S1/05 22-24

Interferometrische Methode zur Bestimmung eines Gas-Jet-Dichteprofils — •Julian Rausch für die Magix/MESA-Kollaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

MESA "Mainz Energy-Recovering Superconducting Accelerator" wird 2017 an der Johannes Gutenberg Universität Mainz als neuer Elektronenbeschleuniger in Betrieb gehen. Dieser ermöglicht hochpräzise Messungen bei niedrigen Energien und hoher Strahlintensität am MAGIX-Experiment. MAGIX verfügt über ein sogenanntes Gas-Jet-Target, welches die energierückgewinnende Eigenschaft des MESA-Beschleunigers zu nutzen ermöglicht. Außerdem wird es fensterlos betrieben, wodurch zusätzlich eine hohe Luminosität erreicht wird.

Die genaueren Eigenschaften des Targets wollen wir mithilfe einer interferometrischen Methode zur Bestimmung des Gas-Jet-Dichteprofils genauer überprüfen. Wir illustrieren den Aufbau des Targets, erläutern die Messmethode im Detail und stellen einige vorläufige Ergebnisse vor.

HK 45.66 Mi 18:30 S1/05 22-24

Entwicklungen für den $\overline{\text{P}}$ANDA MVD Silizium-Streifen-Detektor* — •Robert Schnell, Kai-Thomas Brinkmann, Valentino Di Pietro, Tommaso Quagli, Alberto Riccardi und Hans-Georg Zaunick für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

Das $\overline{\text{P}}$ANDA-Experiment am zukünftigen Beschleunigerzentrum FAIR in Darmstadt wird Reaktionen von Antiprotonen mit stationären Targets (Wasserstoff und schwere Kerne) untersuchen. Dadurch sollen wesentliche Erkenntnise zur starken Wechselwirkung erlangt werden. Der Mikro-Vertex-Detektor (MVD) als zentraler Tracking-Detektor soll hoch aufgelöste Spurvermessung und das Erkennen sekundärer Vertizes mit einer Auflösung von bis zu 100 μm ermöglichen. Dazu werden Hybrid-Pixel-Sensoren und doppelseitige Silizium-Streifen-Sensoren eingesetzt.

Vorgestellt werden aktuelle Entwicklungen und Ergebnisse. Dies beinhaltet Tests der ersten Lieferung finaler Sensoren für den MVD Detektor. Diese Messungen zur Charakterisierung werden zum Zwecke der Qualitätssicherung durchgeführt. Desweiteren werden erste Ergebnisse des speziell für den $\overline{\text{P}}$ANDA MVD entwickelten selbst-triggernden Front-End Chips zur Auslese der Streifen-Sensoren - PASTA (**P**ANDA **ST**rip **A**SIC) - präsentiert.

Unterstützt vom BMBF, HICforFAIR und JCHP.

HK 45.67 Mi 18:30 S1/05 22-24

Construction of a Test Stand for the Measurement of the Light Output Uniformity of CALIFA Crystals — •Markus Susenburger, Alexander Ignatov, and Thorsten Kröll — Technische Universität Darmstadt, Darmstadt, Germany

Currently, the **F**acility for **A**ntiproton and **I**on **R**esearch (FAIR) at GSI in Darmstadt is under construction. One experiment at GSI and FAIR is called **R**eactions with **R**elativistic **R**adioactive **B**eams (R^3B). A key component of the R^3B is the **CAL**orimeter for **I**n **F**light detection of γ-rays and light charged p**A**rticles (CALIFA), which will surround the R^3B target chamber and will be capable of the detection of γ-rays in a wide energy range from 100 keV to 30 MeV as well as of light charged particles. CALIFA is built out of two parts, the so called CALIFA barrel and CALIFA endcap. The barrel consists of 1952 CsI(Tl) detector crystals which have to fulfill several specifications. One of these specifications is the uniformity of the light output. Depending on the location of the deposited energy, the crystal's light output varies due to optical focusing effects. This behavior can be manipulated by lapping the crystal's surface. The aim of this work is the development of a test stand which will check if the crystals match the requirements according to the light output uniformity. Because of the large number of crystals needed to be tested, the stand automates the test procedure, which guarantees comparable test measurement for all crystals. The development and construction of this stand is reported.

Work supported by the German BMBF (05P15RDFN1).

HK 45.68 Mi 18:30 S1/05 22-24

The primary target for the hypernuclear experiment at $\overline{\text{P}}$ANDA — Sebastian Bleser[1], Felice Iazzi[2], •Marta Martinez Rojo[1], Josef Pochodzalla[1,3], Nicolas Rausch[3], Alicia Sanchez Lorente[1], and Marcell Steinen[1] for the PANDA-Collaboration — [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 mechanical integration of this system within the vacuum chamber attached to the beampipe. Its motion is controlled using the EPICS framework as planned for $\overline{\text{P}}$ANDA. In addition the results of radiation tests with foreseen target wires will be presented.

HK 45.69 Mi 18:30 S1/05 22-24

Experimental study of nuclear vorticity with the ^{12}C(e,e'γ) reaction at the QCLAM electron spectrometer* — •Tobias Klaus, Simela Aslanidou, 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 plan 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 45.70 Mi 18:30 S1/05 22-24

Development of an event builder for the new SADC-readout of the Crystal Barrel calorimeter — •Jan Schultes and Johannes Müllers for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The CBELSA/TAPS experiment at the electron accelerator ELSA in Bonn investigates the photoproduction of mesons off nucleons.

Presently the readout of the CsI(Tl)-crystals of the Crystal Barrel calorimeter is being upgraded from a PIN-diode readout to an APD readout to create a fast signal for first-level-triggering. Furthermore, an entirely new setup consisting of Sampling-ADCs (SADC) with FPGA-based readout is being prepared to increase the possible data rate achievable.

The SADC is capable of sampling pulses from the detector with 80 MHz, extracting features by FPGA-logic and transferring this data via UDP. To improve package-handling, a server-client structure will be provided. It is foreseen to receive packages from each of the 48 SADC units (32 channels each), detect and handle possible package losses, distribute the received information further via TCP and control the SADC-behaviour. In addition and to assist the FPGA firmware development, a tool to monitor outgoing pulses and to extract important features, such as the deposited energy, timing information and pile-up detection to cross-check the information given by the FPGA is being developed.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 45.71 Mi 18:30 S1/05 22-24

Superconducting Shielding for a Polarized Target in $\bar{\text{P}}$ANDA — •María Carmen Mora Espí[1], Bertold Fröhlich[1], Alaa Dbeyssi[1], Patricia Aguar Bartolomé[1], Kathrin Gerz[1], Samer Ahmed[1], Yadi Wang[1], Dexu Lin[1], Ana Peñuelas[2], and Florian Feldbauer[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz — [2]Universitat de València

The measurement of the phase between the electric and the magnetic form factors of the proton can be measured using a polarized interaction. A feasible possibility to allow this kind of reactions would be to develop a transversely polarized proton target to be used in the $\bar{\text{P}}$ANDA experiment. 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 $\bar{\text{P}}$ANDA solenoid.

BSCOO-2212, a new high-temperature superconductor material, has been identified as a possible candidate to be used for shielding this ex-

ternal magnetic field. Tests at 4 K have taken place in the Helmholtz Institute Mainz with this material, and the first preliminary results will be shown here.

HK 45.72 Mi 18:30 S1/05 22-24

An FPGA-based Slowcontrol Module and a Baseline shifting extension card for the Sampling-ADC Readout of the Crystal Barrel Calorimeter — •Georg Urff and Timo Poller for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

At the electron accelerator ELSA (Bonn) the CBELSA/TAPS experiment investigates the photoproduction of mesons off protons and neutrons. The CsI(Tl)-crystals of the Crystal Barrel calorimeter are being upgraded from a PIN-diode readout to an APD readout. In the context of this upgrade, an FPGA-based Sampling-ADC (SADC) is presently being developed (HK 304).

A Slowcontrol Module for the SADC with TCP/Telnet access has been developed on the basis of a Spartan6 FPGA. Control and monitoring of the SADC's power supply as well as control of parameters of the analog and digital data processing in the SADC is realized via PMBus/I^2C. The prototype as well as an overview of its functionality will be presented.

In order to fully utilize the dynamic input range of the SADCs, an interfacing extension board was designed. It receives the differential signal generated by previous amplification stages and adds an individual DC offset voltage to each channel supplied by a digital-to-analog converter. The circuit and the used techniques as well as simulations and measurements will be presented.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 45.73 Mi 18:30 S1/05 22-24

Event reconstruction for the RICH prototype beamtest data 2012 and 2014. — •Semen Lebedev for the CBM-Collaboration — II. Physikalisches Institut JLU Giessen

The Compressed Baryonic Matter (CBM) experiment at the future FAIR facility will investigate the QCD phase diagram at high net baryon densities and moderate temperatures in A+A collisions from 2-11 AGeV (SIS100). Electron identification in CBM will be performed by a Ring Imaging Cherenkov (RICH) detector and Transition Radiation Detectors (TRD).

A real size prototype of the RICH detector was tested together with other CBM prototypes (TRD, TOF) at the CERN PS/T9 beam line in 2012 and 2014. In 2014 for the first time the data format used the FLESnet protocol from CBM delivering free streaming data. The analysis was fully performed within the CBMROOT framework. In this contribution the event reconstruction methods which were used for obtained data are discussed. Rings were reconstructed using an algorithm based on the Hough Transform method and their parameters were derived with high accuracy by circle and ellipse fitting procedures. Results of the application of the presented algorithms will be also presented.

HK 45.74 Mi 18:30 S1/05 22-24

Feasibility studies for the open-charm production in proton-antiproton reactions for the PANDA experiment — •Solmaz Vejdani for the PANDA-Collaboration — KVI-CART, University of Groningen, The Netherlands — Forschungszentrum Jülich, Jülich, Germany

The PANDA experiment is one of the pillars of the future Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. The PANDA physics program is focused on answering fundamental questions related to Quantum Chromodynamics (QCD), mostly in the non-perturbative energy regime. Spectroscopy exploiting Λc -baryons that are composed of a heavy charm valence quark and two light valence quarks is an integral part of the PANDA physics program. Such systems can systematically provide information on various key features of QCD, such as heavy-quark symmetry, chiral symmetry breaking, and the nature of exotic states. In this work, the experimental feasibility of studying the production mechanisms of associative open-charm baryons in antiproton-proton annihilations is investigated by using Monte Carlo simulations. I present results obtained for the channel $p\bar{p} \to \bar{\Lambda}_c \Lambda_c$, highlighting the detector performances (efficiencies and resolutions) and the statistical significance that can be achieved with the foreseen luminosities.

HK 45.75 Mi 18:30 S1/05 22-24

Test of a PCIe based readout option for PANDA — •Simon Reiter[1], Heiko Engel[2], Sören Lange[1], and Wolfgang Kühn[1] for the PANDA-Collaboration — [1]Justus-Liebig-Universität Giessen, Germany — [2]Goethe-Universität 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, leading to the requirement of large data bandwidths. The data reduction will be guaranteed on the rst level by an array of FPGAs running a full online reconstruction followed by the second level of a CPU/GPU cluster to achieve a reduction factor more than 1000.

The C-RORC (Common Readout Receiver Card), originally developed for ALICE (A. Borga et al., JINST 10 (2015) 02, C02022), provides on the one hand 12 optical links with 6.25 Gbps each, and on the other hand a PCIe interface with up to 40 Gbps.

The receiver card has been installed and tested, and the rmware has been adjusted for the Panda data format. Test results will be presented.
*This work is supported by BMBF(05P12RGFPF).

HK 46: Hauptvorträge II

Zeit: Donnerstag 11:00–12:30 Raum: S1/01 A1

Hauptvortrag HK 46.1 Do 11:00 S1/01 A1

Charmonium(like) Spectroscopy — •Zhiqing Liu — Johannes Gutenberg University Mainz, Mainz, Germany

Since its discovery in 1974, charmonium spectroscopy has always been an important probe to study strong interactions and the structure of hadronic matter. Below open-charm threshold, the charmonium spectrum is well established now. Also our understanding of charmonium states above the open-charm threshold has seen a big progress during recent years. However, the most surprising was the discovery of charmoniumlike states, which have a similar mass scale as charmonium states but can not be classified as conventional states easily. Indeed, charmoniumlike states are good candidates for the so-called exotic hadron states, i.e. particles with a quark content different from normal mesons and baryons, such as multi-quark states, hybrid states or molecule states. Although neutral charmoniumlike states are more difficult to be identified, the observation of charged states provide us a convincing evidence. In this talk, I'll review the recent progress on charmonium and charmoniumlike spectroscopy from BESIII, Belle, BABAR, CLEO-c and LHCb and the prospect for future experiments at Belle II and PANDA.

Hauptvortrag HK 46.2 Do 11:30 S1/01 A1

Ever-changing proton radius?! — •Miha Mihovilovic — Institut für Kernphysik, Johannes-Gutenberg-Universität, Johann-Joachim-Becher-Weg 45, D-55128 Mainz, Germany

The discrepancy between the proton charge radius extracted from the muonic hydrogen Lamb shift measurement and the presently best value obtained from elastic scattering experiments remains unexplained and represents a burning problem of today's nuclear physics. Therefore, several new experiments are underway, committed to provide new insight into the problem. High-precision electron scattering experiments are in progress at the Jefferson Lab and the Mainz Microtron. As a counterpart to these measurements, a muon-proton scattering experiment is envisioned at the Paul Scherrer Institute. Together with the nuclear scattering experiments, new atomic measurements are underway at the Max Planck Institute in Garching, which aim to further improve also the spectroscopic results on electronic hydrogen. These experiments are complemented by extensive theoretical efforts focused on studying various processes contributing to the atomic Lamb shift measurements that could explain the difference, as well as on pursuing different ways to interpret nuclear form-factor measurements, which could lead to a consistent value of the radius.

In this presentation the currently best proton radius measurements will be summarized, and the importance of the observed inconsistency

between the hydrogen and the muonic-hydrogen data will be discussed. Selected new experiments dedicated to remeasuring the radius will be described, and the results of the MAMI experiment will be presented.

Hauptvortrag HK 46.3 Do 12:00 S1/01 A1

Towards HISPEC@FAIR: Opportunities and first results with AGATA — •Christian Stahl — Institut für Kernphysik, TU Darmstadt, Germany

The Advanced GAmma Tracking Array (AGATA) will be the central instrument for the in-beam γ-ray spectroscopy experiment HISPEC at the future FAIR facility. The technique of γ-ray tracking and the position-sensitivity of the AGATA detector array will provide unprecedented sensitivity for the spectroscopy of fast-moving, exotic nuclei and facilitate novel experimental approaches and refinements of well-established techniques. This talk will introduce the opportunities for γ-spectroscopy arising from AGATA for FAIR, discuss novel experimental techniques and present first results obtained with AGATA in in-beam γ-ray spectroscopy experiments at various experimental setups.

This work was supported by the BMBF under grants 05P12RDFN8 and 05P15RDFN1.

HK 47: Hadron Structure and Spectroscopy VIII

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A5

Gruppenbericht HK 47.1 Do 14:00 S1/01 A5

Study of η-Meson Decays with the WASA-at-COSY experiment — •Daniel Lersch for the WASA-at-COSY-Collaboration — Forschungszentrum Juelich, Germany

The study of η-decays allows to probe symmetry-breaking phenomena (e.g. C- and CP-violation), to measure the electromagnetic transition form factor and to explore the anomalous sector of QCD.

In order to perform those studies two data samples have been acquired with the WASA-at-COSY facility at Forschungszentrum Jülich. A proton beam, provided by COSY, is impinged upon a liquid deuterium / hydrogen pellet target producing η-mesons via: $pd \rightarrow {}^3\mathrm{He}\eta$ / $pp \rightarrow pp\eta$. The η-decay products as well as the forward-scattered projectiles are detected within the 4π WASA-at-COSY detector.

A first iteration of measurements was done using the $pd \rightarrow {}^3\mathrm{He}\eta$ reaction for the study of the more abundant η decay channels (such as $\eta \rightarrow \pi^+\pi^-\pi^0$) and to set up the framework for a common analysis. In order to address the rare η-decays (e.g. $\eta \rightarrow \pi^+\pi^-e^+e^-$) a high-statistics data set has been collected using the reaction $pp \rightarrow pp\eta$.

The current analysis of the $pp \rightarrow pp\eta$ data set is dedicated to the isospin violating decay $\eta \rightarrow \pi^+\pi^-\pi^0$; The determination of the electromagnetic transition form factor via the decays $\eta \rightarrow e^+e^-\gamma$ and $\eta \rightarrow e^+e^-e^+e^-$; Testing C- and CP-violation by investigating $\eta \rightarrow \pi^0e^+e^-$ and $\eta \rightarrow \pi^+\pi^-e^+e^-$; Exploring the box anomaly via the radiative decay $\eta \rightarrow \pi^+\pi^-\gamma$.

This talk will give an overview about the status of the analyses.

HK 47.2 Do 14:30 S1/01 A5

Study of excited η mesons at CLAS. — •Cathrina Sowa — Institut für Experimentalphysik I, Ruhr Universität Bochum

The analysis presented in this talk focuses on the reaction $\gamma p \rightarrow p\pi^+\pi^-\eta$ to investigate excitations of η mesons. The CLAS experiment at CEBAF at Jefferson Laboratory investigates photoproduction on the proton with high intensities. The observed η' as well as the $\eta(1295)$ and $\eta(1405)$ decay preferably to $\pi^+\pi^-\eta$.

Based on SU(3) symmetry for the light mesons a singlet as well as an octet is formed. Each contains one isoscalar state which mix to the lightest pseudoscalar mesons η and η'. Thus two first radial excitations are expected, but three states were found: $\eta(1295)$, $\eta(1405)$ and $\eta(1475)$. The $\eta(1405)$ is debated to be a gluonic bound state because it has been observed in gluon rich production mechanisms only. In this scenario the $\eta(1405)$ should have a low production cross section in $\gamma\gamma$ fusion or photoproduction.

We report on preliminary results for η',$f_1(1285)/\eta(1295)$ and $\eta(1405)$ production cross sections in $\gamma p \rightarrow p\pi^+\pi^-\eta$.

HK 47.3 Do 14:45 S1/01 A5

Measuring the branching fraction of $\omega \rightarrow \eta\gamma$ 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_γ = 1.4 to 1.6 GeV) and the liquid hydrogen target.

With this dataset we want to measure the branching fraction of the $\omega \rightarrow \eta\gamma$ 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. This work is supported by DFG under contract SFB1044.

HK 47.4 Do 15:00 S1/01 A5

Measurement of the relative branching fraction of $\eta' \rightarrow \pi^0\pi^0\pi^0$ — •Martin Wolfes und Wolfgang Gradl für die A2-Kollaboration — Institut für Kernphysik Universität Mainz, Mainz, Rheinland-Pfalz

The A2 Collaboration uses an electron beam provided be 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 photo-produced η' and ω mesons off a hydrogen nuclei. This dataset is used to determine various branching fractions.

In this talk the ongoing work on the analysis of the isospin-violating decay of η' to three neutral pions is presented. We will also present an addon for the PLUTO event generator, which produces a cocktail of photo-production data for a given energy distribution.

HK 47.5 Do 15:15 S1/01 A5

XYZ rates with $\overline{\mathrm{P}}$ANDA at FAIR — •Elisabetta Prencipe[1] and Jens Soeren Lange[2] for the PANDA-Collaboration — [1]Forschungszentrum Jülich IKP1, Jülich (DE) — [2]Justus-Liebig-Universität Giessen, Giessen (DE)

Narrow states have been recently observed, which do not fit into the predictions of static quark anti-quark potential, and thus they are often regarded as exotic states. The $\overline{\mathrm{P}}$ANDA experiment at FAIR aims, among other topics of interest, to investigate XYZ states in the charmonium mass region in antiproton-proton collisions, with a very high rate ($\leq 10^7$ interactions per second), leading to a copious and statistically significant production of theses states with up to 10^4 per day, already on the first day of data taking with an average luminosity of L=10^{31} cm^{-2}s^{-1}. We present results from a complete MC simulation, and estimates on cross sections of the X(3872), the Y(4260) and the charged Z(3900). In particular new, yet unobserved states will be explained, for which the production in e^+e^- collisions, radiative decays or B meson decays is forbidden, e.g. by parity conservation, and production in $\bar{p}p$ collisions represents a unique possibility.

HK 47.6 Do 15:30 S1/01 A5

simulations of the measurement of the form factor for the D_s semileptonic decay with the PANDA detector — •Lu Cao[1], Tobias Stockmanns[1], and James Ritman[1,2] for the PANDA-Collaboration — [1]Forschungszentrum Jülich GmbH — [2]Ruhr- Universität Bochum

The PANDA experiment will study a wide range of physics topics with beams of antiprotons incident on fixed protons or complex nuclei targets. One of the interesting issues is the D_s semileptonic decay, which is governed by both the weak and strong forces. Here the strong interaction effects can be parameterized by the transition form factor. Techniques such as lattice QCD offer increasingly precise calculations, but as the uncertainties shrink, experimental validation of the results

becomes increasingly important. The achievable performance of the full PANDA detector for these types of reactions has not yet been studied in detail; however, this is expected to work very well based upon the design performance and experience with similar detector systems.

We evaluate the performance in the measurement of the semileptonic decay form factor of $D_s^+ \to \eta\nu_e e^+$. With different beam momenta, the Monte Carlo studies have been performed to obtain the achievable reconstruction efficiency using a complete simulation model of the detector and analysis tools. In the reconstruction procedure, we focus on developing the software and evaluating the expected precision. This talk summarizes the simulation status of the D_s decay chain. With theoretical predictions of the cross section, we obtain a preliminary estimate of the expected count rate for the future data taking.

HK 47.7 Do 15:45 S1/01 A5

Momentum dependence of the imaginary part of the ω- and η'-nucleus optical potential* — •Stefan Friedrich and Mariana Nanova for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The attenuation of ω- and η'-mesons in cold nuclear matter has been studied in photonuclear reactions on ^{12}C and ^{93}Nb for photon energies of 1.2-2.9 GeV, using the tagged photon beam at the ELSA accelerator. ω- and η'-mesons have been identified via the $\omega \to \pi^\circ\gamma$ and $\eta' \to \pi^\circ\pi^\circ\eta$ decays, respectively, registered with the CBELSA/TAPS detector system. The momentum dependence of the transparency ratio has been determined for both mesons. Results on the in-medium width of the ω- and η'-meson and the corresponding meson-nucleon inelastic cross sections will be compared to previous experimental data [1,2] and recent theoretical predictions [3,4,5]. The energy dependence of the imaginary part of the ω- and η'-nucleus optical potential has been extracted. The higher statistics and finer binning of the present data allow an extrapolation to the production threshold. Corresponding values for the imaginary part of the optical potential will be discussed in view of recent determinations of the ω and η' scattering lenghts [6,7].

*Funded by DFG (SFB/TR16)

[1] M. Kotulla et al., *PRL* **100**, 192302 (2008). [2] M. Nanova et al., *PLB* **710**, 600 (2012). [3] D. Cabrera and R. Rapp, *PLB* **729**, 67 (2014). [4] A. Ramos et al., *EPJA* **49**, 148 (2013). [5] E. Oset and A. Ramos, *PLB* **704**, 334 (2012). [6] I. Strakovsky et al., *PRC* **91**, 045207 (2015). [7] E. Czerwinski et al., *PRL* **113**, 062004 (2014).

HK 48: Heavy Ion Collision and QCD Phases X

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A01

Gruppenbericht HK 48.1 Do 14:00 S1/01 A01

Charged-particle production in Pb-Pb collisions at the LHC measured with ALICE — •Federica Sozzi for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

In June 2015 data taking started at the LHC at CERN, with substantially increased collision rates and energies with respect to Run 1. Particle production at collider energies originates from the interplay of perturbative (hard) and non-perturbative (soft) QCD processes. Inclusive charged-particle production in pp collisions has been studied with the new data set collected by the ALICE experiment at $\sqrt{s} = 13TeV$. In this report the pseudorapidity distributions of primary charged particles are presented, as well as the transverse-momentum distribution and its evolution with the event multiplicity. In Pb-Pb measurements the investigation focuses on the deconfined quark-gluon state. The transverse-momentum spectrum measured in Pb-Pb collisions is compared with a pp minimum-bias reference spectrum measured at the same energy. The comparison is presented here in terms of the so called nuclear modification factor R_{AA} measured at $\sqrt{s_{NN}} = 5TeV$, the highest collision energy ever achieved in laboratory. The measurements in pp and Pb-Pb collisions are compared with results from Run 1 as well as with predictions from theoretical models.

HK 48.2 Do 14:30 S1/01 A01

Centrality dependence of charged-particle multiplicity at $\sqrt{s_{NN}}$=5.02 TeV Pb-Pb collisions measured by ALICE at LHC — •Tatiana Drozhzhova[1,2] and Alberica Toia[1,2] for the ALICE-Collaboration — [1]Goethe-Universitat, Frankfurt am Main — [2]GSI, Darmstadt

The multiplicity of produced particles is an important property of the collisions related to the initial energy density and collision geometry. Its dependence on the collision centrality is sensitive to the interplay between particle production from hard and soft processes and coherence effects between individual nucleon-nucleon scatterings. The Large Hadron Collider (LHC) now operates at a higher energy producing Pb-Pb collisions at a center-of-mass energy per nucleon pair of 5.02 TeV. Our work is concentrated on the centrality estimation and the study of the performance of centrality selection using different detector systems in ALICE. We have developed a new framework which allows a dynamic definition of the centrality estimators and allows to perform a run-by-run calibration in a more robust way. We present the centrality dependence of particle production in Pb-Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV measured by the ALICE experiment with a special emphasis on the event classification in centrality classes and its implications in the interpretation of the nuclear effects. Supported by Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe).

HK 48.3 Do 14:45 S1/01 A01

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 — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The charged-particle transverse momentum spectrum is an important observable for understanding quantum chromo-dynamics (QCD), theory of strong interactions in proton-proton collisions. In 2015 pp collisions at $\sqrt{s} = 13$ TeV and $\sqrt{s} = 5$ TeV were recorded using the ALICE detector at the LHC. The measurement of inclusive production of charged-particles in high-energy proton-proton collisions and its evolution with the event multiplicity is a key observable to characterize the global properties of the collision. With the increase in collision energy, the role of hard processes (parton scatterings with large momentum transfer) in final state particle production rapidly increases and offers the possibility to further constrain particle production models. The reach of the maximum beam energy of the Large Hadron Collider (LHC) allows the study of pp collisions over a wide range of centre-of-mass energy, and specifically the measurement of charged-particle spectrum at 5 TeV plays a key role in the construction of the nuclear modification factor (R_{AA}). In the talk transverse momentum distributions measured with ALICE at a collision energy of $\sqrt{s} = 13$ TeV and $\sqrt{s} = 5$ TeV in pp collisions will be presented. Results will be compared to models and to the previous ALICE measurements at other energies.

HK 48.4 Do 15:00 S1/01 A01

Measurement of jet fragmentation into charged particles in p-Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE — •Dennis Weiser for the ALICE-Collaboration — Physikalisches Institut, Heidelberg, Deutschland

The measurement of jet energy loss or jet properties in ultrarelativistic Pb-Pb collisions allows to access the properties of the Quark-Gluon Plasma. Specifically, measurements of jet fragmentation are sensitive to possible modifications of the parton radiation pattern and thus give insights into the energy loss mechanisms in the hot and dense medium.

The measurement of jet fragmentation in p-Pb collisions provides an important reference to the measurement in Pb-Pb collisions. To assign possible modifications observed in Pb-Pb collisions to in-medium effects a measurement in a reference system is needed in that the medium is not created, but where possible initial-state- or cold-nuclear-matter effects are present.

We present the measurement of the longitudinal momentum distribution of charged particles with transverse momentum $p_{\rm T} > 0.15$ GeV/c in charged jets in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV. Charged jets are reconstructed with the anti-$k_{\rm T}$ algorithm with a radius parameter of R=0.4. The underlying event is subtracted event-by-event as well as on the event ensemble level. The observed distributions are compared to a reference based on pp collisions.

HK 48.5 Do 15:15 S1/01 A01

Measurement of Identified Charged Hadrons 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) 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.

We report on the measurement of the charged hadron composition in charged jets from p-Pb collisions at $\sqrt{s_{\mathrm{NN}}}$= 5.02 TeV. The jets are reconstructed from charged tracks using the anti-k_{T} algorithm. Charged hadrons are identified via their specific energy loss dE/dx in the ALICE TPC.

We show the jet constituent spectra for different event multiplicities as functions of $p_{\mathrm{T}}^{\mathrm{charged}}$ and $z = p_{\mathrm{T}}^{\mathrm{track,charged}}/p_{\mathrm{T}}^{\mathrm{jet,charged}}$ and compare the results to those of pp collisions.

HK 48.6 Do 15:30 S1/01 A01

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

ALICE is a LHC experiment dedicated to heavy ion collisions, with the aim of understanding the physics of the hot and dense medium produced in collisions of lead ions.

Since November 2015 the LHC is running close to the designed energy, delivering collision energies of $\sqrt{s_{\mathrm{NN}}} = 5$ TeV per nucleon pair in the Pb–Pb collision system.

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

In this talk transverse momentum distributions measured with ALICE at a collision energy of $\sqrt{s_{\mathrm{NN}}} = 5$ TeV in Pb–Pb collisions will be presented. Spectra and R_{AA} will be shown in dependence on centrality. In addition the findings will be compared to current models.

HK 48.7 Do 15:45 S1/01 A01

Performance of the CBM experiment for measurements of charged particles anisotropic flow — •Vitalii Blinov[1,2] and Ilya Selyuzhenkov[2] for the CBM-Collaboration — [1]Goethe-Universitat, Frankfurt am Main — [2]GSI, Darmstadt

Energies of the beam provided by SIS100 at FAIR allow to reach high net baryon density that is important for the investigation of a part of the QCD matter phase diagram that is currently not well known. Anisotropic flow in heavy-ion collisions is an important observable for such investigations. Our work is concentrated on CBM performance for anisotropic flow measurements via azimuthal correlations between charged hadrons in a heavy-ion collisions. We use collisions simulated at various energies for different colliding systems with several models. The CBM experiment response is simulated with GEANT4 Monte-Carlo. For the analysis the CBM ROOT was used as well as the Q-vector Correction Framework that allows to remove effects of the azimuthal non-uniformity of the detectors.

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

HK 49: Astroparticle Physics III

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A02

Gruppenbericht HK 49.1 Do 14:00 S1/01 A02

Status des KATRIN-Experiments und aktive Methoden zur Untergrundreduktion — •Jan David Behrens für die KATRIN-Kollaboration — Institut für Kernphysik, Wilhelm-Klemm- Str. 9, 48149 Münster

Durch das **KA**rlsruhe **TRI**tium **N**eutrino-Experiment soll die Masse des Elektron-Antineutrinos mit einer Sensitivität von 200 meV/c^2 (90% C.L.) bestimmt werden. Die Vermessung der Form des Tritium-β-Spektrums im Endpunktbereich ermöglicht eine modellunabhängige Bestimmung dieses wichtigen Parameters.

Das Experiment besteht besteht aus einer gasförmigen Tritiumquelle, von der die Zerfallselektronen magnetisch durch differentielle und kryogene Pumpstrecken geführt werden. Die Energieanalyse der Elektronen erfolgt in einem Tandem aus elektrostatischen Spektrometern, die nach dem Prinzip des MAC-E-Filters arbeiten. Dort gespeicherte Elektronen und Ionen können zu einem erhöhten Untergrund führen. Eine Möglichkeit zur Untergrundreduktion ist das aktive Entfernen von gespeicherten Elektronen durch Erzeugung eines elektrischen Dipolfeldes oder eines magnetischen Pulses, um die Speicherbedingungen aufzuheben.

Der Vortrag gibt einen Überblick des aktuellen Status des KATRIN-Experiments mit Fokus auf die Ergebnisse der zweiten Inbetriebnahmephase des Hauptspektrometers und Detektors im Jahr 2014/2015. Außerdem wird die Methode des magnetischen Pulses zur Untergrundreduktion vorgestellt. Dieses Projekt wird unter dem Kennzeichen 05A14PMA durch das BMBF gefördert.

Gruppenbericht HK 49.2 Do 14:30 S1/01 A02

Status and Recent Results of the Double Chooz Neutrino Experiment — •Ilja Bekman for the Double Chooz-Collaboration — III. Physikalisches Institut B, RWTH Aachen University, 52056 Aachen, Germany

The Double Chooz experiment is a reactor neutrino disappearance experiment for the precision measurement of the mixing angle θ_{13}, neutrino oscillation parameter. Located on the nuclear reactor site in Chooz, France, two identical liquid scintillator detectors with baselines of 1050 m and 400 m are installed. These are measuring the flux of the antineutrinos from two reactor cores utilizing the signature of the inverse beta decay (IBD). With the far detector operating since 2011 first indication of the non-zero value of the mixing angle θ_{13} was found, and later refined with utilization of the neutron captures on Hydrogen - additionally to the Gadolinium - in the IBD channel. With the commissioning of the near detector in early 2015 one year of data with both detectors are now available. In this talk the overview of the experiment is given and newest results are presented.

HK 49.3 Do 15:00 S1/01 A02

Removal of stored particle background via the electric dipole method in the KATRIN main spectrometer — •Daniel Hilk for the KATRIN-Collaboration — Institut für Experimentelle Kernphysik, KIT, Karlsruhe

The goal of the KArlsruhe TRItium Neutrino (KATRIN) experiment is to determine the effective mass of the electron anti neutrino by measuring the electron energy spectrum of tritium beta decay near the endpoint. The goal is to reach a sensitivity on the neutrino mass of 200 meV for which a low background level of 10^{-2} counts per second is mandatory. Electrons from single radioactive decays of radon and tritium in the KATRIN main spectrometer with energies in the keV range can be magnetically stored for hours. While cooling down via ionization of residual gas molecules, they produce hundreds of secondary electrons, which can reach the detector and contribute to the background signals. In order to suppress this background component, several methods are investigated to remove stored electrons, such as the application of an electric dipole field and the application of magnetic pulses. This talk introduces the mechanism of background production due to stored electrons and their removal by the electric dipole method in the main spectrometer. In context of the spectrometer- and detector-commissioning phase in summer 2015, measurement results of the application of the electric dipole method are presented. This work was supported by the BMBF under grant no. 05A14VK2 and by the Helmholtz Association.

HK 49.4 Do 15:15 S1/01 A02

Electron spectroscopy measurements with a shifted analyzing

plane setting in the KATRIN main spectrometer — •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 200 meV/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.

To understand the various background contributions inside the spectrometer vessel different electric and magnetic field settings were investigated during the last commissioning phase.

This talk will focus on the so called shifted analyzing plane measurement in which the field settings were tuned in a way to provide non standard potential barriers within the spectrometer. The different settings allowed to perform a spectroscopic measurement, determining the energy spectrum of background electrons born within the spectrometer.

This project is supported by BMBF under contract number 05A11PM2.

HK 49.5 Do 15:30 S1/01 A02

Separation and Implantation of the Electron Capture Isotope ^{163}Ho for the ECHo Project — •Fabian Schneider for the ECHo-Collaboration — Institute für Physik und Kernchemie, Johannes Gutenberg-Universität Mainz

The ECHo collaboration aims at measuring the electron neutrino mass by recording the spectrum following electron capture of ^{163}Ho. To reach a sub-eV sensitivity, a large number of individual microcalorimeters is needed, into which the isotope must be implanted in a well controlled manner. The necessary amount of ^{163}Ho is produced by neutron irradiation of enriched ^{162}Er in the ILL high flux reactor. This introduces significant contaminations of other radioisotopes, which have to be quantitatively removed both, by chemical and mass spectrometric separation. The application of resonance ionization at the RISIKO mass separator guarantees the required isotope selectivity for purification and suitable energy for ion implantation. For optimum implantation into the detector pixels (170×170 μm^2) with minimum losses, a small ion beam spot at the implantation site is needed. For this purpose, post focusing ion optics were installed and characterized. Furthermore, to reliably provide an ion beam with high ionization efficiency, the temperature distribution of the ion source was optimized based on results of finite-element analysis of the heat flow.

HK 49.6 Do 15:45 S1/01 A02

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

The **E**lectron **C**apture ^{163}**Ho** experiment, **ECHo**, has the goal to probe the electron neutrino mass on a sub-eV level via the analysis of the calorimetrically measured **e**lectron **c**apture spectrum (**EC**) of ^{163}Ho.

For this metallic magnetic calorimeters will be used. The performance achieved by a first prototype of MMC with embedded ^{163}Ho already shows that the desired values of an energy resolution of $\Delta E_{FWHM} < 3$ eV and a signal risetime of $\tau < 1$ μs for ECHo can be reached.

Recently the energy available for the decay $Q_{EC} = 2833(30_{stat})(15_{sys})$ eV/c^2 has been precisely determind by ECHo. Given this Q_{EC}-value we expect a sensitivity on the electron neutrino mass below 10 eV in the first phase of the ECHo experiment, ECHo-1k. In this phase a high purity ^{163}Ho source with a total activity of 1 kBq will be measured by about 100 detectors operated in a dedicated cryogenic platform in a reduced background environment. The results from this experiment will define parameters to scale the experiment to the next phase ECHo-1M. There the total activity of the source will be 1 MBq and it will be measured by using 10^5 detectors. We present the current status of the ECHo experiment.

HK 50: Nuclear Astrophysics IV

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A04

Gruppenbericht HK 50.1 Do 14:00 S1/01 A04

The role of nuclear inputs in r-process nucleosynthesis — •Samuel Andrea Giuliani, Alexander Arzhanov, Stephen Friess, Gabriel Martínez-Pinedo, Heiko Möller, Andre Sieverding, and Meng-Ru Wu — TU Darmstadt

We have studied the sensitivity of the r-process abundances produced in dynamical ejecta from neutron star mergers to different nuclear mass models. For each mass model, the resulting abundances are almost independent of the astrophysical conditions and reproduce the general features of the observed r-process abundance. We find that the second peak around $A \sim 130$ is produced by the fission yields of the material that piles up in nuclei with $A \gtrsim 250$. We also find distinct differences in the predictions at and just above the third peak ($A \sim 195$) for different mass models, due to different neutron separation energies at $N = 130$.

Due to the crucial role that fission plays in r-process nucleosynthesis, we have computed the fission properties of superheavy nuclei using the BCPM energy density functional. We found that certain combinations of neutron and proton number lead to an enhanced stability against the spontaneous fission process, related with the existence of magic numbers in the superheavy region. However, the systematic of the fission properties is strongly affected by the choice of the collective degree of freedom when the fission path is obtained by minimizing the action integral. Finally, a comparison with other theoretical models and the consequences for r-process nucleosynthesis are discussed.

This work was supported by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute (VH-VI-417).

Gruppenbericht HK 50.2 Do 14:30 S1/01 A04

Recent progress at the LUNA 400 kV underground accelerator — •Daniel Bemmerer for the LUNA-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden

The experimental study of radiative capture reactions directly at the energies of relevance for astrophysics requires long experiments with low counting rate. This type of study has greatly benefited in recent years from the ultra-low γ-ray background level underground, in the INFN Gran Sasso laboratory, Italy. There, the LUNA 400 kV accelerator has enabled a rich research program. The ^{2}H(α,γ)^{6}Li reaction has been studied for the first time in the Big Bang energy region [1]. Very recently, three resonances have been observed for the first time in the ^{22}Ne(p,γ)^{23}Na reaction, directly at energies relevant for the hot-bottom burning process in asymptotic giant branch stars [2]. Studies on other hydrogen burning reactions on ^{17,18}O and ^{23}Na are ongoing, with promising preliminary results. The group report will show an overview of recent progress and discuss future perspectives, in particular on the future LUNA experiment on the Big Bang ^{2}H(p,γ)^{3}He reaction. — Supported by NAVI (HGF VH-VI-417).

[1] M. Anders *et al.*, Phys. Rev. Lett. 113, 042501 (2014).
[2] F. Cavanna *et al.*, Phys. Rev. Lett. in press, arXiv:1511.05329

HK 50.3 Do 15:00 S1/01 A04

Low-energy resonances in the ^{22}Ne(p,γ)^{23}Na reaction addressed with a 4π BGO summing detector — •Marcell Takács for the LUNA-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — TU Dresden

The ^{22}Ne(p,γ)^{23}Na reaction takes part in the neon-sodium cycle of hydrogen burning. This cycle is active in asymptotic giant branch (AGB) stars as well as in novae, and contributes to the nucleosythesis of neon and sodium isotopes. In order to reduce the uncertainties in the predicted nucleosynthesis yields, new experimental efforts to measure the ^{22}Ne(p,γ)^{23}Na cross section directly at the astrophysically relevant energies are needed.

In the first phase of the LUNA ^{22}Ne(p,γ)^{23}Na experiment, three new resonances have been discovered at 156-260 keV [1]. In the present talk, the results from the second experimental phase are reported. In this campaign, a 4π bismuth germanate summing detector has been used to address the lowest-energy resonances at 71 and 105 keV as well as direct capture. — Supported by NAVI (HGF VH-VI-417).

[1] F. Cavanna *et al.*, Phys. Rev. Lett. in press, arXiv:1511.05329

HK 50.4 Do 15:15 S1/01 A04

Investigation of the s-process branch-point nucleus ^{86}Rb at

HIγS* — •Philipp Erbacher[1], Jan Glorius[1], Johann Isaak[2], Bastian Loeher[2], Rene Reifarth[1], Deniz Savran[2], Kerstin Sonnabend[1], and Werner Tornow[3] — [1]Goethe Universität Frankfurt am Main, Germany — [2]GSI Helmholzzentrum für Schwerionenforschung, Germany — [3]Duke University, USA

The branch-point nucleus ^{86}Rb determines the isotopic abundance ratio ^{86}Sr/^{87}Sr in s-process nucleosynthesis. Thus, stellar parameters such as temperature and neutron density and their evolution in time as simulated by modern s-process network calculations can be constrained by a comparison of the calculated isotopic ratio with the one observed in SiC meteoritic grains. To this end, the radiative neutron-capture cross section of the unstable isotope ^{86}Rb has to be known with sufficient accuracy.
Since the short half-life of ^{86}Rb prohibits the direct measurement, the nuclear-physics input to a calculation of the cross section has to be measured. For this reason, the γ-ray strength function of ^{87}Rb was measured using the γ^3 setup at the High Intensity γ-ray Source facility at TUNL in Durham, USA. First experimental results will be presented.
*supported by the DFG (SO907/2-1), HGS-HIRe, and HIC for FAIR

HK 50.5 Do 15:30 S1/01 A04

Bestimmung der Halbwertszeit am langlebigen Isoptop 129-Iod — •Lukas Bott[1], Tanja Heftrich[1], Mario Weigand[1], Jan Glorius[1,2] und René Reifarth[1] — [1]Goethe-Universität Frankfurt am Main, 60438 Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt

Bei der Nukleosynthese im s- und r- Prozess spielen unter anderen (n,γ)-Reaktionen eine wichtige Rolle. Zur Bestimmung des Neutroneneinfangquerschnitts zum Beispiel bei ^{129}I(n,γ) ist eine genaue Kenntnis der vorhandenen Probenmenge nötig. Dazu wurde bei vorangegangenen Messungen auf verschiedene Möglichkeiten der Aktivitätsbestimmung zurückgegriffen. Die auf dieser Basis erhaltenen Querschnitte differieren allerdings um einen Faktor drei [1]. Um diesen Widerspruch zu klären soll eine neue Halbwertszeitbestimmung des ^{129}I, mit Hilfe von Niederenergie-Germaniumdetektoren stattfinden. Hierzu wurde stabiles ^{128}Te im Forschungsreaktor TRIGA an der Johannes Gutenberg Universität Mainz aktiviert und eine genaue Bestimmung der Teilchenzahl des produzierten ^{129}Te durchgeführt [2]. Erste Ergebnisse der Messung an ^{129}I werden in diesem Vortrag vorgestellt.

[1] R. Reifarth: Die Verzweigung des Nukleosynthesepfades am ^{128}I - ein stellares Thermometer, Dissertation, Eberhard-Karls-Universität zu Tübingen, 2002.

[2] M. Ziegler-Himmelreich: Produktion der radioaktiven Probe ^{129}I, Bachelorarbeit, Goethe-Universität Frankfurt am Main, 2014 (unveröffentlicht).

HK 50.6 Do 15:45 S1/01 A04

Relativistic mean-field model with energy-dependent self-energies for finite nuclei — •Sofija Antić[1,2] and Stefan Typel[1] — [1]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany — [2]Technische Universitt Darmstadt, Germany

Following previous applications to infinite nuclear matter and neutron stars, a relativistic mean-field (RMF) model that includes higher-order derivative (NLD) couplings and density dependent (DD) couplings of nucleons to the meson fields is extended to describe finite nuclei. For that purpose, it is necessary to determine a new parametrization of the DD-NLD RMF model. Experimental binding energies, charge and diffraction radii, surface thicknesses and other observables of a set of nuclei (^{16}O,^{24}O,^{40}Ca,...^{208}Pb) are used as constraints. The results are studied for different energy dependencies of the regulator functions in order to find the most suitable one that is consistent with the optical potential constraint for nucleons in nuclear matter.

This work is supported by the Helmholtz Association (HGF) through the Nuclear Astrophysics Virtual Institute (NAVI, VH-VI-417).

HK 51: Structure and Dynamics of Nuclei X

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A03

HK 51.1 Do 14:00 S1/01 A03

Beobachtung des gemischt-symmetrischen Ein-Phononen-$2^+_{1,ms}$-Zustands von ^{204}Hg — •Robert Stegmann[1], Thomas Möller[1], Norbert Pietralla[1], Georgi Rainovski[2], Christian Stahl[1], Marc Lettmann[1], Robert Janssens[3], Mike Carpenter[3] und 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

Im Rahmen des Interacting Boson Modells ergeben sich Proton-Neutron gemischt-symmetrische Zustände als Vertreter niedrigliegender Anregungen mit isovektoriellem Charakter. Der grundlegende gemischt-symmetrische Zustand in schwach kollektiven Kernen ist der stark mit dem 2^+_1-Zustand verwandte Ein-Quadrupol-Phonon-$2^+_{1,ms}$-Zustand. Bisher wurden solche Zustände in stabilen Kernen der Region um $A \approx 90$ und kürzlich auch um $A \approx 130$ untersucht. In der Umgebung des schwersten stabilen doppeltmagischen Kerns ^{208}Pb hingegen wurden noch keine solchen Zustände identifiziert. Als einzig stabiler Kern in der unmittelbaren Nachbarschaft mit $2\pi - 2\nu$-Struktur erweist sich ^{204}Hg. Aus diesem Grund wurde am Argonne National Laboratory ein Experiment durchgeführt, bei dem ^{204}Hg-Projektile mit dem ATLAS-Beschleuniger auf 890 MeV beschleunigt und beim Durchgang durch ein ^{nat}C-Target Coulomb-angeregt wurden. Gammastrahlung wurde mit dem Gammasphere-Spektrometer detektiert. Ergebnisse werden präsentiert und mit Rechnungen aus dem „quasiparticle phonon model“ verglichen. Gefördert durch die DFG unter Pi 393/2-3 und durch das BMBF unter 05P12RDCIB und 05P15RDCIA.

HK 51.2 Do 14:15 S1/01 A03

Identifikation niederenergetischer isovektorieller Oktupol-Zustände in ^{144}Nd — •Michael Thürauf, Thorsten Kröll und Marcus Scheck für die EXILL-Kollaboration — Institut für Kernphysik, TU Darmstadt, Germany

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 2012 im Verlauf der (n,γ)-Kampagne mit dem EXILL-Aufbau am ILL, Grenoble, ein ^{143}Nd(n,γ)-Experiment durchgeführt. Mit den Daten aus dieser Kampagne war es möglich, die Multipolmischungsverhältnisse δ der Übergänge $3^-_i \rightarrow 3^-_1$ zu bestimmen und damit die Natur der 3^-_i-Zustände festzulegen. Die Bestimmung der Linearpolarisation und dem damit verbundenen Strahlungscharakter σ durch Compton-Polarimetrie der $3^-_i \rightarrow 3^-_1$-Übergänge wird zurzeit noch ausgewertet. Erste vorläufige Ergebnisse sowie ein Ausblick auf die bevorstehende Lebensdauermessung des 3^-_3-Zustandes mit GAMS@ILL werden gezeigt.

Gefördert durch die DFG (KR 1796/2-1) und HGS-HIRe for FAIR.

HK 51.3 Do 14:30 S1/01 A03

Probing the O(6) character of ^{196}Pt with inelastic electron scattering — •Simela Aslanidou, Sergej Bassauer, Christoph Kremer, Andreas Krugmann, Peter von Neumann-Cosel, Norbert Pietralla, Maxim Singer, and Volker Werner — Institut für Kernphysik, Technische Universität Darmstadt

The Interacting-Boson-Model (IBM) [1] provides an elegant tool to classify low-lying collective states in medium and heavy mass even-even nuclei. One of its dynamical symmetries is O(6) and a crucial test of this theory is to investigate the monopole transitions to the band head of the K=0 , σ=N-2 band. A powerful tool to investigate monopole transitions is inelastic electron scattering. An experiment on ^{196}Pt -claimed to be a perfect O(6) nucleus [2]- has been recently completed at the superconducting electron linear accelerator S-DALINAC at Darmstadt using the high resolution LINTOTT spectrometer. The experiment and analysis results will be presented as well as the interpretation within the framework of IBM.
This work was supported by the DFG under contract SFB 634.

[1] F. Iachello, Phys. Rev. Lett. **87**, 052502 (2001)
[2] J. Cizewski et al., Phys. Rev. Lett. **40**, 167 (1978)

HK 51.4 Do 14:45 S1/01 A03

Study of the neutron deficient nucleus ^{180}Pt — •Claus Müller-Gatermann[1], Christoph Fransen[1], Alfred Dewald[1], Thomas Braunroth[1], Julia Litzinger[1], Jan Jolie[1], Karl-Oskar Zell[1], Rauno Julin[2], Tuomas Grahn[2], and Pavel Petkov[3] — [1]Institut für Kernphysik, Universität zu Köln, Deutschland — [2]Dept. of Physics, University of Jyväskylä, Finnland — [3]Bulgarian Academy of Sciences, Sofia, Bulgarien

The nuclei ^{176,178,180}Os are known to show the characteristic features of the critical point symmetry X(5). This symmetry was introduced by F. Iachello and describes nuclei at the critical point of deformation phase transition from a vibrator to axial rotor. A rapid change in deformation is expected when the proton number is changed, because the neutron number is close to mid-shell. Therefore we performed measurements to determine the lifetimes of low lying states in ^{180}Pt which is a neighbor of the X(5) type Os nuclei, from which absolute transition probabilities can be deduced directly. In this contribution we will report on a Recoil distance Doppler shift experiment which was performed at the JYFL, Jyväskylä (Finland). Furthermore the results of the ^{168}Yb(^{16}O,4n)^{180}Pt experiment using the fast timing technique to determine the lifetime of the rather longlived first 2+ state at the IKP, University of Cologne (Germany) will be presented. The experimental results will be discussed in the framework of the Interacting Boson Model and compared to a General Collective Model calculation. Supported by the Project ENSAR in the seventh framework programme, and the DFG under contract number DE 1516/3-1 and JO 391/16-1

HK 51.5 Do 15:00 S1/01 A03

Mixed-symmetry states and shape coexistence in N=52-56 Mo isotopes — •V. Werner[1,2], T. Thomas[2,3], J. Jolie[3], K. Nomura[4,5], T. Ahn[2,6], N. Cooper[2], H. Duckwitz[3], A. Fitzler[3], C. Fransen[3], A. Gade[3,7], M. Hinton[2], G. Ilie[2], K. Jessen[3,8], A. Linnemann[3], P. Petkov[3,9], N. Pietralla[1], and D. Radeck[3,10] — [1]IKP, TU Darmstadt — [2]WNSL, Yale U — [3]IKP, U Köln — [4]GANIL — [5]U Zagreb — [6]U Notre Dame — [7]NSCL, Michigan State U — [8]LMU München — [9]Bulg. Acad. Sci., Sofia — [10]PTB Braunschweig

Angular correlation experiments have been performed on ^{96}Mo and ^{98}Mo [1] at the IKP, Universität zu Köln, and at WNSL, Yale University. Lifetimes of excited states have been determined from line shape analyses. The extensive data set, compared to IBM-2 configuration mixing calculations based on microscopic EDFs, reveals the occurrence of coexistence of near-spherical and deformed configurations in both Mo isotopes. Furthermore, the main fragments of one-phonon mixed-symmetry 2^+ states have been identified. The systematic of their decay behavior in the Mo chain from N=52 to 56, namely the crossing of the strongest M1 decay branch to the first and second 2^+ states as a function of neutron number, suggests a new signature for shape coexistence. Supported through U.S. DOE Grant No. DE-FG02-91ER-40609 and DFG grant SFB 634.

[1] T. Thomas *et al.*, Phys. Rev. C **88**, 044305 (2013).

HK 51.6 Do 15:15 S1/01 A03

First measurement of the decoupling parameter for the $K = 1$ band of ^{156}Gd ⋆ — •Tobias Beck[1], Jacob Beller[1], Vera Derya[2], Udo Gayer[1], Johann Isaak[3,4], Bastian Löher[3,4], Norbert Pietralla[1], Philipp Ries[1], Christopher Ries[1], Marcus Scheck[1,5,6], Werner Tornow[7], Henry R. Weller[7], Volker Werner[1], and Markus Zweidinger Markus[1] — [1]IKP, TU Darmstadt — [2]IKP, Universität zu Köln — [3]EMMI, GSI, Darmstadt — [4]FIAS, Frankfurt — [5]School of Engineering, UWS Paisley, UK — [6]SUPA, Glasgow, UK — [7]Duke University, Durham, USA

In a deformed nucleus the nuclear states are combinations of an intrinsic motion and a rotational motion of the core. In this scenario the Coriolis force changes the projection of the angular momentum on the symmetry axis and admixes different K values. The effects of the Coriolis interactions have been observed experimentally for $K = 1/2$ bands. The recent observation of the first excited rotational state of the isovector low-lying $J^\pi_K = 1^+_1$ scissors mode in a (γ,γ') experiment inaugurates a case to study the Coriolis decoupling for $K = 1$ bands. In the talk, the theoretical description provided by Bohr and Mottelson will be presented and their adaption to the particular case will be explained alongside the ongoing analysis and open questions.
⋆ Supported by the DFG within the scope of SFB 634

HK 51.7 Do 15:30 S1/01 A03

Investigation of dipole strength in ^{156}Gd up to 7.1 MeV — •E. Aciksoz[1,2], T. Beck[3], J. Beller[3], U. Gayer[3], L. Mertes[3], H. Pai[3], N. Pietralla[3], P. Ries[3], C. Romig[3], V. Werner[3], M. Zweidinger[3], J. Isaak[4,5], B. Löher[6], D. Savran[4,6], J. Silva[4,5], and M. Tamkas[4,7] — [1]Akdeniz University, Department of Physics, 07058 Antalya, Turkey. — [2]Nuclear Science Application and Research Center, Akdeniz University, 07058 Antalya, Turkey. — [3]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt. — [4]ExtreMe Matter Institute EMMI, GSI, Darmstadt. — [5]Frankfurt Institute for Advanced Studies FIAS, Frankfurt. — [6]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt. — [7]Graduate School of Natural and Applied Sciences, Yıldız Technical University, Istanbul.

Low-lying magnetic and electric dipole strengths, the latter often referred to as the pygmy dipole resonance (PDR), has been investigated in the nucleus ^{156}Gd using the Nuclear Resonance Fluorescence (NRF) technique up to a bremsstrahlung endpoint of 7.1 MeV. The experiment was performed at the S−DALINAC using an unpolarized and continuous spectrum of bremsstrahlung photons. The fragmentation of dipole strength was found to be high. Nevertheless, NRF cross sections were determined for the strongest excitations that may be attributed to the PDR. Some of these states have been observed in an (γ,γ') experiment for the first time in ^{156}Gd. The results achieved from $^{156}Gd(\gamma,\gamma')$ experiment will be presented and discussed.

HK 51.8 Do 15:45 S1/01 A03

Low-lying dipole strength in the well-deformed nucleus ^{156}Gd — •M. Tamkas[1,2], J. Isaak[1,3], D. Savran[1,5], B. Löher[5], J. Silva[1,3], E. Aciksoz[8], T. Beck[4], J. Beller[4], U. Gayer[4], N. Pietralla[4], C. Romig[4], W. Tornow[6], H. Weller[6], V. Werner[4], A. Zilges[7], and M. Zweidinger[4] — [1]ExtreMe Matter Institute EMMI, GSI, Darmstadt — [2]Graduate School of Natural and Applied Sciences, Yıldız Technical University, Istanbul — [3]Frankfurt Institute for Advanced Studies FIAS, Frankfurt — [4]Institut für Kernphysik, Technische Universität, Darmstadt — [5]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — [6]Department of Physics, Duke University, TUNL, Durham, USA — [7]Institut für Kernphysik, Universität zu Köln — [8]Department of Physics, Akdeniz University, Turkey

In this study the dipole strength has been investigated in the well-deformed nucleus ^{156}Gd using the method of Nuclear Resonance Fluorescence (NRF). The NRF experiment was performed at the High Intensity $\vec{\gamma}$-ray Source at Duke University in combination with the γ^3 setup [1] using a mono-energetic and linearly polarised beam. The dipole strength of ^{156}Gd has been studied with photon beam energies between 3 MeV and 6.2 MeV. The parity quantum numbers of J=1 states have been determined for the energy region above $\sim$ 3 MeV for the first time. Recent results of the ^{156}Gd$(\vec{\gamma},\gamma')$ experiment will be presented and discussed.
[1] B. Löher *et al.*, NIM A 723 (2013) 136.
*Supported by TÜBİTAK-BİDEB 2214/A Program and by HA216/EMMI, SFB 634 and ZI 510/7-1.

HK 52: Instrumentation XIII

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A3

HK 52.1 Do 14:00 S1/01 A3

Development of a thin, internal superconducting polarisation magnet for the Polarised Target — •Marcel Bornstein, Hartmut Dutz, Stefan Goertz, Scott Reeve, and Stefan Runkel — Physikalisches Institut, Bonn, Germany

In order to improve the figure of merit of double-polarisation experiments at CB-ELSA in Bonn, the Polarised Target is working on a new dilution refrigerator. For maximum polarisation of nucleons low temperatures and a high homogeneous magnetic field within the target area is needed. A thin, superconducting magnet is in development, which will create a continuous longitudinal magnetic field of 2.5 T and

which will be used within the new refrigerator. The solenoidal geometry of this magnet uses two additional correction coils, placed at a well defined calculated position, for reaching the homogeneity criteria of 10^{-4} needed for the dynamic nuclear process. Practically, the superconducting wires as well as the correction coils have to be placed with maximum precision: Small fluctuations of the distance between the current loops can diminish the requested homogeneity. A second build prototype passes first tests and looks promising to fulfil the particular requirements.

HK 52.2 Do 14:15 S1/01 A3

CFD-Simulations of a 4π-continuous-mode dilution refrigerator for the CB-ELSA experiment — Marcel Bornstein, Hartmut Dutz, Stefan Goertz, Scott Reeve, and •Stefan Runkel for the CBELSA/TAPS-Collaboration — Physikalisches Institut, Bonn, Germany

The polarized target group at Bonn operates a dilution refrigerator for double polarization experiments at the Crystal Barrel in Bonn. To get high target polarizations and long relaxation times low temperatures are indispensable. To reach temperatures below 30 mK and to allow for the use of an internal polarization magnet, the polarized target group is building a new continuous mode dilution refrigerator. As a optimizing tool for the construction of dilution refrigerators and for a better understanding of the different incoming and outgoing fluid streams several **C**omputational **F**luid **D**ynamic simulations are done. The heat exchange between the different streams of the refrigerator were simulated for the precooling stages within one simulation including a submesh for each fluid and solid. This leads to a better estimation of the flow characteristics and the operational parameter of the refrigerator. The last steps of construction and the preparation of the refrigerator for first test measurements are ongoing.

HK 52.3 Do 14:30 S1/01 A3

Design and performance of an ionisation chamber for the measurement of low alpha-activities — •Heinrich Wilsenach and Kai Zuber — Institut für Kern- und Teilchenphysik, Technische Universität Dresden

The study of alpha decay has been important for the understanding of nuclei and their properties for more than a century. Currently these studies still have impact in various areas of nuclear physics, providing information which is valuable and often not accessible otherwise. The measurement of half-lifes from alpha decays of the order of 1×10^{15} yr is of particular interest. A measurement of such a long lived decay imposes, however, a series of challenges, where the correct discrimination between background and true signal is critical.

This work discusses an ionisation chamber used for low rate alpha-spectroscopy. The measurement makes use of pulse shape analysis to discriminate between signal and background events. The design and performance of the chamber is described in this work. A background rate of (10.9 ± 0.6) counts per day in the energy region of 1 MeV to 9 MeV was achieved with a run period of 30.8 days, this will also be presented. The remeasurement of the half-life of ^{147}Sm will also be presented here, as well as a discussion on the current half-life values.

HK 52.4 Do 14:45 S1/01 A3

Magnetic shielding for a transversely polarized target in the longitudinal field of the PANDA solenoid — •Bertold Fröhlich[1], Samer Ahmed[1], Alaa Dbeyssi[1], María Carmen Mora Espí[1], Kathrin Gerz[1], Dexu Lin[1], Frank Maas[1], Ana Peñuelas Martinez[1], Cristina Morales[1], Yadi Wang[1], and Patricia Aguar Bartolome[2] — [1]Helmholtz Institut Mainz — [2]Institut für Kernphysik Johannes Gutenberg-Universität Mainz

A transversely polarized target in PANDA would allow for the first time access to the imaginary part of the time like electromagnetic proton form factors, namely the phase angle in the imaginary plane between electric and magnetic form factors. Moreover it would allow for a number of other target single spin asymmetries revealing nucleon structure observables connected with the transverse spin structure of the proton.

As a first step for achieving a transverse target polarization, the target region has to be shielded against the 2 T longitudinal magnetic flux from the solenoid of the PANDA spectrometer. We present experimental results on intense magnetic flux shielding using a BSCCO-2212 high temperature superconducting hollow cylinder at liquid helium temperature.

HK 52.5 Do 15:00 S1/01 A3

Entwicklung und Test einer Probenhalterung für intensive Protonenstrahlen — •Markus Reich[1], Ulrich Giesen[2], Ole Hinrichs[1], Rene Reifarth[1], Kerstin Sonnabend[1] und Benedikt Thomas[1] — [1]Goethe Universität Frankfurt am Main — [2]Physikalisch-Technische Bundesanstalt, Braunschweig

Zur Messung der Wirkungsquerschnitte von (p,γ)-Reaktionen mit intensiven Protonenstrahlen wurde eine wassergekühlte Probenhalterung entwickelt. Die Spezifikationen sind an die sich im Aufbau befindende Neutronenquelle am Stern-Gerlach Zentrum in Frankfurt am Main (FRANZ) angepasst. Bei einer Protonenenergie von 2 MeV und einem Strahlstrom von 2 mA wird eine Leistungsdeposition von 4 kW in den Proben erwartet. Das Design der Halterung wurde durch Simulationen optimiert.

Bei einem Langzeitbelastungstest an der Physikalisch-Technischen Bundesanstalt in Braunschweig (PTB) wurde die Halterung bei einer mittleren Leistungsdeposition von etwa 200 W erfolgreich getestet.

Dieser Beitrag wurde gefördert durch DFG (SO907/2-1)/Emmy Noether.

HK 52.6 Do 15:15 S1/01 A3

Development of the Jet-Target System of the MAGIX experiment. — •Aulenbacher Stephan for the Magix/MESA-Collaboration — Institut für Kernphysik - JGU, Mainz, Deutschland

Since the new accelerator MESA which will be built up in Mainz in the next years operates at low Energies (˜100 MeV), but at high beam currents (˜1 mA), a thin windowless target is required. Therefore the MAGIX collaboration is developing a Jet-Target. This target blasts a Gas-Jet perpendicular to the beam through the scattering chamber of MAGIX. This talk is about the development of this Target System.

HK 52.7 Do 15:30 S1/01 A3

Improvement of the photon flux measurement at the BGO-OD experiment* — •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 the nucleon, using an energy tagged bremsstrahlung photon beam. Absolute normalisation of the beam flux is required for cross section determination. In this talk the measurement principle is presented and an improved method of the photon flux monitoring of the experiment is introduced.

* Supported by the DFG (SFB/TR-16)

HK 52.8 Do 15:45 S1/01 A3

Effects of Irradiation Temperature on Polarisation and Relaxation Characteristics of Polymeric Materials. — Marcel Bornstein, Harmut Dutz, Stefan Goertz, •Scott Reeve, and Stefan Runkel — Physikalisches Institut, Bonn, Germany

To achieve significant enhancement of polarisation of solid target materials one must use the principles of dynamic nuclear polarisation and utilise the coupling of the nuclear and electron spins. The unpaired electrons needed can be created as paramagnetic structural defects by irradiation of the material. Polyethylene and polypropylene materials were irradiated at various temperatures and subsequently polarised with microwaves of approximately 70 GHz at temperatures around 1 K. Additionally the samples were investigated with respect to the nature of the created paramagnetic defects using a X-band EPR spectrometer. It was found that the irradiation temperature has a significant effect on the polarisation values achieved and also on the relaxation times of the materials in the 2.5 T magnetic field. The EPR line shape is clearly dominated by the well known alkyl radical structure.

HK 53: Instrumentation XIV

Zeit: Donnerstag 14:00–16:00 Raum: S1/01 A4

Gruppenbericht HK 53.1 Do 14:00 S1/01 A4

Das P2-Experiment: Hochpräzise Messung des schwachen Mischungswinkels an MESA — •Sebastian Baunack für die P2-Kollaboration — PRISMA Cluster of Excellence und Institut für Kernphysik, 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.

Im Vortrag wird zum einen auf die Motivation für eine solche Messung eingegangen. Zum anderen werden die vielfältigen experimentellen und theoretischen Herausforderungen vorgestellt, um das Experiment durchzuführen und die Resultate zu interpretieren. Der aktuelle Stand der Arbeiten wird präsentiert.

Gruppenbericht HK 53.2 Do 14:30 S1/01 A4

Developement of Closed Orbit Diagnostics towards EDM Measurements at COSY in Jülich — •Fabian Hinder for the JEDI-Collaboration — Forschungszentrum Jülich, Institut für Kernphysik IV — RWTH Aachen University, III. Physikalisches Institut B

Electric Dipole Moments (EDMs) violate parity and time reversal symmetries. Assuming the CPT-theorem, this leads to CP violation, which is needed to explain the matter over antimatter dominance in the Universe. Thus, a non-zero EDM is a hint to new physics beyond the Standard Model. The JEDI collaboration (Jülich Electric Dipole moment Investigations) has started investigations of a direct EDM measurement of protons and deuterons at a storage ring. To measure a tiny EDM signal with high precision, systematic effects have to be controlled to the same level. One major source of systematic uncertainties is a distortion of the closed orbit. To control and measure this effect, the orbit measurement system, including the readout electronics, the orbit correction system and the beam position monitor pick-ups are improved. All the mentioned developments are ongoing at the Cooler Synchrotron (COSY) at Jülich. The achievements in the mentioned fields will be presented at the conference.

HK 53.3 Do 15:00 S1/01 A4

Search for a permanent Xe-elecric dipole moment — •Stefan Zimmer for the MIXed-Collaboration — Institut für Physik, Universität Mainz

A permanent electric dipole moment (EDM) of the isotope ^{129}Xe would imply a breakdown of both parity P and time-reversal symmetry T and, through the CPT theorem, a breakdown in CP, the combined symmetries of charge conjugation C and parity P. Our goal is to improve the present experimental limit ($d_{Xe} < 3 \cdot 10^{-27}$ ecm) by about three orders of magnitude. The most precise EDM limit on diamagnetic atoms was measured on ^{199}Hg ($d_{Hg} < 3.1 \cdot 10^{-29}$ ecm). To get more stringent limits, we perform a ^{3}He/^{129}Xe clock comparison experiment with the detection of free spin precession of gaseous, nuclear polarized ^{3}He or ^{129}Xe samples with a SQUID as magnetic flux detector. The precession of co-located ^{3}He/^{129}Xe nuclear spins are used as an ultra-sensitive probe for non-magnetic spin interactions of type $\delta\nu \sim d_{Xe} \cdot E$. With our experimental setup at the research center Jülich we are able to observe spin coherence times T_2^* of several hours for both species. We report on first experimental results achieved within the MIXed-collaboration.

HK 53.4 Do 15:15 S1/01 A4

Status and First Measurement Results for a High Gradient CH- Cavity — •Ali Almomani and Ulrich Ratzinger — Institut für Angewandte Physik - Frankfurt Universität, Frankfurt am Main, Germany

This pulsed linac activity aims on compact designs and on a considerable increase of the voltage gain per meter. A high gradient CH * cavity operated at 325 MHz was developed at IAP * Frankfurt. The mean effective accelerating field for this cavity is expected well above 10 MV/m at $\beta = 0.164$. This cavity is developed within a funded project. The results might influence the rebuilt of the UNILAC * Alvarez section, aiming to achieve the beam intensities specified for the GSI * FAIR project (15 mA U28+). Another motivation is the development of an efficient pulsed ion accelerator for significantly higher energies like 60 AMeV. The new GSI 3 MW Thales klystron test stand will be used for the cavity RF power tests. Detailed studies on two different types of copper plating will be performed with this cavity.

HK 53.5 Do 15:30 S1/01 A4

Teststand zur HEBT-Sektion für FRANZ — •Ole Hinrichs, Christine Claessens, Oliver Meusel, Daniel Noll, Markus Reich, René Reifarth, Malte Schwarz, Kerstin Sonnabend, Benedikt Thomas, Christopher Wagner und Christoph Wiesner — Goethe-Universität Frankfurt

Die Frankfurter Neutronenquelle am Stern-Gerlach-Zentrum (FRANZ), die sich gegenwärtig im Aufbau befindet, wird von einem Protonenstrahl mit einer anfänglichen Stromstärke von 2 mA Dauerstrom und Energien zwischen 1,8 und 2,2 MeV betrieben. Diese Anlage hat das Ziel, protonen- und neutroneninduzierte Reaktionen von astrophysikalischem Interesse zu untersuchen, bei denen nur geringe Reaktionsausbeuten zu erwarten sind, z.B. aufgrund instabiler Targetkerne.
In dieser Präsentation wird der derzeitige Status der Strahlführung in Richtung des Experimentierplatzes mit einem 4π BaF_2-Kalorimeters, der HEBT-Sektion (High-Energy Beam-Transport), vorgestellt. Diese besteht aus einem Dipolmagneten und einem Quadrupoldublett als finalem Fokussierelement.
Hierbei liegt der Schwerpunkt auf vorbereitenden Testmessungen, die mithilfe eines Teststandes durchgeführt werden. Der Teststand umfasst einen RFQ-Beschleuniger mit angeschlossener He^+-Ionenquelle und Stahldiagnostik. Die Messungen werden mit den entsprechenden Strahldynamiksimulationen verglichen.
Dieses Projekt wird gefördert durch die DFG (SO907/2-1), HGS-HIRe und HIC for FAIR.

HK 53.6 Do 15:45 S1/01 A4

Development of a Compton camera prototype for prompt gamma medical imaging — •S. Liprandi[1], S. Aldawood[1,2], A. Miani[1,3], T. Marinšek[1], I. Valencia[1], C. Lang[1], J. Bortfeldt[1], L. Maier[4], R. Lutter[1], R. Gernhäuser[4], D.R. Schaart[5], G. Pausch[6,7], F. Fiedler[7], W. Enghardt[6,7], G. Dedes[1], K. Parodi[1], and P.G. Thirolf[1] — [1]LMU München, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]Universitá degli Studi di Milano, Italia — [4]TU München, Germany — [5]Delft University of Technology, The Netherlands — [6]OncoRay and TU Dresden, Germany — [7]Helmholtz-Zentrum Dresden-Rossendorf, Germany

At LMU in Garching 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 (50 x 50 mm^2, 0.5 mm thick, 128 strips/side, Gassiplex ASIC readout) acting as scatterers and an absorber formed by a $LaBr_3$(Ce) scintillator (50 x 50 x 30 mm^3, 256-fold multianode PMT readout). The detectors have been characterized in the laboratory and recently also online with a therapeutic proton beam at the University Proton Therapy Dresden (UPTD): we used 100, 160 and 225 MeV proton beams, irradiating water and PMMA targets. The offline and online characterization of the camera and its components will be presented.

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

HK 54: Instrumentation XV

Zeit: Donnerstag 14:00–15:45 Raum: S1/01 A2

HK 54.1 Do 14:00 S1/01 A2

The COMPASS trigger for Drell-Yan Measurements — •Benjamin Veit — For the COMPASS collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55128 Mainz

In 2014/15 the COMPASS experiment measured double-muon-production in the reaction of negative pions of 190 GeV/c with a polarised ammonia target. This process is called Drell-Yan process. The final state consists of two muons and a hadronic state. The hadrons and remaining beam pions were removed by an absorber directly behind the target, the remaining muon pairs were detected in the double stage COMPASS spectrometer. For a symmetric acceptance for positive and negative muons, the single muon trigger system had to be modified. The necessary modifications on the single muon trigger and the performance of the new trigger will be presented.

HK 54.2 Do 14:15 S1/01 A2

Improvements of the ALICE High Level Trigger for LHC Run 2 to facilitate online reconstruction, QA, and calibration — •David Rohr for the ALICE-Collaboration — Frankfurt Institute for Advanced Studies, 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 of around 200 nodes that performs a real time event reconstruction of the data delivered by the ALICE detectors. The HLT employs a fast FPGA based cluster finder algorithm as well as a GPU based track reconstruction algorithm and it is designed to process the maximum data rate expected from the ALICE detectors in real time. We present new features of the HLT for LHC Run 2 that started in 2015. A new fast standalone track reconstruction algorithm for the Inner Tracking System (ITS) enables the HLT to compute and report to LHC the luminous region of the interactions in real time. We employ a new dynamically reconfigurable histogram component that allows the visualization of characteristics of the online reconstruction using the full set of events measured by the detectors. This improves our monitoring and QA capabilities. During Run 2, we plan to deploy online calibration, starting with the calibration of the TPC (Time Projection Chamber) detector's drift time. First proof of concept tests were successfully performed using data-replay on our development cluster and during the heavy ion period at the end of 2015.

HK 54.3 Do 14:30 S1/01 A2

Rejection of late conversions in the ALICE TRD trigger — •Ole Schmidt[1], Felix Rettig[2], Jochen Klein[3], Uwe Westerhoff[4], and Guido Willems[4] for the ALICE-Collaboration — [1]Physikalisches Institut, University of Heidelberg — [2]FIAS, University of Frankfurt — [3]CERN — [4]IKP, University of Munster

The ALICE Transition Radiation Detector (TRD) provides various level-1 trigger contributions based on the information of individual tracks. Chamber-wise track segments are merged in the Global Tracking Unit (GTU) and used for the on-line reconstruction of transverse momentum (pt) and electron identification. Based on this information, versatile and flexible trigger conditions were implemented.

Amongst others, several triggers on high-pt electrons were used during Run 1. The dominant background originates from photon conversions in the material in front of the TRD. For the reconstruction of the transverse momentum, the GTU performs a straight line fit under the assumption that the tracks point to the primary vertex. However, electrons from conversions at large radii can falsely point close to the primary vertex and fake high-pt particles.

In our improved tracking algorithm, the local curvature of the tracks is exploited to reject electrons from late conversions by approximating their sagitta. After successful tests in simulations, the algorithm was implemented in the GTU preserving the 7 us latency of the trigger decision relative to a level-0 trigger. We present the performance of the late conversion rejection and show prospects for TRD triggers for data-taking in 2016.

HK 54.4 Do 14:45 S1/01 A2

ALICE High-Level Trigger Readout and FPGA Processing in Run 2 — •Heiko Engel and Udo Kebschull for the ALICE-Collaboration — IRI, Goethe-Universitaet Frankfurt

The ALICE experiment uses the optical Detector Data Link (DDL) protocol to connect the detectors to the computing clusters of Data Acquisition (DAQ) and High-Level Trigger (HLT). The interfaces between the clusters and the optical links are realized with FPGA boards. HLT has replaced all of its interface boards with the Common Read-Out Receiver Card (C-RORC) for Run 2. This enables the read-out of detectors at higher link rates and allows to extend the data pre-processing capabilities, like online cluster finding, already in the FPGA. The C-RORC is integrated transparently into the existing HLT data transport framework and the cluster monitoring and management infrastructure. The board is in use since the start of LHC Run 2 and all ALICE data from and to HLT as well as all data from the TPC and the TRD is handled by C-RORCs. This contribution gives an overview on the firmware and software status of the C-RORC in the HLT.

HK 54.5 Do 15:00 S1/01 A2

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

The Compressed Baryonic Matter (CBM) experiment is a fixed target high energy physics experiment collecting all produced data - no triggers are involved. This causes a very high data rate of 1 TByte/s. The First-level Event Selector (FLES) denotes a high performance computer cluster that will process all data and performs 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.

In order to ensure that the FLES is available the whole time while the detectors are running fault tolerance is inevitable. The questions is how often are incidents going to occur (Mean Time between Failure MTBF) and how long will they pause Timeslice building and hence physics analysis (Mean Time to Repair MTTR). These two factors make up the availability of the FLES. I would like to present a detailed analysis of possible sources of errors and their influence on the availability. Furthermore, I will discuss the development of Timeslice building on the basis of MPI with respect to the availability of the FLES. I will compare this approach to a low-level native Infiniband Verbs implementation combined with a socket-based error handling system.

HK 54.6 Do 15:15 S1/01 A2

Background Suppression by Pulse Shape Discrimination in the CALIFA Calorimeter — •Benjamin Heiss, Roman Gernhäuser, Philipp Klenze, Patrick Remmels, and Max Winkel for the R3B-Collaboration — Technische Universtät München

The 4π-calorimeter CALIFA is one of the major detectors of the R^3B-experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt. This calorimeter with 2464 CsI(Tl) crystals and 96 Phoswich detectors ($LaBr_3$(Ce) and $LaCl_3$(Ce)) plays a major role in the realization of kinematically complete measurements. General demands on CALIFA are a high efficiency, good energy resolution of about 5 % at 1 MeV 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. Due to the very high energies of the light charged particles at the relativistic beam energies, especially in the forward direction of CALIFA, a significant fraction triggers nuclear reactions in the detector material. This talk will present the methods of the background suppression by pulse shape discrimination based on an experiment with protons at kinetic energies up to $E = 480$ MeV at the TRIUMF Laboratory in Vancouver, Canada. Supported by BMBF(05P12 WOFNF,05P15 WOFNA) and TRIUMF Vancouver.

HK 54.7 Do 15:30 S1/01 A2

A real-time high level trigger system for CALIFA — Roman Gernhäuser, Benjamin Heiss, •Philipp Klenze, Patrick Remmels, and Max Winkel — Physik Department, Technische Universität München

The CALIFA calorimeter with its about 2600 scintillator crystals is a key component of the R^3B setup. For many experiments CALIFA will have to perform complex trigger decisions depending on the total energy deposition, γ multiplicities or geometrical patterns with a minimal latency. This selection is an essential tool for the accurate preselection of relevant events and provides a significant data reduction.

The challenge is to aggregate local trigger information from up to 200 readout modules. The trigger tree transport protocol (T^3P) will use dedicated FPGA boards and bus systems to collect trigger information and perform hierarchical summations to ensure a trigger decision within 1 μs. The basic concept and implementation of T^3P will be presented together with first tests on a prototype system.

Supported by BMBF (05P12WOFNF and 05P12WOFNA) and GSI (TMLFRG1316).

HK 55: Hadron Structure and Spectroscopy IX

Zeit: Donnerstag 16:30–18:15 Raum: S1/01 A5

Gruppenbericht HK 55.1 Do 16:30 S1/01 A5

Chiral extrapolation of baryon masses — Matthias F.M. Lutz and •Yonggoo Heo — Gesellschaft für Schwerionenforschung GmbH, PlanckStr.1, 64291 Darmstadt, Germany

We study the quark-mass dependence of baryon masses from the three-flavour chiral Lagrangian formulated for the $J = 1/2^+$ and $J^P = 3/2^+$ ground states. The available lattice data are used to determine the low-energy parameters relevant for the baryon masses at chiral order 4, where large-N_c sum rules are imposed as to reduce the number of independent low-energy operators. We scrutinize the convergence properties of the three-flavour chiral extrapolation.

HK 55.2 Do 17:00 S1/01 A5

First measurements of $\gamma p \to K^+\Lambda$ at extreme forward angles at the BGO-OD experiment* — •Thomas Zimmermann for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment, located at the electron accelerator ELSA at the University of Bonn, is designed to study nucleon excitations with emphasis on understanding the reaction dynamics. One reaction of major interest is $\gamma p \to K^+\Lambda$. The BGO-OD experiment is ideal to investigate the dominant t-channel mechanisms in this reaction channel at forward angles due to the high resolution and acceptance of the forward spectrometer. The new data currently being analyzed covers extremely forward angles with high resolution. This will constrain solutions from data driven models and analysis, such as PWA and isobar models.

* Supported by the DFG (SFB/TR-16)

HK 55.3 Do 17:15 S1/01 A5

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

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

This talk shows the preliminary results of the analysis for the charged decay channel $K^0\Sigma^+ \to \pi^-\pi^+\pi^0 p$. Due to the small production cross section kinematic fitting has been used to discriminate the wanted channel against backround. Supported by DFG (SFB/TR-16).

HK 55.4 Do 17:30 S1/01 A5

Hyperon Interaction in Free Space and Nuclear Matter — •Madhumita Dhar[1] and Horst Lenske[1,2] — [1]Justus-Liebig University Giessen — [2]GSI, Darmstadt

A new approach to the SU(3) flavour symmetric meson-exchange model is introduced to describe free space baryon-baryon interaction. The Bethe-Salpeter equations are solved in a 3-D reduction scheme. The coupling of the various channels of total strangeness S and conserved total charge Q is studied in detail. Special attention is paid to the physical thresholds. The derived vacuum interaction has then been used to derive nuclear medium effect by employing the Pauli projector operator in 3-D reduced Bethe-Salpeter equation.The in-medium properties of the interaction are clearly seen in the variation of the in-medium low-energy parameters as a function of density.

This work is supported by HIC for FAIR and HGS-HIRe.

HK 55.5 Do 17:45 S1/01 A5

Scattering of hadrons within an extended linear sigma model — •Khaled Teilab[1,2], Francesco Giacosa[1,3], and Dirk H. Rischke[1] — [1]Goethe-Universität, Frankfurt am Main — [2]Cairo Universität, Giza, Ägypten — [3]Jan Kochanowski Universität, Kielce, Polen

In the low-energy regime, hadrons (instead of quarks and gluons) are the relevant degrees of freedom. Their masses and interactions can be well described by effective approaches to QCD. The extended linear sigma model is an effective model based on chiral and dilatation symmetries (together with their explicit as well as spontaneous breaking). It includes (axial-) vector mesons in addition to (pseudo-) scalar ones, which turns out to be very successful in describing the mass spectrum and decay widths of mesons up to 1.7 GeV.

Moreover, including two baryon doublets in the so-called mirror assignment allows for introducing a chirally invariant mass term for baryons as well as the interaction with a low-mass four-quark field, related to the resonance $f_0(500)$. Thus, the mass of the nucleon arises not solely from the chiral condensate, but also from the four-quark condensate.

The model has been used to describe elastic and inelastic baryon-baryon interactions and can be used to study meson-baryon and photon-baryon interactions as well. A comparison of the theoretical results with experimental data will be shown.

HK 55.6 Do 18:00 S1/01 A5

Study of the Lambda-proton interaction with the femtoscopy technique in p+Nb reactions at 3.5 GeV with HADES — •Oliver Arnold for the HADES-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. By knowing the particle interaction precisely it is possible to make a detailed study of the particle's source. But turning the picture around is also possible: By knowing the source size it is possible to study final state interactions of particle pairs where the interaction strength is not well established.

We use the technique of two-particle correlations in a femtoscopy measurement of proton-proton and proton-Lambda pairs, which were produced in p+Nb collisions and detected with the HADES setup, where the proton had a kinetic beam energy of 3.5 GeV. By using proton pairs we were able to extract the region of homogeneity of the p+Nb system. This information together with UrQMD transport simulations allowed us to concentrate solely on the investigation of the proton-Lambda interaction. We tested different sets of scattering parameters predicted by theoretical calculations on the experimental data and the sensitivity of the method. This work is supported by HIC for FAIR and HGS-HIRe.

HK 56: Heavy Ion Collision and QCD Phases XI

Zeit: Donnerstag 16:30–18:00 Raum: S1/01 A01

HK 56.1 Do 16:30 S1/01 A01

Photons from partonic transport — •Moritz Greif — Goethe Universität Frankfurt

We investigate photon production processes in the quark-gluon plasma. Several photon production processes are included in the partonic cascade BAMPS (Boltzmann Approach to Multi-Parton Scatterings). BAMPS provides a microscopic tool to study expanding fireballs, employing a stochastic method to solve the relativistic 3+1d Boltzmann equation for quarks, gluons and photons. The partonic cascade is applicable over the whole evolution of the plasma, thus giving insights also about the early, off-equilibrium phase. Apart from Compton/annihilation scattering we include inelastic bremsstrahlung cross sections and obtain rates that are compatible with resummed pQCD including interference effects. This opens up a variety of possible studys. We show results for photon spectra from the quark-gluon plasma and investigate its role for the elliptic flow of photons. Especially the transfer of anisotropy from the flowing medium onto photons can be understood microscopically.

HK 56.2 Do 16:45 S1/01 A01

Measurement of isolated photons with ALICE — •Marco Marquard — Institut für Kernphysik, Goethe Universität Frankfurt am Main

Isolated photons at high transverse momenta are produced in initial hard-scattering processes in high-energy pp and heavy-ion collisions. Such processes are thought to scale by the number of binary nucleon-nucleon collisions in heavy-ion collisions, hence isolated photons can be used to test scaling properties of particle production in such collisions. Furthermore they may give insight to possible modifications of nuclear PDFs. In order to interpret isolated photon spectra in heavy-ion and p-Pb collisions at the LHC, they have to be measured in fundamental pp collisions.

After an introduction of the analysis technique, the status of the isolated photon measurement in pp collisions with the ALICE EMCAL will be presented. The cross section of isolated photons, necessary corrections and systematic studies will be discussed.

Supported by BMBF and the Helmholtz Association

HK 56.3 Do 17:00 S1/01 A01

Photon HBT with ALICE — •Hans Beck for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

Photon-photon correlations at small relative momentum carry a distinct signal from the quantum statistical interference of the photons' wave functions. Being sensitive to the size of the emitter, these photon correlations bear the unique opportunity to directly study the supposedly hydrodynamical evolution of the source beyond kinetic freeze-out. This qualitatively distinguishes two-photon correlations from hadron femtoscopy.

ALICE at the LHC allows to observe photons via their conversion to charged leptons reconstructed with the tracking detectors and the direct identification in its electromagnetic calorimeters. An experimental advantage is the absence of two-particle resolution effects when combining the two methods.

We present correlation functions of photon candidates from the Run 1 Pb-Pb dataset and quantify the clear signal at zero relative momentum in terms of its height and width differentially in pair transverse momentum over a range of several GeV/c. We prove previously neglected processes to significantly contribute by rejecting them via specific two-particle criteria and presenting the impact on the correlation function. An outlook is given.

HK 56.4 Do 17:15 S1/01 A01

Status of the direct photon analysis for Au+Au collisions at 1.23 AGeV measured by the HADES experiment — •Christina Deveaux for the HADES-Collaboration — Justus-Liebig-Universitaet

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 the status of our direct photon reconstruction and discuss the option to extend this study to elliptic flow. Supported by BMBF and HIC for FAIR.

HK 56.5 Do 17:30 S1/01 A01

Reconstruction of Neutral Mesons via Conversion Method in Au+Au at 1.23AGeV with HADES — •Claudia Behnke for the HADES-Collaboration — IKF, Goethe Universität Frankfurt

The HADES experiment at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt has measured virtual photon production in Au+Au collisions at 1.23 AGeV. The yield measured for the Au+Au systems exceeds the N+N reference by a factor 8-10. A more accurate determination of the medium radiation depends on a precise knowledge of the underlying hadronic cocktail composed of various sources contributing to the net spectra. Therefore, a measurement of the neutral meson yields together with the dileptons is crucial. In this contribution, the capability of HADES to detect e^+e^- pairs from conversion of real photons will be demonstrated. We will present results from a two-photon analysis of Au+Au collisions at 1.23 AGeV providing information of neutral π^0 and η mesons. A phase space dependent analysis of π^0 production as well as a yield estimation for the η-meson will be presented. Supported by BMBF (05P12RFGHJ,05P15RFFCA), HIC for FAIR, GSI, HGS-HIRe and H-QM.

HK 56.6 Do 17:45 S1/01 A01

Neutral Meson Measurements using Conversions in Proton-Proton Collisions at $\sqrt{s}$ = 8 TeV in ALICE — •Nicolas Schmidt for the ALICE-Collaboration — Physikalisches Institut, Heidelberg University

The ALICE detector is dedicated to study the properties of the Quark-Gluon-Plasma (QGP), 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. This work focuses on the neutral mesons and the measurement via the two photon decay channel. The photons are reconstructed through their 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 of neutral mesons in pp-collisions at $\sqrt{s} = 8$ 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 lower energies.

HK 57: Nuclear Astrophysics V

Zeit: Donnerstag 16:30–18:15 Raum: S1/01 A04

Gruppenbericht HK 57.1 Do 16:30 S1/01 A04

A 5 MV Pelletron accelerator providing $^1H^+$, $^4He^+$, and $^{12}C^+$ beams for underground nuclear astrophysics — •Stefan Reinicke[1,2], Daniel Bemmerer[1], Thomas E. Cowan[1,2], Marcel Grieger[1,2], Arnd R. Junghans[1], Felix Ludwig[1,2], Stefan E. Müller[1], Ferdinand Rath[1,2], Tobias P. Reinhardt[2], Bernd Rimarzig[1], Marko Röder[1,2], Ronald Schwengner[1], Tamás Szücs[1], Marcell P. Takács[1,2], Andreas Wagner[1], Louis Wagner[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — [2]Technische Universität Dresden

Accelerator-based experiments at the 0.4 MV LUNA underground accelerator at Gran Sasso have enabled great progress for studies of Big Bang and solar fusion reactions. However, to complete the picture of solar fusion reactions and open up helium and carbon burning reactions to study, higher beam energies are required. A 5 MV Pelletron accelerator will be installed in the Felsenkeller underground labora-

tory in Dresden. It will allow both, tandem mode operations for $^{12}C^{+}$ beams and the use of a radio frequency ion source on the high voltage terminal for $^{1}H^{+}$ and $^{4}He^{+}$ beams. The beam from the RF ion source is fed in with a remotely controlled electrostatic deflector. In addition, a large, ultra-sensitive high-purity germanium detector for offline measurements will be installed at Felsenkeller. The final timeline of the project will be shown, as well as the science case for in-house research and the capabilities available to external scientific users. – Supported by NAVI (HGF VH-VI-417) and by DFG (TU Dresden Institutional Strategy, "support the best").

HK 57.2 Do 17:00 S1/01 A04

Measurement of the natural neutron background underground with moderated ^{3}He counters in the Dresden Felsenkeller — •Marcel Grieger[1,2], Daniel Bemmerer[1], Stefan E. Müller[1], Tamás Szücs[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

A new underground ion accelerator with 5 MV acceleration potential will soon be installed in the Dresden Felsenkeller. The site consists of altogether nine mutually connected tunnels. It is shielded from cosmic radiation by a 45 m thick rock overburden, enabling uniquely sensitive experiments. Here, a measurement of the neutron flux in Felsenkeller tunnel IV is reported. The flux has been measured in three differently shielded laboratories with a set of seven moderated ^{3}He tubes provided by the BELEN collaboration. FLUKA simulations have been used to calculate the detector responses. The observed neutron count rates were unfolded with the MAXED and GRAVEL algorithms, and an energy spectrum has been derived. — Supported by NAVI (HGF VH-VI-417).

HK 57.3 Do 17:15 S1/01 A04

Charged-particle-induced reactions for astrophysics with storage rings — •Zuzana Slavkovská[1,2], Jan Glorius[1,2], Christoph Langer[1,2], and René Reifarth[1,2] — [1]Goethe-University Frankfurt — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The astrophysical p-process involves reactions on unstable proton-rich isotopes with small cross sections in the astrophysically relevant energy range. As such, no suitable targets can be produced. The use of ion storage rings with beam cooling offers unique experimental conditions for experiments on such isotopes using inverse kinematics. The radioactive beams, especially short-lived, can be stored efficiently. Using a gas-jet hydrogen target, sufficiently high luminosities can be reached allowing investigation of charged-particle-induced reactions.

A pilot experiment using the Experimental Storage Ring (ESR) at GSI in Darmstadt allowed first measurements of (p,γ) reactions using stored ^{96}Ru ions at the energy of a few AMeV close to the Gamow window and proofed the applicability of this method.

This talk describes general advantages of using ion storage rings over traditional methods and improvements of the ESR experimental setup towards measurements directly inside the Gamow window. Future plans of possible measurements at the ESR and the new low-energy storage ring CRYRING will be presented.

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

HK 57.4 Do 17:30 S1/01 A04

Silicon photomultiplier readout of a monolithic 270×5×5 cm^3 plastic scintillator bar for time of flight applications — •Marko Röder[1], Daniel Bemmerer[1], Thomas E. Cowan[1,2], Stefan Gohl[1,2], Klaus Heidel[1], Tobias P. Reinhardt[2], Stefan Reinicke[1,2], Daniel Stach[1], Andreas Wagner[1], David Weinberger[1], and Kai Zuber[2] for the R3B-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — [2]TU Dresden

The detection of 200-1000 MeV neutrons requires large amounts of detector material because of the long nuclear interaction length of these particles. In the example of the NeuLAND neutron time-of-flight detector at FAIR, this is accomplished by using 3000 scintillator bars of 270×5×5 cm^3 size made of the fast plastic polyvinyltoluene. In the present work, we investigated whether silicon photomultiplier (SiPM) photosensors can replace fast timing photomultiplier tubes. The response of the system consisting of scintillator, SiPM, and preamplifier was studied using 30 MeV single electrons provided by the ELBE superconducting electron linac. The results were interpreted by a simple Monte Carlo simulation, and the time resolution was found to obey an inverse-square-root scaling law with the number of fired pixels. In the electron beam tests, a time resolution of $\sigma_t = 136$ ps was reached with a pure SiPM readout, well within the design parameters for NeuLAND. — Supported by NupNET NEDENSAA (BMBF 05 P 09 CRFN5), GSI F&E (DR-ZUBE), Helmholtz DTS, and the EU (MUSE, contract no. 690835).

HK 57.5 Do 17:45 S1/01 A04

Recent results from the Penning-trap mass spectrometer ISOLTRAP — •Dinko Atanasov for the ISOLTRAP-Collaboration — Max-Planck Institute for Nuclear Physics

Precision mass measurements of the nuclides $^{129-131}$Cd have been performed by using the mass spectrometer ISOLTRAP at ISOLDE/CERN. Deviation of about 400 keV is found in the case of ^{130}Cd compared to the previous nuclear studies in the same region. These new findings confirm and quantify the previous indications for the decrease of the shell closure below doubly magic ^{132}Sn. Furthermore, ^{130}Cd in a nuclear astrophysical context is a key nuclide, i.e. a classical waiting-point nuclide for the production of heavy nuclei through the rapid neutron-capture process. The results of the measurement campaign were used to theoretically study the nucleosynthesis by two different astrophysical scenarios, the neutrino driven wind of type-II supernovae and the compact object binary mergers, respectively. The astrophysical simulations result in direct and consistent impact on the Solar System abundance around $A = 128 - 132$ peak. In this contribution all measured masses will be presented and their influence on the nucleosynthesis discussed.

HK 57.6 Do 18:00 S1/01 A04

High Precision Mass Measurements of Thermalized Relativistic Uranium Projectile and Fission Fragments with a Multiple-Reflection Time-of-Flight Mass Spectrometer — •Samuel Ayet San Andrés for the FRS Ion Catcher-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Justus Liebig Universität, Gießen, Germany

At the FRS Ion Catcher at GSI, a relativistic beam of ^{238}U at 1GeV/u was used to produce fission and projectile fragments on a beryllium target. The ions were separated in-flight at the FRS, thermalized in a cryogenic stopping cell and transferred to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) where high precision mass measurements were performed.

The masses of several fission and projectile fragments were measured (including short-lived nuclei with half-lives down to 18 ms) and the possibility of tailoring an isomerically clean beam for other experiments was demonstrated. With the demonstrated performance of the MR-TOF-MS and the expected production rates of exotic nuclei far from stability at the next-generation facilities such as FAIR, novel mass measurements of nuclei close to the neutron drip line will be possible and key information for understanding the r-process will be available.

The results from the last experiment and an outlook of possible future mass measurements close to the neutron drip line at FAIR with the MR-TOF-MS will be presented.

HK 58: Structure and Dynamics of Nuclei XI

Zeit: Donnerstag 16:30–18:15 Raum: S1/01 A03

Gruppenbericht HK 58.1 Do 16:30 S1/01 A03

Decay Spectroscopy with EURICA in the region of ^{100}Sn — •Daniel Lubos, Roman Gernhäuser, Thomas Faestermann, and Konrad Steiger for the EURICA RIBF09-Collaboration — Technische Universität München, Germany

At the radioisotope beam factory (RIBF) at the RIKEN Nishina Center, an experiment on properties of nuclei in the region of ^{100}Sn has been performed regarding the Gamow-Teller transition strength and the search for new isotopes as well as isomers. For decay spectroscopy, we used the detector arrays EURICA and WAS^{3}ABi which consist of

Ge- and LaBr- as well as Si-detectors, respectively.
The experiment has revealed new nuclei along the N = Z - 2 line and uncertainties of half-lives, close to the proton dripline southwest of ^{100}Sn, are significantly improved. The region around ^{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 presentation gives an overview of the dedicated high efficiency setup and the experimental program. Results of the Q_β-value analysis of ^{100}Sn using a Monte Carlo simulation, lifetime analysis and γ-spectroscopy of nuclei in this region as well as the nuclear structure are discussed. This project is supported by the DFG Cluster of Excellence: „Origin and Structure of the Universe“ and Hanns-Seidel-Stiftung.

HK 58.2 Do 17:00 S1/01 A03

Study of multiple isomeric states in ^{95}Ag via electron and gamma-ray spectroscopy — •Kevin Moschner[1], Andrey Blazhev[1], Plamen Boutachkov[2], Paul Davies[3], Magda Górska[2], Hubert Grawe[2], Robert Wadsworth[3], and Nigel Warr[1] — [1]Institut für Kernphysik - Universität zu Köln — [2]GSI Darmstadt — [3]Department of Physics, University of York

Recently, we studied isomeric decays of ^{95}Ag at the RIKEN Nishina Center using a fragmentation reaction of ^{124}Xe on a ^{9}Be target. The separated and identified reaction products were implanted in the modified SIMBA Silicon calorimeter, which was surrounded by the EURICA Germanium array, to measure the isomer and particle decays. The half-lives of all three isomeric states previously identified by Döring [Phys. Rev. C 68, 034306 (2003)] were measured from the analysis of the gamma-ray and conversion-electron (CE) data. Analysis of coincident gamma-rays and CE-gamma-ray data was used to verify the published level scheme. We have performed new shell-model calculations in a larger model space $pn(f_{5/2}, p_{3/2}, p_{1/2}, g_{9/2})$ using a modified interaction. These calculations provide an improved description of the isomers and the reduced transition rates extracted from the experimental half-lives. While for the isomeric states $(1/2^-)$ and $(23/2^+)$ the choice of E3 for the depopulating transitions is appropriate, the comparison of the shell-model to the experimental results is used as a basis to suggest a change of the spin and parity assignment of the high-spin isomer in with the former assignment of $(37/2^+)$.

HK 58.3 Do 17:15 S1/01 A03

B(E2) massurement of ^{112}Sn with NRF — •Marcel Schilling, Tobias Beck, Udo Gayer, Laura Mertes, Haridas Pai, Norbert Pietralla, Philipp C. Ries, Christopher Romig, Volker Werner, and Markus Zweidinger — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Deutschland

Significant differences in B(E2) values in the Sn isotopic chain exist in literature. Namely, the methods of Coulomb excitation and Doppler shift attenuation yield non-consistent B(E2) excitation strengths. Within this work, the method of nuclear resonance fluorescence (NRF) was used, in order to derive a new $B(E2; 2_1^+ \rightarrow 0_1^+)$ value for ^{112}Sn. The high precision experiment at the superconducting Darmstadt electron linear accelerator S-DALINAC yields a new value in a model-independent way. A sample of 4428.5 mg of highly enriched ^{112}Sn (99.995%) was irradiated with a bremsstrahlung photon beam at an endpoint energy of 2.5 MeV. Known level widths from the calibration standards ^{27}Al and ^{59}Co were used for photon-flux calibration. The extended target and the finite opening angles were taken into account. First results of the measurements and the evaluation will be presented and discussed.

HK 58.4 Do 17:30 S1/01 A03

Lifetime measurement in neutron-rich A ∼ 100 nuclei — •Saba Ansari, Jan Jolie, Jean-Marc Régis, Nima Saed-Samii, and Nigel Warr for the EXILL-FATIMA-Collaboration — Institute for Nuclear Physics, University of Cologne, Cologne, Germany

Rapid shape changes are observed in the region of neutron rich nuclei with a mass around A=100. Precise lifetime measurements are a key ingredient in the systematic study of the evolution of nuclear deformation and the degree of collectivity in this region. Nuclear lifetimes of excited states can be obtained using the fast-timing technique with $LaBr_3$(Ce)-scintillators.

We used neutron induced fission of ^{241}Pu in order to study lifetimes of excited states of fission fragments in the A ∼ 100 region. The EXILL-FATIMA array located at the PF1B cold neutron beam line at the Institut Laue-Langevin comprises of 8 BGO-shielded EXOGAM clover detectors and 16 very fast $LaBr_3$(Ce)-scintillator detectors, which were installed around the fission target. We have studied the lifetimes of low lying states for the nuclei ^{98}Zr, ^{100}Zr and ^{102}Zr by applying the generalized centroid difference method. In this contribution we will report on the used fast-timing setup and present preliminary results for the studied isotopes.

HK 58.5 Do 17:45 S1/01 A03

High resolution electron scattering off ^{96}Zr — •Christoph Kremer, Simela Aslanidou, Sergej Bassauer, Andreas Krugmann, Norbert Pietralla, Vladimir Ponomarev, Maxim Singer, Gerhart Steinhilber, Peter von Neumann-Cosel, and Markus Zweidinger — Institut für Kernphysik TU Darmstadt

The mass region $A \approx 100$ displays several intriguing nuclear structure phenomena. Of particular interest is the nucleus ^{96}Zr which exhibits features of a subdouble shell closure at $Z = 40$ and $N = 56$. Its strong octupole correlations lead to a large electric octupole transition strength $[B(E3; 3_1^+ \rightarrow 0_1^+) = 57(4)\ W.u.]$. Even though ^{96}Zr is a good testing ground for theoretical investigations [1] some basic low-energy observables are known with insufficient precision. Especially the transition strenghts of low-lying 2^+ states, that are important signatures for nuclear structure, have large uncertainties. Electron scattering at low momentum transfer is capable of obtaining these $B(E2)$ values with high precision [2]. A ^{96}Zr(e,e') experiment has been performed at the superconducting electron linear accelerator S-DALINAC at Darmstadt using the high-resolution LINTOTT spectrometer. The $B(E2; 2_2^+ \rightarrow 0_1^+)$ value has been directly measured for the first time. An interpretation in terms of type II shell evolution [3] is discussed.
[1] K. Sieja *et al.*, Phys. Rev. C **79**, 064310 (2009)
[2] A. Scheikh Obeid *et al.*, Phys. Rev. C **87**, 014337 (2013), Phys. Rev. C **89**, 037301 (2014)
[3] Y. Tsunoda *et al.*, Phys. Rev. C **89**, 031301(R) (2014)
Supported by DFG under contract SFB 1245.

HK 58.6 Do 18:00 S1/01 A03

First application of the *Spectral Difference Method* for lifetime measurements of *Doppler* attenuated line shapes — Hannah Duckwitz[1] and •Pavel Petkov[2] — [1]Institut für Kernphysik, Zülpicher Str. 77, 50937 Köln — [2]Bulgarian Academy of Sciences, Institute for Nuclear Research and Nuclear Energy, 1784 Sofia, Bulgaria

In this new approach to lifetime measurements via *Doppler* attenuated line shapes, the spectra of a feeding f and a deexciting transition d of the level of interest are used to determine the lifetime without any lineshape analysis of the feeding transition (direct or indirect). Similarly to the DDC method, the decay function $\lambda_d n_d(t)$ of the deexciting transition is determined.

The feeding of the level is included via the spectral difference of the two successive decays. Consequently, the determined lifetime is the real lifetime. After transforming both transitions into the same energy region, their spectral difference $D(v_\theta) = S_d(v_\theta) - S_f(v_\theta) = \int_0^\infty \frac{\partial P_\theta(t, v_\theta)}{\partial t} n_d(t) dt$, is solved for $n_d(t)$. Dividing $n_d(t)$ by the decay function $\lambda_d n_d(t)$ should yield a constant τ value for the level lifetime as a function of the time t.

After the development and test of the procedure in 2015 [1], it is now applied for the first time. Two level lifetimes are determined in ^{86}Sr for the 2_2^+ and the 2_3^+ levels.

[1] P. Petkov *et al.*, NIM A 783 (2015), 6-11

HK 59: Instrumentation XVI

Zeit: Donnerstag 16:30–18:15 Raum: S1/01 A3

Gruppenbericht HK 59.1 Do 16:30 S1/01 A3

The Barrel and Disc DIRC Counters for the PANDA Experiment at FAIR — •Mustafa Schmidt for the PANDA-Collaboration — II. Physikalisches Institut, Universität Gießen

The PANDA spectrometer for the future FAIR facility at GSI will be used to address open questions in hadronic physics by investigating antiproton collisions with a fixed target in the momentum range between 1.5 GeV/c and 15 GeV/c. In order to achieve a particle identification with a high precission, two different DIRC detector concepts have been developed by PANDA, which allow a compact detector design together with an excellent performance to cleanly separate pions, kaons, and protons. The Barrel DIRC in the target spectrometer of PANDA is based on the successful BaBar DIRC with several key improvements. It is designed for polar angles between $\theta = 22°$ and $\theta = 140°$ and momenta up to 3.5 GeV/c. The Disc DIRC is part of the endcap region of the spectrometer and covers the angular range from $\theta = 5°/10°$ to $\theta = 22°$ in the forward direction of PANDA. It will provide a π/K separation with a 4-σ seperation power up to a momentum of 4 GeV/c. Both Cherenkov detectors will use MCP-PMTs for the photon detection in combination with fast readout electronics. The radiators are synthetic fused silica plates with precision polished surfaces that guarantee to have very little photon losses by total reflection and conserve the Cherenkov angle during propagation through the optical system. Simulations with Geant4 and tests with several prototypes at various test beam facilities have been used to evaluate the designs and validate the expected PID performance of the DIRC counters.

HK 59.2 Do 17:00 S1/01 A3

Deriving the effective focal plane for the CBM-RICH detector* — •Ievgenii Kres 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 CO2 as radiator gas, and a focussing optic with a large spherical mirror. In the present design, the optimal focal plane is approximated using four individual, flat detection surfaces. However, the exact shape and position of the ideal focal plane is subject to further optimization due to effects from tilting the focussing mirror and from momentum dependant deflection of the electron tracks in the magnetic stray field. In this talk, we present a new approach to derive the effective 3-dimensional shape of the focal plane based on a set of Monte Carlo simulations, comparing the ring sharpness at each point of a preliminary focal plane as function of z-position.

*gefördert durch BMBF 05P15PXFCA, und GSI.

HK 59.3 Do 17:15 S1/01 A3

Measurements of the mirror surface homogeneity in the CBM-RICH — •Elena Lebedeva and Claudia Hoehne for the CBM-Collaboration — II. Physikalisches Institut JLU Giessen

The Compressed Baryonic Matter (CBM) experiment at the future FAIR (Facility for Antiproton and Ion Research) complex will investigate the phase diagram of strongly interacting matter at high baryon densities and moderate temperatures in A+A collisions from 2-11 AGeV (SIS100) beam energy.

One of the key detector components required for the CBM physics program is the RICH (Ring Imaging CHerenkov) detector, which is developed for efficient and clean electron identification and pion suppression.

The CBM-RICH detector is being planned with gaseous radiator and in a standard projective geometry with focusing mirror elements and photon detector planes. One of the important criteria for the selection of appropriate mirrors is their optical surface quality (surface homogeneity). It defines the imaging quality of projected Cherenkov rings, and directly effects the ring finding and fitting performance. The global homogeneity has been tested with the D0 measurement. Local deformations e.g. by the mirror holding structure can be investigated with the Ronchi test and Shack-Hartmann method from which first results are discussed in this contribution.

HK 59.4 Do 17:30 S1/01 A3

CBM RICH geometry optimization* — •Tariq Mahmoud and Claudia Höhne for the CBM-Collaboration — II. Physikalisches Institut, Gießen; Deutschland

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) beam energy. The main electron identification detector in the CBM experiment will be a RICH detector with a CO_2 gaseous-radiator, focusing spherical glass mirrors, and MAPMT photo-detectors being placed on a PMT-plane. The RICH detector is located directly behind the CBM dipole magnet. As the final magnet geometry is now available, some changes in the RICH geometry become necessary. In order to guarantee a magnetic field of 1 mT at maximum in the PMT plane for effective operation of the MAPMTs, two measures have to be taken: The PMT plane is moved outwards of the stray field by tilting the mirrors by 10 degrees and shielding boxes have been designed. In this contribution the results of the geometry optimization procedure will be presented.

(*Gefördert durch das LOEWE Zentrum HIC for FAIR und BMBF 05P15 RGFCA)

HK 59.5 Do 17:45 S1/01 A3

Prototype Test for the PANDA Barrel DIRC — •Dzhygadlo Roman[1], Gerhardt Andreas[1], Kalicy Grzegorz[1], Krebs Marvin[1], Lehmann Dorothe[1], Peters Klaus[1,2], Schwarz Carsten[1], Schwiening Jochen[1], Belias Anastasios[1], and Traxler Michael[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

The Barrel DIRC (Detector of Internally Reflected Cherenkov light) is designed to provide particle identification (PID) for the PANDA experiment at the new Facility for Antiproton and Ion Research in Europe (FAIR) at GSI, Darmstadt. It is based on the successful BABAR DIRC detector with several key improvements, such as focusing optics, fast timing, and a compact expansion volume.

A large prototype was constructed and tested in a hadronic particle beam at CERN during the summer of 2015 to test the PID performance of different design options. The prototype included a fused silica radiator (either a narrow bar or a wide plate), an optional focusing lens, and a prism-shaped fused silica expansion volume. An array of microchannel-plate photomultiplier tubes measured the location and arrival time of the Cherenkov photons on 960 pixels. Data were collected for two radiator geometries and several types of focusing lenses at different beam momenta and polar angles. Results of the analysis as well as a comparison to the Geant4 simulation will be presented.

Work supported by BMBF 05E12CD2, EU FP7 227431, HGS-HIRe.

HK 59.6 Do 18:00 S1/01 A3

High precision timing in a FLASH — •Matthias Hoek, Matteo Cardinali, Michael Dickescheid, Sören Schlimme, Concettina Sfienti, Björn Spruck, and Michaela Thiel — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

A segmented highly precise start counter (FLASH) was designed and constructed at the Institute for Nuclear Physics in Mainz. Besides determining a precise reference time, a Time-of-Flight measurement can be performed with two identical FLASH units. Thus, particle identification can be provided for mixed hadron beam environments.

The detector design is based on the detection of Cherenkov light produced in fused silica radiator bars with fast multi-anode MCP-PMTs. The segmentation of the radiator improves the timing resolution while allowing a coarse position resolution along one direction. Both, the arrival time and the Time-over-Threshold are determined by the readout electronics, which enables walk correction of the arrival time.

The performance of two FLASH units was investigated in test experiments at the Mainz Microton (MAMI) using an electron beam with an energy of 855 MeV and at CERN's PS T9 beam line with a mixed hadron beam with momenta between 3-8 GeV/c. Effective Time-walk correction methods based on Time-over-Threshold were developed for the data analysis. The achieved Time-Of-Flight resolution after applying all corrections was found to be ~70ps. Furthermore, the PID and position resolution capabilities will be discussed in this contribution.

HK 60: Instrumentation XVII

Zeit: Donnerstag 16:30–18:30 Raum: S1/01 A4

HK 60.1 Do 16:30 S1/01 A4

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 precise spatial information of track hit points together with energy loss information, serving for particle ID. 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, i.e. by receiving additional redundant layers of drift cells in front of the magnet. This involves new front-end electronics, as the original analog read-out ASIC (ASD8) is no longer in stock and cannot be produced due to its legacy silicon process. Employing new FEE would allow to further increase the sensitivity, e.g. providing additional valuable information for the analysis. This contribution presents a market analysis of alternative state-of-the-art technologies for the analog read-out of drift chambers. Test procedures to evaluate the suitability for the HADES MDCs are discussed and preliminary results are shown. Emphasis is put on the benefits and possible implementations of using two separate analog channels for reading out a sense wire, i.e. a fast amplifier with a discriminator for recording the arrival time of the signal pulse and a slow integrating amplifier with a time-over-threshold discriminator to measure the total charge of the pulse. This work has been supported by BMBF (05P12RFGHJ, 05P15RFFCA), GSI and HIC for FAIR.

HK 60.2 Do 16:45 S1/01 A4

PADI ASIC for straw tube read-out — •Jerzy Pietraszko[1], Michael Träger[1], Jochen Frühauf[1], Christian Schmidt[1], and Mircea Ciobanu[2] for the CBM-Collaboration — [1]GSI, Darmstadt, Germany, — [2]ISS Bucharest, Romania

A prototype of the CBM MUCH straw tube detector[1] consisting of six individual straws of 6mm inner diameter and 220 mm length filled with Ar/CO2 gas mixture has been tested at the COSY accelerator in Jülich. The straw tubes were connected to the FEET-PADI6-HDa PCB[2] equipped with PADI-6 fast amplifier/discriminator ASIC. As a reference counter in this measurement the scCVD diamond detector[3] has been used delivering excellent timing, time resolution below 100ps (sigma), and very precise position information, below 50 μm. The demonstrated position resolution of about 160 μm of the straw tube read out with PADI-6 ASIC confirms the capability of the PADI chip and puts this development as a very attractive readout option for straw tubes and wire chambers.

[1] V. Peshekhonov et al., "Straw tube subsystem of the CBM muon detector", Physics of Particles and Nuclei Letters, March 2012, Volume 9, Issue 2, pp 172-179.

[2] M. Ciobanu et al., "PADI, an ultrafast Preamplifier - Discriminator ASIC for Time of Flight Measurements", Nuclear Science, April 2014, IEEE Transactions ,Volume 61, Issue 2, pp 1015-1023.

[3] J. Pietraszko et al., "Diamonds as timing detectors for minimum-ionizing ...", NIM A 618(2010)121-123

HK 60.3 Do 17:00 S1/01 A4

QDC and TDC for understanding QGP — •Adrian Rost — TU Darmstadt

A flexible COME & KISS Charge-to-Digital-Converter (QDC) and Time-to-Digital-Converter (TDC) read-out scheme will be presented. It will be used for read-out of calorimeters equipped with photo-multiplier tubes (PMTs) or with multi-pixel avalanche photo-diodes (MAPDs) in the HADES and CBM experiments at GSI and the future FAIR facility in Darmstadt.

The detector input signals are integrated with the help of simple analogue electronics (KISS: **K**eep **i**t **S**mall and **S**imple). Afterwards the charge measurement is transformed into a Time-over-Threshold (ToT) measurement using a commercial (COME: Use **Com**mercial **E**lements) FPGA as a discriminator. The well-established TRBv3 platform will provide a very precise ($\sigma_t < 12\,\mathrm{ps}$) FPGA TDC for a ToT measurement of the discriminated signals.

An 8-channel prototype board PaDiWa-AMPS was manufactured and successfully tested in the laboratory and under beam conditions. Beam tests and the optimization process for the HADES ECAL detector will be shown. The adaption of the read-out chain to the NA61/SHINE PSD hadron calorimeter at CERN will also be shown.

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

HK 60.4 Do 17:15 S1/01 A4

Digital signal processing applied to fast timing measurements with scintillating detectors — •Guillermo Fernández Martínez, Alexander Ignatov, Stoyanka Ilieva, and Thorsten Kröll — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 9, 64289 Darmstadt

In the last few years, new scintillation materials (like $LaBr_3$(Ce) and $CeBr_3$) have been proved to be very appropriate detectors for fast timing measurements, due to their combination of good energy and time resolution with high efficiency. At the same time, the emergence of fast digitisers, that allow for the collection of data at increasingly higher sampling frequencies and are easily scalable to large arrays, such as FATIMA@FAIR, has favoured the transition from traditional, analogue time pick-off methods towards pure digital ones. In our work, we present the results of time resolution measurements with standard radioactive sources, with new, purely digital methods through pulse shape analysis.

HK 60.5 Do 17:30 S1/01 A4

FPGA-Based Upgrade of the Read-Out Electronics for the Low Energy Polarimeter at COSY/Jülich — •Nils Hempelmann for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich

The Cooler Synchrotron (COSY) is a facility for cooled polarized beams at the Forschungszentrum in Jülich. The Low Energy Polarimeter (LEP [1,2]) is the polarimeter in the injection beam line of COSY [3]. The beam polarization is measured using scattering off carbon and polyethylene (CH2) targets. The outgoing particles are detected using twelve plastic scintillators installed in groups of three to the left, to the right, above, and below the beam. The LEP is the routine tool for beam set-up, but its performance was limited by the old read-out electronics consisting of analog NIM modules. A new system using analog pulse sampling and an FPGA chip for signal processing was installed and tested. The ejectile particles were identified by relative time of flight measurement using a signal from the RF amplifier of the cyclotron used for acceleration as a reference. The new system is able to measure the time at which a particle arrives to an accuracy in the order of 50 ps. The presentation includes a review of available systems and a report about measurements in May and December 2015.

[1] M. Eggert, Entwicklung eines gepulsten Casium-Ionenstrahls fur die Quelle polarisierter Ionen an COSY/Julich, PhD Thesis, 1998 [2] N. Hempelmann, FPGA-Based Upgrade of the Read-Out Electronics for the Low Energy Polarimeter at COSY/Jülich, Presentation at PSTP Bochum, 2015 [3] R. Maier, Nucl. Instr. and Meth. A 390 (1997) 1

HK 60.6 Do 17:45 S1/01 A4

The read-out chain of the CBM STS detector — •Jörg Lehnert and David Emschermann for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter (CBM) experiment at FAIR will explore the QCD phase diagram at high baryon densities during nucleus-nucleus collisions in a fixed target setup. Its physics goals require interaction rates up to 10 MHz, which can be exploited with fast and radiation hard detectors equipped with free-streaming front-end and readout electronics, connected to a common Data Aquisition (DAQ) system to forward data to the First Level Event Selector (FLES). The core component of the CBM DAQ system is the Data Processing Board (DPB) implementing three important functionalities:

- The incoming data via multiple lower-speed, short distance links is preprocessed, concentrated and forwarded to the FLES via higher-speed, long distance links.
- The DPBs provide an interface for the Detector Control System (DCS) to configure readout and front-end electronics (FEE).
- As part of the Timing and Fast Control (TFC) system the DPBs ensure transmission of the reference clock and synchronous commands necessary to synchronize the FEE.

This contribution will present the readout and DAQ chain on the example of the core subdetector, the Silicon Tracking System (STS).

HK 60.7 Do 18:00 S1/01 A4

Thin and Reliable Connectivity for the CBM-MVD — •Philipp Klaus for the CBM-MVD-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The CBM Micro Vertex Detector requires reliable connectivity to its ∼ 300 CMOS Monolithic Pixel Sensors (CPS). This includes stable powering but also reliable data transmission and fault tolerance. Another requirement is to keep the material budget to a minimum as the cables will be partially in the acceptance of the micro vertex detector. This contribution will summarize our current efforts to reduce the material budget of the readout cables while ensuring reliable connectivity. Our latest prototype of the second station of the MVD (named PRESTO) was studied to obtain the presented results.
*This work has been supported by BMBF (05P12RFFC7), H-QM, HIC for FAIR und GSI.

HK 60.8 Do 18:15 S1/01 A4

Implementation of the ALICE HLT hardware cluster finder algorithm in Vivado HLS — •Frederik Grüll, Heiko Engel, and Udo Kebschull for the ALICE-Collaboration — Infrastructure and Computer Systems in Data Processing, Goethe University Frankfurt, Germany

The FastClusterFinder algorithm running in the ALICE High-Level Trigger (HLT) read-out boards extracts clusters from raw data from the Time Projection Chamber (TPC) detector and forwards them to the HLT data processing framework for tracking, event reconstruction and compression. It serves as an early stage of feature extraction in the FPGA of the board. Past and current implementations are written in VHDL on reconfigurable hardware for high throughput and low latency. We examine Vivado HLS, a high-level language that promises an increased developer productivity, as an alternative. The implementation of the application is compared to descriptions in VHDL and MaxJ in terms of productivity, resource usage and maximum clock frequency.

HK 61: Instrumentation XVIII

Zeit: Donnerstag 16:30–18:30 Raum: S1/01 A2

Gruppenbericht HK 61.1 Do 16:30 S1/01 A2

MAGIX: progressing towards a new experiment — •Sabato Stefano Caiazza for the Magix/MESA-Collaboration — Institut für Kernphysik - JGU, Mainz, Deutschland

In the next years, the Institut für Kernphysik at the Johannes Gutenberg-Universität Mainz, will build a new high-intensity accelerator for low-energy polarized electron beams. The MAGIX experiment will be one of the two exploiting this new machine. This experiment is designed to perform high precision measurement on the intense beam provided by the accelerator with polarized an unpolarized gas targets. This report will present an overview of the experiment and of its objectives, focussing on the development of the first prototypes of the experimental components and the first simulations of the experimental performances with an outlook on the future perspectives.

HK 61.2 Do 17:00 S1/01 A2

Entwicklung großflächiger mikrostrukturierter Gasdetektoren für MAGIX — •Pepe Gülker für die Magix/MESA-Kollaboration — Institut für Kernphysik, Mainz

Das geplante MAGIX-Experiment wird im energierückgewinnenden Bogen des zukünftigen MESA-Beschleunigers stehen und von diesem mit einem Elektronenstrahl (105 MeV | bis zu 10 mA) versorgt werden. In der Fokalebene der hochauflösenden Spektrometer (TARDIS) sollen MPGDs genutzt werden, die speziell für diese Anwendung zu entwickeln sind. Aufgrund der niedrigen Energien muß die effektive Strahlungslänge der Detektoren auf ein Minimum reduziert werden um unerwünschte Effekte, wie Vielfachstreuung zu reduzieren. Die hiermit zusammenhängenden Herausforderungen im Bezug auf die Optimierung der Effizienz und des räumlichen Auflösungsvermögens stehen im Mittelpunkt der Entwicklung. In diesem Vortrag werden die ersten Ergebnisse verschiedener Prototypen, so wie die ersten Tests mit einer dünnen Kapton basierten Auslesestruktur vorgestellt.

HK 61.3 Do 17:15 S1/01 A2

Filtering of common mode effect baseline shift on GEM-based detectors — •Konstantin Münning[1], Bernhard Ketzer[1], Markus Ball[1], Christian Lippmann[2], Arild Velure[3], and Bruno Cavalcante de Souza Sanches[4] for the ALICE-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]GSI - Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]University of Bergen, Department of Physics & Technology — [4]Universidade de Sao Paulo, Instituto de Fisica

Future upgrades of accelerator-based particle physics experiments aim at drastically increased event rates and challenge both detector and readout performance. At high count rates in particle detectors effects like signal pileup, baseline shift and fluctuations become important.

Large size GEM detectors as envisaged e.g. for the ongoing ALICE TPC upgrade have the advantage of delivering a fast signal without ion tail in comparison to wire chambers but the large capacitive coupling between channels via the GEM electrode facing the readout pads leads to significant baseline shift and fluctuations (common mode effect).

The talk is presenting the work on improving the stability of current baseline correction filters and introducing new filters and new data output modes in the read out electronics. The implementation in the SAMPA MPW2 chip to be used at ALICE and other experiments, which has now reached prototype production stage, is being introduced.

Supported by the BMBF and the EU.

HK 61.4 Do 17:30 S1/01 A2

Performance studies with the quadruple GEM detectors for the ALICE TPC upgrade — Piotr Gasik and •Andreas Mathis for the ALICE-Collaboration — TU München, Physik Department E62, Excellence Cluster 'Universe', D-85748 Garching, Germany

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 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 used gated MWPC (Multi-Wire Proportional Chamber) 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 present baseline solution for the TPC upgrade consists of a stack of four large-size GEM foils as amplification stage. An extensive R&D program with small detector prototypes has yielded a specific voltage configuration fulfilling the design specifications in terms of ion backflow suppression, gain stability, energy and $\mathrm{d}E/\mathrm{d}x$ resolution and stability against discharges. Moreover, large-size prototypes have been built in order to validate the production techniques and the performance with respect to operational stability against electric discharges and $\mathrm{d}E/\mathrm{d}x$ resolution both with beams and radioactive sources.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe' and BmBf Verbundsprojekt ALICE at HIG rate 05P15WOCA1.

HK 61.5 Do 17:45 S1/01 A2

Ion backflow and energy resolution in quadruple GEM stack for the ALICE TPC upgrade — •Michael Jung, Rainer Renfordt, and Harald Appelshäuser for the ALICE-Collaboration — Institut für Kernphysik Frankfurt, Goethe-Universität Frankfurt, Germany

After the upgrade of the LHC at CERN the interaction rate of Pb–Pb collisions in RUN3 will be about 50 kHz. Therefore the Time Projection Chamber (TPC) of the ALICE experiment will be upgraded with quadruple stacks of Gas Electron Multipliers (GEMs), to provide operation in continuous mode. A test detector with a quadruple GEM stack has been set up in Frankfurt to investigate the behaviour of GEMs with emphasis on ion backflow (IBF) and energy resolution by varying GEM voltages, transfer fields between GEMs and the pitch between the GEM holes. Furthermore the electron transport properties of GEM foils were studied for different GEM hole pitches.

HK 61.6 Do 18:00 S1/01 A2

Measurement of ion mobility in Argon and Neon based gas mixtures — •Alexander Deisting for the ALICE-Collaboration — Research Division and EMMI, GSI Helmholtzzentrum für Schwerionenforschung — Physikalisches Institut, Universität Heidelberg

Gaseous drift chambers are currently operated at different experiments. In addition such detectors are foreseen for new experiments or upgrades of existing experiments. The performance of detectors with gas as detection medium strongly depends on the parameters of the gas used. One of these is the ion mobility μ, relating the velocity of drifting ions to the applied drift field. If the ion mobility is known it is e.g. possible to estimate the time development of space charges created by ions drifting through the gas volume of the detector and to correct for them.

To measure μ a dedicated gaseous detector was built. It features a gas amplification stage using a stack of three Gas Electron Multiplier (GEM) foils. In parallel to the GEM stack a mesh is mounted, which serves as drift cathode. For the measurement this detector is irradiated with an ionising source. The primary ionisation charges are then amplified by the GEM stack and a signal at the pad plane can be measured. In addition the ions produced during the amplification process will drift towards the mesh and induce a signal there. From the time difference between these signals, the ion mobility can be calculated.

With this setup the ion mobility in several Argon and Neon based gas mixtures was measured. The influence of O_2 and H_2O contamination on the mobility was studied as well.

HK 61.7 Do 18:15 S1/01 A2

A Photoelectric Effect based Field Calibration System for the Time Projection Chamber at the CBELSA/TAPS Experiment — •Dimitri Schaab, Markus Ball, Reinhard Beck, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Deutschland

One challenge of gaseous track detectors, such as the Time Projection Chamber (TPC), is the calibration of the electric field inside the sensitive volume. This is crucial since deviations from a perfectly homogeneous drift field deteriorates the performance of the TPC. Reasons for these deviations are, on the one hand, static imperfections of the detector structure and, on the other hand, dynamic changes of the space charge inside the sensitive volume. The dynamic space charge distortions are collision rate dependent and mainly related to the unwanted ion backflow from the amplification region near the readout plane. For the CBELSA TPC, a calibration system is planned which is based on the T2K calibration system. Here, electrons are released via the photoelectric effect at well-known positions on the cathode, which then drift towards the readout plane and show the integrated spatial distortions.
The concept of the calibration system as well as first results of a small prototype will be presented.
Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 62: Hauptvorträge III

Zeit: Freitag 11:00–13:00 Raum: S1/01 A1

Hauptvortrag HK 62.1 Fr 11:00 S1/01 A1

Baryon Spectroscopy - Recent Results from the CBELSA/TAPS Experiment at ELSA — •Jan Hartmann for the CBELSA/TAPS-Collaboration — HISKP, Universität Bonn

One of the remaining challenges within the standard model is to gain a good understanding of QCD in the non-perturbative regime. A key step towards this aim is baryon spectroscopy, investigating the spectrum and the properties of baryon resonances. To gain access to resonances with small πN partial width, photoproduction experiments provide essential information. Partial wave analyses need to be performed to extract the contributing resonances. Here, a complete experiment is required to unambiguously determine the contributing amplitudes. This involves the measurement of carefully chosen single and double polarization observables.

The CBELSA/TAPS experiment with a longitudinally or transversely polarized target and an energy tagged, linearly or circularly polarized photon beam allows the measurement of a large set of polarization observables. Due to its good energy resolution, high detection efficiency for photons, and the nearly complete solid angle coverage it is ideally suited for the measurement of photoproduction of neutral mesons decaying into photons.

In this talk recent results for various double polarization observables in single- and multi-meson final states will be presented and their impact on the partial wave analysis will be discussed.

Supported by DFG within the SFB/TR16.

Hauptvortrag HK 62.2 Fr 11:30 S1/01 A1

Electromagnetic Probes of the Quark-Gluon Plasma — •Torsten Dahms — Excellence Cluster Universe, TUM, Garching, Germany

Electromagnetic probes, i. e. lepton pairs or photons, provide an excellent probe of the Quark-Gluon Plasma (QGP) produced in nuclear collisions at ultrarelativistic energies. Lepton pairs and photons are emitted, e. g. as blackbody radiation, during all stages of the collision. They preserve information about the properties of the medium at the time of emission as they remain unperturbed by strong final state interactions. Thus, their momentum and, in case of lepton pairs, their invariant-mass distributions are sensitive to the medium temperature but also to modifications caused by a possible restoration of chiral symmetry that is spontaneously broken in vacuum and responsible for the generation of hadron masses. Measurements of such signals are extremely challenging due to the large background from ordinary hadron decays.

This talk will review the latest developments at the Relativistic Heavy Ion Collider and the Large Hadron Collider in the quest to measure the temperature of the QGP and to understand whether and how chiral symmetry is restored.

Hauptvortrag HK 62.3 Fr 12:00 S1/01 A1

Few-body universality in halo nuclei — •Hans-Werner Hammer — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

Few-body systems with resonant interactions show universal properties that are independent of the interaction at short distances. These properties include a geometric spectrum of three- and higher-body bound states and universal correlations between few-body observables. They can be observed over a wide range of scales from hadrons and nuclei to ultracold atoms. In this talk, I will focus on few-body universality in halo nuclei which can be considered effective few-body systems consisting of halo nucleons and a tightly bound core. This concept provides a unifying framework for the description of halo nuclei with systematically calculable corrections. I will discuss recent progress and future challenges in this field with a special emphasis on the prospects of observing Efimov states in halo nuclei.

Hauptvortrag HK 62.4 Fr 12:30 S1/01 A1

Upgrade of the GSI-Unilac as a FAIR High Current Injector — •Hendrik Hähnel — Institut für Angewandte Physik, Goethe Universität Frankfurt, Deutschland

The existing UNIversal Linear Accelerator (UNILAC) at GSI will serve as ion and dedicated uranium ion injector for the Facility for Antiproton and Ion Research (FAIR). For nominal FAIR operation, 15 emA of Uranium 28+ at low emittances have to be injected by multiturn-injection into FAIR. To meet these requirements and to ensure reliable operation, the UNILAC will undergo a significant upgrade process. Upgrade measures concerning key accelerator components are described and a main focus is put on a replacement of the 54m Alvarez-section by a compact IH-DTL. This will open new options for future injection schemes into SIS100.

HK 63: Hadron Structure and Spectroscopy X

Zeit: Freitag 14:00–15:45 Raum: S1/01 A4

Gruppenbericht HK 63.1 Fr 14:00 S1/01 A4

Hyperons in nuclear matter from SU(3) chiral effective field theory — •Stefan Petschauer[1], Johann Haidenbauer[2], Norbert Kaiser[1], Ulf-G. Meissner[2,3], and Wolfram Weise[1,4] — [1]Technische Universität München — [2]Forschungszentrum Jülich — [3]Universität Bonn — [4]ECT*, Trento, Italy

Brueckner theory is used to investigate the properties of hyperons in nuclear matter. The hyperon-nucleon interaction is taken from chiral effective field theory at next-to-leading order with SU(3) symmetric low-energy constants. Furthermore, the underlying nucleon-nucleon interaction is also derived within chiral effective field theory. We present the single-particle potentials of Λ and Σ hyperons in symmetric and asymmetric nuclear matter computed with the continuous choice for intermediate spectra. The results are in good agreement with the empirical information. In particular, our calculation gives a repulsive Σ-nuclear potential and a weak Λ-nuclear spin-orbit force. The splittings among the Σ^+, Σ^0 and Σ^- potentials have a non-linear dependence on the isospin asymmetry which goes beyond the usual parametrization in terms of an isovector Lane potential.

This work has been supported in part by DFG and NSFC (CRC110).

HK 63.2 Fr 14:30 S1/01 A4

Study of NΣ Cusp in p + p → p + K^+ + Λ with Partial Wave Analysis — •S. Lu[1], R. Muenzer[1], E. Epple[1], L. Fabbietti[1,3], J. Ritman[2], E. Roderburg[2], and F. Hauenstein[2] — [1]Excellenz Cluster Universe - Technische Universität München — [2]FZ Jülich — [3]Hades and FOPI Collaboration

In the last years, an analysis of exclusive reaction of p + p → p + K^+ + Λ has been carried out using Bonn-Gatchina Partial Wave Analysis. In a combined analysis of data from Hades, Fopi, Disto and Cosy-TOF, an energy dependent production process is determined. This analysis has shown that a sufficient description of the p + p → p + K^+ + Λ is quite challanging due to the presence of resonances N^* and interference, which requires Partial Wave Analysis. A pronounced narrow structure is observed in its projection on the pΛ-invariant mass. This peak structure, which appears around the NΣ threshold, has a strongly asymmetric structure and is interpreted a NΣ cusp effect. In this talk, the results from a combined analysis will be shown, with a special focus on the NΣ cusp structure and a description using Flatt$\grave{e}$ parametrization.*supported by the DFG Project FA 898/2-1

HK 63.3 Fr 14:45 S1/01 A4

Polarization Observables Measured in the Reaction $\vec{p}p \to pK^+\Lambda$ by COSY-TOF — •Florian Hauenstein for the COSY-TOF-Collaboration — Forschungszentrum Juelich, Juelich

The $\vec{p}p \to pK^+\Lambda$ reaction was measured with the COSY-TOF detector using a polarized proton beam with beam momenta 2.7 GeV/c and 2.95 GeV/c. The measurements with a polarized beam allow the determination of polarization observables in addition to the differential cross sections. These observables are the Λ polarization, the spin transfer to the Λ and the analyzing power of the final state particles. The latter is connected with the partial wave composition of the final state system, while the first two can improve the understanding of the underlying reaction mechanism of the associated strangeness production. Currently, no sophisticated models exist in this energy regime, thus, conclusive results concerning the reaction mechanism can not be drawn yet. Nevertheless, the obtained data are the first with full phase space acceptance and high statistics in this beam energy regime.

In this talk the extraction methods for the different polarization observables will be explained, and results for the polarization observables as a function of different variables will be shown. The dependencies of the results on the beam momentum will be discussed. Furthermore, a comparison with theoretical expectations from high energy physics for the Λ polarization will be given.

HK 63.4 Fr 15:00 S1/01 A4

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

The BGO-OD experiment at the ELSA facility in Bonn is built to investigate 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 for the neutral decay channel $K^0\Sigma^+ \to \pi^0\pi^0\pi^0 p$ will be presented. Due to the small production cross section and branching ratio kinematic fitting is used to discriminate the reaction against background.

Supported by DFG (SFB/TR-16).

HK 63.5 Fr 15:15 S1/01 A4

Inclusive Λ production in proton-proton at 3.5 GeV in HADES — •Rafal Lalik for the HADES-Collaboration — Excellence Cluster Universe, Technische Universität München, Boltzmannstr. 2, D-85748, Garching, Germany

The total production cross-section of Λ hyperions was measured with the HADES spectrometer at GSI Helmholtz in Darmstadt in the proton-proton reactions at $\sqrt{s}$ = 3.18 GeV. Experimental data were compared to data-driven model based on experimental results of Λ production in various exclusive channels measured in the same reaction at HADES. Beside phase-space production, contributions from $\Sigma(1385)$, Δ and N^* intermediate resonances has been considered. It is shown in Partial Wave Analysis of pKΛ channel that pure phase-space production does not describe all kinematical variables of the observed distributions and inclusion of coherent sum of intermediate resonances is necessary. The differential cross-sections of each contributing channel is extracted via fit to the experimental data providing full description of the Λ production in this energy regime.

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

HK 63.6 Fr 15:30 S1/01 A4

A Three-Flavor Chiral Effective Model with Four Baryonic Multiplets within the Mirror Assignment — •Lisa Olbrich, Miklós Zétényi, Francesco Giacosa, and Dirk H. Rischke — Institute for Theoretical Physics, Goethe University Frankfurt am Main

Chiral symmetry requires the existence of chiral partners in the hadronic mass spectrum. In this talk, we address the question which is the chiral partner of the nucleon. We employ a chirally symmetric linear sigma model, where hadrons and their chiral partners are treated on the same footing. We construct four spin-1/2 baryon multiplets from left- and right-handed quarks as well as left- and right-handed diquarks. Two of these multiplets transform in a "mirror" way, which allows for chirally invariant mass terms. We then embed these baryonic multiplets into the Lagrangian of the extended Linear Sigma Model, which features (pseudo)scalar and (axial-)vector mesons, as well as glueballs. Reducing the Lagrangian to the two-flavor case, we obtain four doublets of nucleonic states. These mix to produce the positive-parity nucleon $N(939)$ and the Roper resonance $N(1440)$, as well as the negative-parity resonances $N(1535)$ and $N(1650)$. We determine the parameters of the nucleonic part of the Lagrangian from a fit to masses and decay properties of these states. Studying the limit of vanishing quark condensate, we conclude that $N(939)$ and $N(1535)$, as well as $N(1440)$ and $N(1650)$ form pairs of chiral partners.

[1] L. Olbrich, M. Zétényi, F. Giacosa, and D.H. Rischke, arXiv:1511.05035 [hep-ph].

HK 64: Hadron Structure and Spectroscopy XI

Zeit: Freitag 14:00–16:00 Raum: S1/01 A5

Gruppenbericht HK 64.1 Fr 14:00 S1/01 A5

Status of $d^*(2380)$ and Search for an Isospin $I = 3$ Dibaryon Resonance*. — •Heinz Clement[1], Mikhail Bashkanov[2], and Tatiana Skorodko[1] for the WASA-at-COSY-Collaboration — [1]Physikalisches Institut der Universität Tübingen — [2]School of Physics and Astronomy, University of Edinburgh, UK

For the meanwhile established dibaryon resonance $d^*(2380)$ with $I(J^P) = 0(3^+)$ all decay branchings into NN and $NN\pi\pi$ channels have been determined. A principially possible, though unlikely decay into the isoscalar $NN\pi$ channel is under investigation – see separate contribution. The total decay width as well as the extracted branching ratios bear important information about the internal structure of the dibaryon. They agree with a subthreshold $\Delta\Delta$ system as asymtotic two-hadron configuration in the intermediate state and discriminate against other recently discussed decay scenarios like, *e.g.* via the $N\Delta$ threshold state $D_{12}(2144)$.

The experimental results are compared with various theoretical calculations in the framework of Faddeev or quark model treatments. The possible role of hidden color is discussed.

Many of these theoretical studies predict also another, truly exotic state with mirrored quantum numbers $I(J^P) = 3(0^+)$, *i.e.* decoupled from the NN system and consisting of just six up-quarks in its $I_z = +3$ state. Such a state may be searched for in four-pion production. The status of this search by use of WASA data on the $pp \to pp\pi^+\pi^+\pi^-\pi^-$ reaction will be reported.

*supported by DFG (CL 214/3-1) and STFC (ST/L00478X/1)

HK 64.2 Fr 14:30 S1/01 A5

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 single pion production in NN collisions may be decomposed into its isoscalar and isovector parts, which give important information about the pion production mechanism – in particular on the role of isoscalar and isovector resonance excitations in the course of the reaction process.

Whereas the isovector pion production being sensitive to baryonic Δ excitations is reasonably well known from threshold up to several GeV, the isoscalar pion production has been determined experimentally only for beam energies below 1 GeV. The reason is that the isoscalar strength needs pn collisons for its experimental extraction.

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 are being analyzed. Since these reactions have been 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. We observe a pronounced signal from the Roper resonance, in particular in the $pp\pi^-$ channel. A possible, though unlikely contribution from $d^*(2380)$ is being searched for.

*supported by DFG (CL 214/3-1) and STFC (ST/L00478X/1)

HK 64.3 Fr 14:45 S1/01 A5

Search for η'-nucleus bound states by missing mass spectroscopy*,** — •Stefan Friedrich[1] and Yoshiki Tanaka[2] for the EtaPrime-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen — [2]University of Tokyo

In a search for η'-mesic states in ^{11}C the ^{12}C(p,d) reaction has been studied at a proton beam energy of 2.5 GeV, using the fragment separator FRS at GSI in spectrometer mode, as proposed in [1,2]. Applying several $B\rho$ settings of the FRS, the missing-mass spectrum was measured by analyzing the momentum of the ejectile deuterons through particle tracking with two multi-wire drift chambers in the dispersive focal plane, covering an excitation energy range in ^{11}C of -90 MeV to +30 MeV with respect to the η' production threshold. Particle identification was achieved by momentum and time-of-flight measurements. Backward elastic scattering in the D$(p,d)p$ reaction was used for momentum calibration. Background processes such as multi-pion production were studied in the D$(p,d)X$ reaction. The current status of the data analysis will be discussed. Upper limits for the population cross section of $\eta' \otimes ^{11}$C states will be presented and compared to theoretical predictions [1,2].

[1] H. Nagahiro et al., *Phys. Rev. C* **87** (2013) 045201
[2] K. Itahashi et al., *Prog. Theo. Phys.* **128** (2012) 601

*Funded by Grant-in-Aid for Young Scientists (A) (No.25707018) from JSPS
**Experiment performed in the framework of the Super-FRS collaboration for FAIR

HK 64.4 Fr 15:00 S1/01 A5

Determination of the real part of the η'-Nb optical potential — •Mariana Nanova for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The excitation function and momentum distribution of η' mesons have been measured in photo production off ^{93}Nb in the energy range of 1.2-2.9 GeV. The experiment has been performed with the combined Crystal Barrel and MiniTAPS detector system, using tagged photon beams from the ELSA electron accelerator. Information on the sign and magnitude of the real part of the η'-Nb potential has been extracted from a comparison of the data with model calculations. An attractive potential of -$(38 \pm 9(stat) \pm 12(syst))$ MeV depth at normal nuclear matter density is deduced within model uncertainties. This value is consistent with the potential depth of -$(37 \pm 10(stat) \pm 10(syst))$ MeV obtained in an earlier measurement for a light nucleus (carbon) [1].

[1] M. Nanova et al., *Phys. Lett. B* **727** (2013), 417

*Funded by DFG (SFB/TR16)

HK 64.5 Fr 15:15 S1/01 A5

Measurement of the absolute differential cross section of proton-proton elastic scattering at small angles, using ANKE-COSY facility — •Zara Bagdasarian — Forschungszentrum Juelich

The most accepted approach to describe nucleon-nucleon (NN) interaction is the partial wave analysis (PWA). The goal of many experiments held at COSY-Jülich has been to provide PWA with valuable precision measurements at different energies aiming to cover the full angular range. This contribution reports on the differential cross section for proton-proton elastic scattering that has been measured at a beam energy of 1.0 GeV and in 200 MeV steps from 1.6 to 2.8 GeV at centre-of-mass angles between about 10 and 30 degrees.

The ANKE collaboration and the COSY machine crew have jointly developed a very accurate method for determining the absolute luminosity in an experiment at an internal target position. The technique relies on measuring the energy losses due to the electromagnetic interactions of the beam as it passes repeatedly through the thin target and measuring the shift of the revolution frequency by studying the Schottky spectrum. This powerful technique allows one to measure the absolute differential cross section for elastic pp scattering with the accuracy of typically 3%.

After extrapolating the differential cross sections to the forward direction, the results are broadly compatible with the predictions of forward dispersion relations. Finally, it is shown that the data have a significant impact on the partial wave analysis.

HK 64.6 Fr 15:30 S1/01 A5

Studies on the η meson production channel $d + p \to {}^3\mathrm{He} + \eta$ — •Christopher Fritzsch, Alfons Khoukaz, Marcel Rump, 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, analysis of the asymmetry factor α of the differential cross sections show a distinct effect of s- and p-wave interference with the η momentum, 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, located at the Forschungszentrum Jülich in Germany, enable the extraction of additional total and differential cross sections for

the η production up to an excess energy of $Q = 15\,\mathrm{MeV}$ with significantly improved 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.

HK 64.7 Fr 15:45 S1/01 A5

The quasi-free reaction p+d → d+η+p_{sp} at ANKE* — •Daniel Schröer, Christopher Fritzsch, Alfons Khoukaz, and Marcel Rump for the ANKE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität, 48149 Münster, Germany

The interaction between η mesons and hadrons is an intensively investigated topic. Due to its stength it might lead to the formation of η-mesic nuclei. In order to study the characteristics of this interaction a measurement of the reaction $p + d \rightarrow d + \eta + p_{sp}$ has been performed at the ANKE spectrometer at the COSY accelerator of the Forschungszentrum Jülich. In this context the deuteron serves as an effective neuteron target whereas the proton is treated as a spectator particle. The 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 grant access to the determination of total and differential cross sections in an excess energy range from threshold up to Q = 90 MeV. While the course of the total cross section, especially near threshold, will allow to compute the scattering length $a_{d\eta}$ of an s-wave final state interaction ansatz, the differential cross sections permit to verify the legitimacy of the s-wave assumption. 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.

*Supported by the FFE program of the Forschungszentrum Jülich

HK 65: Heavy Ion Collision and QCD Phases XII

Zeit: Freitag 14:00–16:00 Raum: S1/01 A01

Gruppenbericht HK 65.1 Fr 14:00 S1/01 A01

Jets with ALICE: from vacuum to QCD at high temperatures — •Cunqueiro Leticia for the ALICE-Collaboration — University of Muenster, Germany

The hot and dense medium created in heavy-ion collisions is expected to modify the yield and radiation pattern of jets relative to proton proton collisions. The study of medium-induced modifications in jets aims at the understanding of the detailed mechanisms of in medium energy loss of partons and of fundamental properties of QCD at high temperatures.

ALICE measures jets in pp, p–Pb and Pb–Pb collisions, where pp and p–Pb are conceived primarily as a reference for vacuum and cold nuclear effects respectively.

The jet program comprises measurements like yields for different resolution R, intra-jet and inter-jet modifications via jet shapes and hadron-jet correlations, path length dependence of energy loss via jet flow v_{2}, hadrochemistry via jet constituent identification, flavour/mass hierarchy of energy loss via heavy flavour tagging etc.

Several of the latest ALICE jet physics results will be presented and discussed with emphasis on new studies on jet substructure and jet shapes.

HK 65.2 Fr 14:30 S1/01 A01

Parallel 4-Dimensional Cellular Automaton Track Finder for the CBM Experiment — •Valentina Akishina[1,2,3,4] and Ivan Kisel[1,2,3] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt am Main, Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]JINR Joint Institute for Nuclear Research, Dubna, Russia

The CBM experiment at FAIR will focus on the measurement of rare probes at interaction rates up to 10 MHz. The beam will provide free stream of particles, so that information about different collisions may overlap in time. It requires the full online event reconstruction not only in space, but also in time, so-called 4D (4-dimensional) event building. This is a task of the First-Level Event Selection (FLES) package. The FLES reconstruction package consists of several modules: track finding, track fitting, short-lived particles finding, event building and selection.

The Silicon Tracking System (STS) time measurement information was included into the Cellular Automaton (CA) track finder algorithm. The 4D track finder algorithm speed (8.5 ms per event in a time-slice) and efficiency is comparable with the event-based analysis. The CA track finder was fully parallelised inside the time-slice. The parallel version achieves a speed-up factor of 10.6 while parallelising between 10 Intel Xeon physical cores with a hyper-threading. The first version of event building based on 4D track finder was implemented. Supported by FIAS, HICforFAIR, HGS-HIRe and Hessischen Ministerium für Wissenschaft und Kunst.

HK 65.3 Fr 14:45 S1/01 A01

Analysis of charge-dependent azimuthal correlations with HADES — •Frederic Kornas[1], Ilya Selyuzhenkov[2], and Tetyana Galatyuk[1,2] for the HADES-Collaboration — [1]TU Darmstadt — [2]GSI

Charge-dependent azimuthal correlations relative to the reaction plane have been proposed as a probe in the search for the chiral magnetic effect in relativistic heavy-ion collisions. These type of correlations have been measured at the RHIC BES by STAR and at the LHC by ALICE. This contribution discusses two charged particle correlations with respect to the reaction plane measured with high statistic sample of Au+Au collisions at 1.23 AGeV collected by HADES. The Forward wall detector allows to reconstruct the reaction plane using the spectator fragments. The status of the analysis with protons and charged pions will be presented.

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

HK 65.4 Fr 15:00 S1/01 A01

Production of charged pions at SIS 18 energies. — •Malgorzata Gumberidze for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

The High Acceptance DiElectron Spectrometer HADES is devoted mainly to study production of dielectron pairs from proton, pion and nucleus induced reactions at 1-2 AGeV. At the same time, the spectrometer provides detection and high quality identification of charged-hadron with a large solid angle.

In this contribution we present the results of a study of charged pion production at SIS18 energies using the HADES spectrometer at GSI. The main focus is on 40% most central Au(1.23 GeV per nucleon)+Au collisions. The results contribute to the data base from previous systematic studies of pion production with an unprecendented statistics, and serve as an input for the normalization of the dielectron data obtained in the same experiment.

In particular we have performed a measurement of the transverse momentum distributions of pi+ and pi- mesons covering a fairly large rapidity interval. The yields, transverse mass and angular distributions are compared with transport model calculations as well as with existing data from other experiments.

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

HK 65.5 Fr 15:15 S1/01 A01

Reconstruction of charged pions at SIS 18 energies. — •Malgorzata Gumberidze for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

The High Acceptance DiElectron Spectrometer HADES is devoted mainly to study production of dielectron pairs from proton, pion and nucleus induced reactions at 1-2 AGeV. At the same time, the spectrometer provides detection and high quality identification of charged particles with a large solid angle.

In this contribution we present the results of a study of charged pion production at SIS18 energies using the HADES spectrometer at GSI. The main focus is on 40% most central Au(1.23 GeV per nucleon)+Au collisions. The results contribute to the data base from previous systematic studies of pion production with an unprecendented statistics,

and serve as an input for the normalization of the dielectron data obtained in the same experiment.

In particular we have performed a measurement of the transverse momentum distributions of pi+ and pi- mesons covering a fairly large rapidity interval. The yields, transverse mass and angular distributions are compared with transport model calculations as well as with existing data from other experiments.

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

HK 65.6 Fr 15:30 S1/01 A01

Investigations on corrections of higher order moments of (net-)proton number fluctuations in Au+Au collisions at 1.23 AGeV with HADES — •Melanie Szala for the HADES-Collaboration — Goethe Universität Frankfurt

Higher order moments of conserved quantities are promising probes of the structure of the QCD phase diagram and especially of the critical point. Investigations of heavy-ion collisions at low beam energies give access to the thermodynamics of QCD in the low T and high μ_B region of the phase diagram.

The HADES experiment at GSI Helmholtzzentrum fuer Schwerionenforschung in Darmstadt measured Au+Au collisions at $\sqrt{s_{NN}}$ = 2.41 GeV in 2012. In this talk we present investigations on the efficiency correction of higher moments of (net-)proton multiplicity distributions as well as investigations on the centrality and rapidity/p_t dependence of the higher order moments.

This work has been supported by BMBF (05P12RFGHJ, 05P15RFFCA), GSI and HIC for FAIR.

HK 65.7 Fr 15:45 S1/01 A01

Particle production in nucleus-nucleus and pion-nucleus collisions at $E_{lab} = 0.8 - 2\,\mathrm{AGeV}$ — •Vinzent Steinberg[1], Hannah Petersen[1,2,3], Dmytro Oliinychenko[1,4], and Janus Weil[1] — [1]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [2]Institute for Theoretical Physics, Goethe University, 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 is a new hadronic transport model designed to describe the non-equilibrium evolution of heavy-ion collisions. After a brief introduction to the model, it will be shown that SMASH correctly reproduces the cross sections and maintains detailed balance. First comparisons to pion spectra measured by FOPI and HADES will be presented, demonstrating that the energy deposition and transverse expansion are correctly described. Predictions for strangeness production in pion-nucleus collisions as recently measured by HADES will be given.

HK 66: Heavy Ion Collision and QCD Phases XIII

Zeit: Freitag 14:00–16:00 Raum: S1/01 A04

Gruppenbericht HK 66.1 Fr 14:00 S1/01 A04

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 with free-streaming readout electronics. A high-speed Data Aquisition system will forward data from the detector front-ends to the First Level Event Selector (FLES), providing an online event selection. We will report on the current status of the CBM experiment and its subsystems.

HK 66.2 Fr 14:30 S1/01 A04

Effective Polyakov loop models for QCD-like theories at finite baryon density — •Philipp Scior[1], Lorenz von Smekal[2] und Bjoern Wellegehausen[2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen

We study the heavy quark limit of QCD-like theories by using a three-dimensional Polyakov theory. This theory can be derived from the full QCD-like theory by a combined strong coupling expansion. In particular we investigate the cold and dense regime of the phase diagram where we expect to find the Silverblaze property realized as Bose-Einstein-condensation of diquarks or a fist order liquid-gas transition, depending on the gauge group of the theory. We find evidence for the Silverblaze property when the quark chemical potential μ reaches half the diquark mass. For even higher μ we find the deconfinement transition indicated by the rise of the Polyakov loop as well as the quark number density.

HK 66.3 Fr 14:45 S1/01 A04

Vacuum-fluctuation effects on inhomogeneous chiral symmetry breaking — •Michael Buballa[1], Stefano Carignano[2], and Bernd-Jochen Schaefer[3] — [1]TU Darmstadt — [2]INFN Gran Sasso — [3]Justus-Liebig-Universität Gießen

Various model studies suggest that the phase diagram of strong-interaction matter contains an inhomogeneous region where the chiral condensate is non-uniform in space. Most of these studies have been performed in the mean-field approximation. As a first step to include fluctuation effects, we investigate the phase structure of the quark-meson (QM) model in the so-called extended mean-field approximation, where the Dirac-sea contributions of the quarks are taken into account. In contrast to the frequently employed Nambu–Jona-Lasinio (NJL) model the QM model is renormalizable, so that the results eventually become independent of the cutoff parameter. Compared with the case where the Dirac sea is neglected, we find that the inhomogeneous phase shrinks, but in general does not disappear. It turns out, however, that the inhomogeneous phase is particularly sensitive to a proper choice of the renormalization conditions, fixing meson pole masses, rather than curvature masses. With that choice the Lifshitz point of the inhomogeneous phase coincides with the tricritical point if the ratio between sigma-meson and constituent quark mass in vacuum is chosen to be 2, corresponding to the fixed mass ratio in the NJL model. Finally, we uncover a general instability of the model, indicating that further improvements of the approximation scheme, in particular including bosonic fluctuations, are necessary.

HK 66.4 Fr 15:00 S1/01 A04

Modeling chiral criticality and its consequences for heavy-ion collisions — •Gabor Almasi[1], Bengt Friman[1,2], and Krzysztof Redlich[2,3,4] — [1]Gesellschaft für Schwerionenforschung, GSI, D-64291 Darmstadt, Germany — [2]ExtreMe Matter Institute (EMMI), D-64291 Darmstadt, Germany — [3]University of Wrocław - Faculty of Physics and Astronomy, PL-50-204 Wrocław, Poland — [4]Department of Physics, Duke University, Durham, NC 27708, USA

We explore the critical fluctuations near the chiral critical endpoint (CEP), which belongs to the Z(2) universality class, in a chiral effective model and discuss possible signals of the CEP, recently explored in nuclear collision experiments [1]. Particular attention is attributed to the dependence of such signals on the location of the phase boundary and the CEP relative to the hypothetical freeze-out conditions in nuclear collisions. We argue that in effective models freeze-out fits to heavy-ion results should not be used directly, and relevant quantities should be investigated on lines of the phase diagram, that are defined self-consistently in the framework of the model [2]. We discuss possible choices for such an approach. Additionally we discuss the effect of the repulsive vector interaction of quarks on the location of the CEP and

on the structure of the baryon number cumulant ratios.

[1] L. Adamczyk, et al., Phys. Rev. Lett. **112** (2014) 032302.

[2] G. Almasi, B. Friman, and K. Redlich, Quark Matter 2015 Proceedings, to be published.

HK 66.5 Fr 15:15 S1/01 A04

Chiral Mirror-Baryon-Meson Model and Nuclear Matter beyond Mean-Field — •Johannes Weyrich[1,2], Nils Strodthoff[3], and Lorenz von Smekal[2] — [1]TU Darmstadt — [2]Justus-Liebig-Universität Gießen — [3]Universität Heidelberg

We consider a chiral mirror-baryon-meson model to describe the properties of nuclear matter around the liquid-gas transition in the low temperature region of the QCD phase diagram together with chiral symmetry restoration in the high density phase. In the mean-field approximation this model is known to provide a successful description of nuclear matter properties. Here, we go beyond the mean-field approximation using a functional renormalization group (FRG) framework to study this chiral mirror-baryon-meson model (or parity doublet model) at finite temperature and baryon chemical potential.

HK 66.6 Fr 15:30 S1/01 A04

Kinetics of the chiral phase transition — •Hendrik van Hees[1,2], Christian Wesp[1], Alex Meistrenko[1], and Carsten Greiner[1] — [1]Johann-Wolfgang-Goethe-Universität Frankfurt, Institut für theoretische Physik, Max-von-Laue-Str. 1, D-60438 Frankfurt — [2]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Str. 1, D-60438 Frankfurt

We simulate the kinetics of the chiral phase transition in hot and dense strongly interacting matter within a novel kinetic-theory approach. Employing an effective linear σ model for quarks, σ mesons, and pions we treat the quarks within a test-particle ansatz for solving the Boltzmann transport equation and the mesons in terms of classical fields. The decay-recombination processes like $\sigma \leftrightarrow \bar{q} + q$ are treated using a kind of wave-particle dualism using the exact conservation of energy and momentum. After demonstrating the correct thermodynamic limit for particles and fields in a "box calculation" we apply the simulation to the dynamics of an expanding fireball similar to the medium created in ultrarelativistic heavy-ion collisions.

HK 66.7 Fr 15:45 S1/01 A04

FRG study of the chiral phase transition in a quark-meson model with (axial-)vector mesons — •Jürgen Eser and Dirk Rischke — Institut für Theoretische Physik, Goethe-Universität, Max-von-Laue- Str. 1, 60438 Frankfurt am Main

The functional renormalization group (FRG) technique, as a non-perturbative continuum approach towards the thermodynamics of quantum chromodynamics (QCD), is complementary to lattice calculations. We use this method to investigate the chiral phase transition in a quark-meson model based on the so-called extended linear sigma model (eLSM). Besides (pseudo-)scalar degrees of freedom the latter also includes vector and axial-vector mesons, which are promising candidates in order to indicate the formation of a quark- gluon plasma (QGP) during heavy-ion collisions. Compared to previous investigations of the eLSM, the evidently significant contribution of quark fields to the renormalization flow is now also taken into account. The chiral phase transition order within this model as well as the mass degeneracy of chiral partners occurring above the critical temperature will be discussed.

HK 67: Nuclear Astrophysics VI

Zeit: Freitag 14:00–15:45 Raum: S1/01 A02

Gruppenbericht HK 67.1 Fr 14:00 S1/01 A02

Neutrino interactions with supernova matter* — •Alexander Bartl[1,2], Christian Drischler[1,2], Kai Hebeler[1,2], and Achim Schwenk[2,1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

Neutrino pair bremsstrahlung and absorption ($NN \leftrightarrow NN\nu\bar{\nu}$) as well as inelastic scattering of neutrinos ($NN\nu \leftrightarrow \nu NN$) are of great relevance for the generation of and energy transport by neutrinos in core-collapse supernovae. In this talk, we will present improved interaction rates including the first calculation of neutrino rates in mixtures of protons and neutrons that includes chiral three-nucleon forces. We will also discuss the impact of these improved rates in supernova simulations.

*This work was supported by the Studienstiftung des Deutschen Volkes, BMBF ARCHES and the ERC Grant No. 307986 STRONGINT.

HK 67.2 Fr 14:30 S1/01 A02

Microphysics of neutrino-nucleon interactions in supernova matter — •Andreas Lohs[1] and Gabriel Martinez-Pinedo[2,3] — [1]Universität Basel, Schweiz — [2]Technische Universität Darmstadt — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

In core-collapse supernova (CCSN) simulations, neutrino-nucleon interactions are mostly described by simplified microphysics, such as the so called elastic approximation. Further subleading order contributions, resulting from tensor couplings in the weak hadronic current and from nucleon recoil, are often included in the form of analytic correction factors. We compare these approximations with exact calculations of the mean free path in the picture of quasi free nucleons. We find that deviations to the approximations of the order of 10% appear already at relatively low temperatures of a few MeV or densities around $10^12\,\mathrm{g/cm^3}$. It is therefore recommended to include the exact neutrino-nucleon microphysics in order to achieve e.g. reliable predictions for the emitted neutrino spectrum during the first hundred milliseconds to several seconds postbounce. Eventually we discuss possible improvements to the analytic approximations to improve their applicability.

HK 67.3 Fr 14:45 S1/01 A02

Neutrino-induced nucleosynthesis in Core-Collapse Supernovae — •Andre Sieverding[1], Gabriel Martínez-Pinedo[1,2], and Karlheinz Langanke[2] — [1]1 Institut für Kernphysik (Theoriezentrum), Technische Universit*at Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]Gesellschaft für Schwerionenforschung Darmstadt, Planckstr. 1, D-64259 Darmstadt, Germany

We study influence of an extensive set of neutrino induced reactions on nucleosynthesis calculations for the outer layers of supernovae. We use cross sections calculated for almost the whole nuclear chart including multi-particle evaporation. Some of the critical cross-sections e.g. for ^{26}Mg, could be constrained by experimental data. We explore the sensitivity to the neutrino spectra and stellar structure for a large set of solar metallicity progenitor models.

Our studies confirm the fact that ^{7}Li, ^{11}B and ^{19}F, ^{138}La and ^{180}Ta are produced by neutrino processes. However, calculations with neutrino spectra consistent with state-of-the-art Supernova simulations predicting substantially reduced average energies, we find a significant reduction of the yields of these nuclei.

Despite the lower neutrino energies we find significant contributions of neutrino-nucleosynthesis for the production of ^{26}Al and ^{22}Na.

This work is supported by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute and by the Helmholtz International Center for FAIR in the context of the LOEWE initiative.

HK 67.4 Fr 15:00 S1/01 A02

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 necessary requirements for launching a GRB and compare with our numerical results.

[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.

HK 67.5 Fr 15:15 S1/01 A02

Moments of inertia of neutron stars — •Svenja Kim Greif[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

Neutron stars are unique laboratories for matter at extreme conditions. While nuclear forces provide systematic constraints on properties of neutron-rich matter up to around nuclear saturation density, the composition of matter at high densities is still unknown. Recent precise observations of 2 $M_\odot$ neutron stars made it possible to derive systematic constraints on the equation of state at high densities and also neutron star radii.

Further improvements of these constraints require the observation of even heavier neutron stars or a simultaneous measurement of mass and radius of a single neutron star. Since the precise measurement of neutron star radii is an inherently difficult problem, the observation of moment of inertia of neutron stars provides a promising alternative, since they can be measured by pulsar timing experiments. We present a theoretical framework that allows to calculate moments of inertia microscopically, we show results based on state of the art equations of state and illustrate how future measurements of moments of inertia allow to constrain the equation of state and other properties of neutron stars.

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

HK 67.6 Fr 15:30 S1/01 A02

Equation of state of neutron-rich nuclear matter from chiral effective field theory — Norbert Kaiser and •Susanne Strohmeier — Technische Universität München

Based on chiral effective field theory, the equation of state of neutron-rich nuclear matter is investigated systematically. The contributing diagrams include one- and two-pion exchange together with three-body terms arising from virtual $\Delta(1232)$-isobar excitations. The proper expansion of the energy per particle, $\bar{E}(k_f,\delta) = \bar{E}_n(k_f) + \delta B_1(k_f) + \delta^{5/3} B_{5/3}(k_f) + \delta^2 B_2(k_f) + \ldots$, for the 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 for the various interaction contributions. One observes essential structural differences to the commonly used quadratic approximation. The density dependent coefficient $B_1(k_f)$ turns out to be unrelated to the isospin-asymmetry of nuclear matter. The coefficient $B_{5/3}(k_f)$ of the non-analytical $\delta^{5/3}$-term receives contributions from the proton kinetic energy and from the one- and two-pion exchange interactions. The physical consequences for neutron star matter are studied.

HK 68: Structure and Dynamics of Nuclei XII

Zeit: Freitag 14:00–16:00 Raum: S1/01 A03

Gruppenbericht HK 68.1 Fr 14:00 S1/01 A03

Axial asymmetry of excited heavy nuclei as essential feature for the prediction of level densities — •Eckart Grosse[1], Arnd R. Junghans[2], and Ralph Massarczyk[3] — [1]Institute of Nuclear and Particle Physics, Technische Universität Dresden — [2]Institute of Radiation Physics, Helmholtz-Zentrum Dresden-Rossendorf — [3]Los Alamos National Laboratory, New Mexico, USA

In previous studies a considerable improvement of predictions for neutron resonance spacings by a modified back-shifted Fermi-gas model (BSFM) was found. The modifications closely follow the basic priciples for a gas of weakly bound Fermions as given in text books of statistical physics: (1) Phase transition at a temperature defined by theory, (2) pairing condensation independent of A, and (3) proportionality of entropy to temperature (and thus the level density parameter) fixed by the Fermi energy.

For finite nuclei we add: (4) the back-shift energy is defined by shell correction and (5) the collective enhancement is enlarged by allowing the axial symmetry to be broken. Nearly no parameter fitting is needed to arrive at a good reproduction of level density information obtained by various methods for a number of nuclei in a wide range of A and E. To that end the modified BSFM is complemented by a constant temperature approximation below the phase transition point. The axial symmetry breaking (5), which is an evidently essential feature, will also be regarded with respect to other observables for heavy nuclei.

HK 68.2 Fr 14:30 S1/01 A03

Study of the Photon Strength Function in Te-128 — •Johann Isaak[1,2], Tobias Beck[3], Vera Derya[4], Udo Gayer[3], Bastian Löher[5], Norbert Pietralla[3], Christopher Romig[3], Deniz Savran[5], Joel Silva[1,2], Makbule Tamkaş[1,6], Werner Tornow[7], Henry R. Weller[7], Andreas Zilges[4], and Markus Zweidinger[3] — [1]EMMI, Darmstadt — [2]FIAS, Frankfurt — [3]IKP, TU Darmstadt — [4]IKP, University of Cologne — [5]GSI, Darmstadt — [6]Graduate School of Natural and Applied Sciences, Yıldız Technical University, Istanbul — [7]TUNL, Duke University, Durham, USA

The Photon Strength Function (PSF) is a crucial input parameter for statistical model calculations such as Hauser-Feshbach calculations to study the nucleosynthesis of the elements in the universe. In practice, it is a challenging task to determine the PSF experimentally. Therefore, photon-scattering experiments were performed at the High Intensity γ-ray Source (HIγS) at Duke University, Durham, USA. Due to the monochromatic photon beam that is provided at HIγS, the excitation energy is well known as well as the ensemble of states that are populated, i.e. mainly J=1 states. The emitted photons from the subsequent deexcitation are measured with the γ-γ coincidence setup γ^3 [1]. With this experimental approach it is possible to determine the PSF for dipole transitions on top of the ground state and the PSF build on low-lying excited states. Recent results on Te-128 are presented and discussed.

[1] B. Löher *et al.*, NIM A 723 (2013) 136.
* Supported by HA216/EMMI and DFG (SFB 634 and ZI 510/7-1).

HK 68.3 Fr 14:45 S1/01 A03

Investigation of the γ-decay behavior of ^{52}Cr with the γ^3 setup at HIγS — •J. Wilhelmy[1], V. Derya[1], P. Erbacher[2], U. Gayer[3], A. Hennig[1], J. Isaak[4], B. Löher[5], N. Pietralla[3], P. Ries[3], C. Romig[3], D. Savran[5], 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]ExtreMe Matter Institute EMMI and Research Division, GSI, Darmstadt — [5]GSI, Darmstadt — [6]Department of Physics, Duke University, USA

The study of the γ-ray strength function (γSF) is important for correct theoretical predictions of nucleosynthesis processes. In the *fp* shell an unexpected low-energy enhancement of the γSF was observed [1]. To study this low-energy enhancement in more detail the γ-decay behavior of the *fp* shell nucleus ^{52}Cr was investigated with the high-efficiency γ^3 setup [2] at the High Intensity γ-ray Source facility at TUNL in Durham, USA, which provides selective excitation in multipolarity (mainly dipole) and energy (quasi mono-energetic). The γ^3 setup consists of an array of HPGe and $LaBr_3$ detectors with high efficiency and enables the measurement of γ-γ coincidences. First experimental results will be presented and discussed in this contribution.

Supported by the BMBF (05P15PKEN9), the Alliance Program of the Helmholtz Association (HA216/EMMI), and the BCGS.

[1] A. C. Larsen *et al.*, Phys. Rev. Lett. **111**, (2013) 242504
[2] B. Löher *et al.*, Nucl. Instr. and Meth. A **723** (2013) 136

HK 68.4 Fr 15:00 S1/01 A03

Statistical decay of dipole-excited states of Zr isotopes* — •Udo Gayer[1], Markus Zweidinger[1], Tobias Beck[1], Nathan Cooper[2], Johann Isaak[3,4], Bastian Löher[5], Laura Mertes[1], Haridas Pai[1], Norbert Pietralla[1], Philipp Ries[1], Christopher Romig[1], Deniz Savran[5], Marcus Scheck[6,7], Werner Tornow[8],

and Volker Werner[1] — [1]IKP, TU Darmstadt — [2]University of Richmond, Richmond, USA — [3]EMMI, GSI, Darmstadt — [4]FIAS, Frankfurt — [5]GSI, Darmstadt — [6]School of Engineering, UWS, Paisley, UK — [7]SUPA, Glasgow, UK — [8]Duke University, Durham, USA

Decay properties of electric dipole excitations below the neutron separation threshold of ^{92,94,96}Zr have been determined in several (γ,γ') and $(\vec{\gamma},\gamma')$ experiments at the Darmstadt High Intensity Photon Setup and the High-Intensity Gamma-Ray Source in Durham, USA. The model of statistical decay is used to guide an interpretation of this low-lying dipole strength which is frequently discussed to arise from the low-energy tail of the giant dipole resonance and potentially an additional resonance structure often referred to as the pygmy dipole resonance. The availability of three complete data sets in the Zr isotopic chain allowed for a precise test of these extrapolations to low energies using different models for the level density and the photon strength function. In the talk, data and calculations will be presented and the suitability of photon scattering data for this kind of analysis will be discussed.

*Supported by the DFG under research grant No. SFB 634

HK 68.5 Fr 15:15 S1/01 A03

Deformation dependence of low-energy M1 strength in Fe isotopes — •Ronald Schwengner[1] and Stefan Frauendorf[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden — [2]University of Notre Dame, Notre Dame, IN 46556, USA

The low-energy enhancement of dipole strength functions observed in various experiments has been described in shell-model calculations as caused by many M1 transitions. The calculations have been done for a few nuclides near shell closures so far [1,2]. We present results of shell-model calculations for a series of Fe isotopes with increasing collectivity. The calculations were performed using the code NuShellX [3] with the ca48mh1 interaction [4]. The change of the M1 strength functions with increasing deformation is discussed.

[1] R. Schwengner, S. Frauendorf and A.C. Larsen, Phys. Rev. Lett. 111, 232504 (2013).
[2] B.A. Brown and A.C. Larsen, Phys. Rev. Lett. 113, 252502 (2014).
[3] B.A. Brown and W.D.M. Rae, Nucl. Data Sheets 120, 115 (2014).
[4] M. Hjorth-Jensen, T.T.S. Kuo and E. Osnes, Phys. Rep. 261, 125 (1995).

HK 68.6 Fr 15:30 S1/01 A03

Laser-nucleus reactions in coherent gamma-ray fields — •Adriana Pálffy and Hans A. Weidenmüller — Max-Planck-Institut für Kernphysik, Heidelberg

The generation of coherent gamma-ray fields envisaged at new laser facilities such as the Extreme Light Infrastructure (ELI) holds promise to open the new field of laser-induced nuclear reactions, so far an unknown territory. The laser-nucleus reaction is expected to depend sensitively on how fast successive photon absorption processes occur compared to the nuclear relaxation rate. Here we investigate theoretically the laser-nucleus interaction both in the quasiadiabatic regime and in the sudden regime. In the quasiadiabatic regime, the nucleus (almost) attains statistical equilibrium between two subsequent photon absorption processes. Consecutive absorption of many MeV-gamma photons then leads to the formation of a compound nucleus with excitation energy several hundred MeV above yrast, i.e., in a so-far totally unexplored parameter regime [1, 2]. In the sudden regime, several or many photons are absorbed before the nucleus has time to relax. In that case, the gamma-ray coherent laser pulse may set several or even all nucleons free. This regime offers the possibility to investigate the transition from a bound system of strongly correlated nucleons to a set of independent particles.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Rev. Lett. 112, 192502 (2014).
[2] A. Pálffy, O. Buss, A. Hoefer and H. A. Weidenmüller, Phys. Rev. C 92, 044619 (2015).

HK 68.7 Fr 15:45 S1/01 A03

Online Strahlmonitor für das ELI-NP Gamma-Beam-System — •Philipp Ries[1], Catalin Matei[2], Matthias Nicolay[1], Norbert Pietralla[1], Calin A. Ur[2] und Volker Werner[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt — [2]Extreme Light Infrastructure - Nuclear Physics, 077125 Magurele, Rumänien

Die Extreme Light Infrastructure ist ein europäisches Gemeinschaftsprojekt zur Forschung an und mit weltweit einzigartigen Lasern. Im Rahmen dieses Projekts wird die Einrichtung Extreme Light Infrastructure - Nuclear Physics (ELI-NP) am Standort Magurele bei Bukarest in Rumänien geschaffen. Unter anderem soll hier durch Compton Rückstreuung von Laserlicht an relativistischen Elektronen ein quasimonochromatischer Gammastrahl von höchster Intensität und bislang unerreichter Energieschärfe für kernphysikalische Experimente zur Verfügung gestellt werden. Um die Qualität des Gammastrahls während der Experimente zu überwachen, wird ein System zur Echtzeit-Strahlanalyse entwickelt, welches in der Lage sein wird, Energie, Intensität, Polarisationsgrad und Position des Strahls durch Compton-Streuung zu prüfen. Der Setup wird zunächst mit Hilfe von GEANT4-Simulationen ausgearbeitet und die einzelnen Elemente in Laborexpertimenten mittels Eichquellen getestet. Diese Tests und die vollständige Konstruktion werden am Institut für Kernphysik der TU Darmstadt stattfinden.

Gefördert durch das BMBF unter 05P15RDEN9

HK 69: Instrumentation XIX

Zeit: Freitag 14:00–16:00 Raum: S1/01 A2

Gruppenbericht HK 69.1 Fr 14:00 S1/01 A2

Development of a high rate TPC - The ALICE TPC upgrade after LS2 — •Markus Ball for the ALICE-Collaboration — Rheinische Friedrich-Wilhelms-Universität Bonn

The ALICE (A Large Ion Collider Experiment at CERN) collaboration plans an upgrade of the detector system during the second long shutdown of the LHC, during which the interaction rate will be increased to 50 kHz for Pb-Pb collisions. This demands operation of the Time Projection Chamber (TPC) in an ungated continuous mode. A conventional gating grid can not be used to prevent ions drifting back into the drift volume. Micro Pattern Gaseous Detectors (MPGD) such as GEMs and Micromegas offer suppression of the ion backflow. To keep distortions due to space-charge at a tolerable level an ion yield of 10 to 20 back drifting ions per incoming electron is required. However, the need for low ion backflow might be in conflict to other key parameters such as the detector performance and stability of the system. Therefore a careful optimisation of all three requirements was needed.

Furthermore the large scale capability of the system has to be guaranteed. Test beams have been carried out to study the large scale performance with an Inner Readout Chamber (IROC) equipped with a multiple GEM system. Also an quadruple GEM Outer Readout Chamber (OROC) was assembled and successfully operated being the largest detector of this type. The upgrade of all readout chambers with a quadruple GEM system has started in 2016. The strategy and the work flow of the TPC upgrade will be presented

HK 69.2 Fr 14:30 S1/01 A2

Space-charge distortion studies in the ALICE TPC — •Ernst Hellbär[1], Jens Wiechula[1], and Marian Ivanov[2] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI - Helmholtzzentrum fur Schwerionenforschung GmbH

The Time Projection Chamber (TPC) is the main particle identification detector of the ALICE experiment at the CERN LHC. For Run 3 starting in 2020, interaction rates of 50 kHz in Pb-Pb require a major upgrade of the TPC readout. The Multiwire Proportional Chambers (MWPCs) will be replaced by stacks of four Gas Electron Multiplier (GEM) foils, introducing an ion backflow of about 1%. In the high-luminosity environment, the back-drifting ions are the dominant source of space-charge, implying significant drift field distortions. In order to study the space-charge effect due to ion backflow, pp collision data was taken during Run 1 with the gating grid of the MWPCs operated in transparent mode. The measured space-charge distortions in the open gating grid data will be presented and compared to expectations for Run 3. The observed distortions in the latest Run 2 data as well as an efficient calibration scheme will be discussed.

Supported by BMBF and the Helmholtz Association.

HK 69.3 Fr 14:45 S1/01 A2

Online Calibration of the ALICE-TPC in LHC-Run 2 — •Alex Chauvin for the ALICE-Collaboration — TUM, Munich, Germany

The Time Projection Chamber (TPC) is the main tracking detector of the ALICE Experiment at the LHC. As the calibration of other detectors in the ALICE central barrel are based on the TPC itself, its calibration and performance are primordial. During the Run I at LHC, a two-step offline calibration was employed, in which first the TPC and then the other detectors were calibrated. However, due to an higher interaction rate and to allow a continuous readout mode during Run III, data will have to be compressed online before storage. This can be done within the High Level Trigger, which also allow to run online calibrations. In this talk, I will present the TPC online calibration procedure during Run II and its improvements for Run III will be presented with a special focus on the dE/dx online calibration in the HLT.

HK 69.4 Fr 15:00 S1/01 A2

Describing charge transfer processes in GEM foils with a model based on electric flux calculations — •Viktor Ratza, Markus Ball, Bernhard Ketzer, and Jonathan Ottnad for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

With the planned upgrade of the ALICE Time Projection Chamber the current readout technology will be replaced by a Gas Electron Multiplier (GEM) - based readout technology in order to allow for a continuous operation at high interaction rates up to 50 kHz. A stack of four GEM stages has been chosen to achieve a suppression of the ion backflow below 1%, while maintaining a good energy resolution and guaranteeing a stable operation of the chamber. As the charge transfer between the GEM stages highly influences the energy resolution and the ion backflow, a detailed understanding of the transfer processes inside the GEM stack is mandatory in order to predict the performance of the detector.

Based on an analytic solution of the Poisson equation for a single GEM, expressions for the transfer efficiencies as a function of the GEM geometry can be deduced from calculations of the corresponding electric fields and electric fluxes. The model as well as the results will be presented and compared to simulations which include charge transfer processes in gases.

Supported by BMBF.

HK 69.5 Fr 15:15 S1/01 A2

A Prototype GEM Detector with 3D-Printing Technology — •Till Mayer, Alexander Austregesilo, Florian Kaspar, and Stephan Paul — Technische Universität München

GEM (Gas Electron Multiplier) detectors are widely used in modern high-energy physics experiments. They provide precise tracking information, have a high-rate capability and a low material budget. However, their production is delicate and time-consuming. Especially the support structures made of fiber-glass frames are expensive and difficult to machine.

The high-end engineering plastic PEEK is extensively used in aerospace, automotive, and chemical process industries. Its low outgassing, electrical insulation and high stiffness make it ideal for the design of GEM detectors. We explored the novel approach to process PEEK with a 3D-printer. A first GEM detector with printed support structures was already built and tested. We will report on the performance of this prototype regarding stability and aging. The next steps towards the realization of a fully 3D-printed GEM detector will also be presented.

Supported by BMBF, MLL and the Cluster of Excellence Exc153 “Origin and Structure of the Universe”

HK 69.6 Fr 15:30 S1/01 A2

Measurement of the spatial and energy-loss resolution with a prototype Straw Tube Tracker (STT) for the $\bar{P}ANDA$ experiment — •Alexandros Apostolou[1,2], Johan Messchendorp[1], James Ritman[2], and Peter Wintz[2] for the PANDA-Collaboration — [1]KVI-CART, University of Groningen — [2]Forschungszentrum Juelich, Juelich

The $\bar{P}ANDA$ experiment is one of the pillars of the future Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany. The $\bar{P}ANDA$ physics program is focused on answering fundamental questions related to Quantum Chromodynamics (QCD), mostly in the non-perturbative energy regime, using antiproton collisions on proton and nuclear targets. The central Straw Tube Tracker (STT) will be the main tracking detector of the $\bar{P}ANDA$ target spectrometer. The STT will reconstruct tracks induced by charged particles (with a spatial resolution of $\simeq$ 150 μm transversal) and measure the corresponding particle momenta and specific energy-losses for particle identification (PID) with an energy resolution better than 10%. The PID information from the STT is especially needed to separate protons, kaons and pions in the momentum region below 1 GeV/c. In this work, the results obtained so far with a prototype STT using the proton beam at COSY in the momentum range from 0.5 to 3.0 GeV/c are summarised and discussed.

HK 69.7 Fr 15:45 S1/01 A2

Cascaded High-Voltage Power Supplies for the ALICE TPC Upgrade with GEMs — •Fabian Liebske for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

For the upgrade of the Time Projection Chamber (TPC) of the ALICE experiment at the CERN LHC it is planned to replace the present MWPC-based readout chambers with detectors that employ stacks of four GEMs. At the same time, new HV power supplies are needed to provide the voltages to the eight GEM electrodes. To this end, a new generation of power supplies is being developed where the voltages are cascaded in such a way, that no over-voltages can occur in case of a GEM discharge. At the IKF in Frankfurt, a test board was developed that simulates the electric network of a 4-GEM system. This board allows to study the characteristics of a cascaded power supply prototype in terms of noise and study its behavior in case of a discharge. In this presentation, results of such tests will be presented.

HK 70: Instrumentation XX

Zeit: Freitag 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 70.1 Fr 14:00 S1/01 A3

The neutron lifetime experiment PENeLOPE — •Wolfgang Schreyer[1], Dominic Gaisbauer[1], Joachim Hartmann[1], Igor Konorov[1], Stephan Paul[1], Rüdiger Picker[2], Dominik Steffen[3], Rainer Stoepler[1], and Christian Tietze[1] — [1]Technische Universität München, Garching, Germany — [2]TRIUMF, Vancouver, Canada — [3]CERN, Geneva, Switzerland

The neutron lifetime $\tau_n = 880.3 \pm 1.1$ 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, especially magnet construction, the ultra-cold neutron polarization system, and the proton detector.

The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft, and the Excellence Cluster "Origin and Structure of the Universe".

HK 70.2 Fr 14:30 S1/01 A3

Low Energy Proton Detector Using APDs for the PENeLOPE Experiment — •Dominic Gaisbauer[1], Joachim Hartmann[1], Igor Konorov[1], Stephan Paul[1], Rüdiger Picker[2], Wolfgang Schreyer[1], Dominik Steffen[3], Rainer Stoepler[1], and Christian Tietze[1] — [1]Technische Universität München, Garching, Germany — [2]TRIUMF, Vancouver, Canada — [3]CERN, Geneva,

Switzerland

PENeLOPE is a neutron lifetime measurement at the Technische Universität München aiming to achieve a precision of 0.1 s. The detector for PENeLOPE consists of about 1250 Avalanche Photodiodes (APDs) with a total active area of 1225 cm^2. The detector and electronics will be operated at a high electrostatic potential of -30 kV, and a magnetic field of 0.6 T. This includes shaper, preamplifier, ADC and FPGA stage. In addition the APDs will be cooled to 77 K. The 1250 APDs are divided into 14 groups of 96 channels, including spares. Each group is processed by one FPGA card which reads out the 12-bit ADCs with 1 MSps. A new firmware was developed for the detector including a self-triggering readout with continuous pedestal calculation and configurable signal detection. The data transmission and configuration is done via the Switched Enabeling Protocol (SEP). It is a time-division multiplexing low layer protocol which provides determined latency for time critical messages, IPBus, and JTAG interfaces. The network has a n:1 topology and thereby reduces the number of optical links.

HK 70.3 Fr 14:45 S1/01 A3

Spatial Resolution of a GEM-TPC Detector* — •Martin Berger — TU München, 85748 Garching, Germany

With the use of GEM foils instead of conventional MWPCs for the electrons amplification in a TPC one can overcome the rate limitations introduced by the gating grid by exploiting the intrinsic ion backflow suppression of the GEM foils. In order to validate the feasibility of such a GEM-TPC, a prototype detector with a drift length of 728 mm and a radius of 308 mm and a total of 10254 electronic channels, was built as an upgrade for the FOPI experiment at GSI (Darmstadt, Germany) to improve the acceptance, PID capabilities and vertex resolution of FOPI. After commissioning, a large statistics of cosmic muon tracks and beam-target reactions have been collected and the obtained tracks in the TPC have been used to improve the tracking algorithms. During the track finding and fitting procedure a clustering algorithm which takes into account the track topology as well as the full 3D spatial information is employed. The clustering algorithm, the cluster error calculation as well as correction algorithms and the tracking resolution will be discussed in this contribution.

*Supported by BMBF, TUM Graduate School and Excellence Cluster "Universe".

HK 70.4 Fr 15:00 S1/01 A3

Charge transfer in Gas Electron Multipliers — •Jonathan Ottnad, Markus Ball, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — HISKP, Bonn University, Nussallee 14-16, D-53115 Bonn

The operation of a Time Projection Chamber at high event rates requires an amplification structure which minimizes the backdrift of ions into the drift volume and at the same time maintains a good energy and spatial resolution. This can be achieved with the implementation of Gas Electron Multipliers (GEM), offering a continuous readout, a stable operation with sufficient charge amplification and an intrinsic suppression of the ions flowing back into the drift volume.

In order to optimize the operation parameters of a GEM based readout, various GEM geometries and different electric field settings inside a multi-GEM stack have been studied experimentally. The transfer efficiencies of electrons and ions have been measured and compared to the results of a microscopic simulation. An effective parametrization of the transfer efficiency is presented. It describes the charge transfer as a function of geometric parameters and the applied electric fields. From this, predictions for the transfer efficiency of electrons and the ion backflow suppression for a given GEM geometry and set of fields become possible.

Supported by SFB/TR16.

HK 70.5 Fr 15:15 S1/01 A3

Investigation of the energy spectra of a hybrid GEM-MicroMegas detector — •Matthias Liebtrau, Viktor Ratza, Markus Ball, and Bernhard Ketzer for the ALICE-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn University

In the context of the upgrade of the LHC during the second long shutdown the interaction rate of the ALICE experiment will be increased up to 50 kHz for Pb-Pb collisions. As a consequence, a continuous operation of the Time Projection Chamber will be required. To handle the expected increase of space charge distortions the currently installed multi wire proportional counter (MWPC) charge amplification system has to be replaced. Micropattern gaseous detectors (MPGDs) offer a way to suppress the backdrift of ions to the drift volume to a tolerable level. At the same time, however, a good energy resolution of the detector has to be maintained. As an alternative to the 4-GEM baseline solution, a hybrid detector consisting of 2 GEMs and a Micromegas stage has been investigated.

Both ion backflow and energy resolution were studied systematically with a small (10×10) cm^2 detector. An ion backflow as low as 0.6% was achieved. A background under the photopeak, if not taken into account in the fit model, was found to systematically bias the energy resolution towards larger values. Methods to suppress the background as well as to fully include it in the fit model were developed. The results show that the hybrid detector fulfills the requirements concerning ion backflow and energy resolution.

HK 70.6 Fr 15:30 S1/01 A3

The CASCADE Project - On the Phase Front of Neutron Detection — •Markus Köhli and Ulrich Schmidt — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Germany

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. We report on the CASCADE Project - a novel detection system, which has been developed for the purposes of neutron spin echo spectroscopy. It features 2D spatially resolved detection of thermal neutrons at high rates. The CASCADE detector 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 deposited in the standard Argon-CO2 counting gas environment. This multi-layer setup increases the detection efficiency of a single entity. For the application in MIEZE spin echo techniques, which use the coherence of a fast oscillating neutron interference pattern as an observable, the signal of the charge traversing the stack is detected to identify the very thin conversion layer of about 1 mum. This allows to precisely determine the time-of-flight. Here we literally sit on the phase front of neutron detection. The RESEDA and MIRA Spectrometers at the FRM II run such new generation systems. This talk will discuss the characteristics of the system, challenges and perspectives, explicitly on the basis of the CASCADE detector at RESEDA.

HK 70.7 Fr 15:45 S1/01 A3

Monte Carlo simulations for the JEDI polarimeter at COSY — •Paul Maanen for the JEDI-Collaboration — III. Physikalisches Institut B, RWTH Aachen

New CP violating sources could manifest as permanent electric dipole moments (EDM). So far, no direct measurement of a charged hadron's EDM has been achieved. The goal of the JEDI (Juelich Electric Dipole moment Investigations) collaboration is to measure the EDM of light nuclei (p,d, ^{3}He). In the current concept the signal is vertical polarisation build-up, measured via counting rate asymmetries scattering on a carbon target. Because the effect is very small, great care has to be taken designing the polarimeter. To study the detector performance the geometry of the candidate detector layout has been implemented in Geant4. This talk gives an overview of the planned detector concept and discusses some results of simulation studies, including comparison of simulation results to experimental data.