Hadronic and Nuclear Physics Division
Fachverband Physik der Hadronen und Kerne (HK)

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Overview of Invited Talks and Sessions

(Lecture rooms: K/HS1, K/HS2, M/HS1, M/HS2, M/HS4, P/H1, P/H2, T/HS1, T/HS2, T/SR14, T/SR19, and T/SR25; Poster: C/Foyer)

Plenary Talks

PV I	Mon	9:35–10:20	PV-Rooms	**Fifty years of revolutions in atomic physics and quantum optics** — •Serge Haroche
PV II	Tue	9:00– 9:45	PV-Rooms	**Exploring the QCD Phase Diagram at the LHC** — •Johanna Stachel
PV III	Tue	9:45–10:30	PV-Rooms	**Precision Electroweak Physics** — •William Marciano
PV IV	Tue	20:00–21:00	Neue Aula	**Klimawandel: Zu spät für 2°C?** — •Thomas Stocker
PV V	Wed	9:00– 9:45	PV-Rooms	**Science at the Timescale of the Electron: The Quantum Nonlinear Optics of High Harmonic Generation** — •Margaret M. Murnane
PV VI	Wed	9:50–10:35	PV-Rooms	**A Bose-Fermi Double Superfluid Mixture** — •Christophe Salomon
PV VII	Wed	20:00–21:00	C/gHS	**Astronomie: Exegese kosmischen Lichts** — •Hans-Walter Rix
PV VIII	Thu	9:00– 9:45	PV-Rooms	**Plutonium in the Environment: Can we Predict its Subsurface Behavior?** — •Annie Kersting
PV IX	Thu	9:45–10:30	PV-Rooms	**Atom Trap, Krypton-81, and Global Groundwater** — •Zheng-Tian Lu
PV X	Thu	20:00–21:00	C/gHS	**Nanoskopie mit fokusiertem Licht** — •Stefan W. Hell
PV XI	Fri	9:00– 9:45	PV-Rooms	**The Oceans in a Warming World: How are the oceans changing and what role do they play in climate change?** — •John Marshall
PV XII	Fri	9:45–10:30	PV-Rooms	**Quantum Measurements** — •Berge Englert

Invited Talks

HK 1.1	Mon	11:30–12:00	T/HS1	**Der Doppeltgammazerfall des $11/2^-$ Isomers in ^{137}Ba** — •Christopher Walz, Tom Aumann, Vladimir Ponomarev, Norbert Pietralla, Ronan Lefol, Heiko Scheit
HK 1.2	Mon	12:00–12:30	T/HS1	**Advances in nuclear matter based on chiral effective field theory*** — •Arianna Carbone
HK 1.3	Mon	12:30–13:00	T/HS1	**Exploring the transverse structure of the nucleon at COMPASS** — •Rainer Joosten
HK 20.1	Tue	11:00–11:40	T/HS1	**Cold nuclear matter effects studied in p-Pb collisions at the LHC** — •Alberica Toia
HK 20.2	Tue	11:40–12:20	T/HS1	**Messungen mit den schwersten Kernen und weitere interessante neue Resultate** — •Kirill Lapidus
HK 20.3	Tue	12:20–13:00	T/HS1	**Pygmy Dipole Resonances - Status and Perspectives** — •Vera Derya
HK 39.1	Wed	11:00–11:40	T/HS1	**Precision Tests of CPT Invariance with Single Trapped Antiprotons** — •Stefan Ulmer
HK 39.2	Wed	11:40–12:20	T/HS1	**Recent results on the proton: Two photon exchange and the radius puzzle** — •Jan Bernauer

HK 39.3	Wed	12:20–13:00	T/HS1	**Precision Experiments with Slowed-down and Thermalized Projectile and Fission Fragments** — •Wolfgang Plass
HK 49.1	Thu	11:00–11:40	T/HS1	**Strong Interactions and the Unitary Limit** — •Hans-Werner Hammer
HK 49.2	Thu	11:40–12:20	T/HS1	**Solare Neutrinospektroskopie in BOREXINO** — •Michael Wurm
HK 49.3	Thu	12:20–13:00	T/HS1	**Precision mass measurements of rare isotopes in nuclear physics** — •Jens Dilling
HK 68.1	Fri	11:00–11:40	T/HS1	**The GBAR antimatter gravity experiment** — •Patrice Perez
HK 68.2	Fri	11:40–12:20	T/HS1	**Jet Physics with ALICE at the LHC** — •Oliver Busch
HK 68.3	Fri	12:20–13:00	T/HS1	**Penning-trap mass spectrometry for neutrino physics** — •Sergey Eliseev, Klaus Blaum, Michael Block, Christine Böhm, Andreas Dörr, Christian Droese, Pavel Filianin, Mikhail Goncharov, Enrique Minaya Ramirez, Dmitriy Nesterenko, Yuri Novikov, Alexander Rischka, Lutz Schweikhard

Invited talks of the joint symposium SYEP

See SYEP for the full program of the symposium.

SYEP 1.1	Mon	11:30–12:00	C/gHS	**Few-body physics with ultracold atoms: What we learned from cesium** — •Rudolf Grimm
SYEP 1.2	Mon	12:00–12:30	C/gHS	**Universality in halo nuclei** — •Daniel Phillips
SYEP 2.1	Mon	14:30–15:00	C/gHS	**Efimov Physics from Quantum Field Theory** — •Eric Braaten
SYEP 2.2	Mon	15:00–15:30	C/gHS	**Efimov physics with multiple spin substates** — •Chris H Greene

Invited talks of the joint symposium SYDM

See SYDM for the full program of the symposium.

SYDM 1.1	Tue	11:00–11:40	C/gHS	**Searching for New Physics Effects in the Muon g -Factor** — •B. Lee Roberts
SYDM 1.2	Tue	11:40–12:20	C/gHS	**Dedicated storage ring EDM methods** — •Yannis Semertzidis
SYDM 2.1	Tue	14:30–15:10	C/gHS	**The experimental search for the neutron electric dipole moment** — •Klaus Kirch
SYDM 2.2	Tue	15:10–15:50	C/gHS	**The muon g-2: where we are, what does it tell us?** — •Friedrich Jegerlehner

Invited talks of the joint symposium SYEM

See SYEM for the full program of the symposium.

SYEM 1.1	Wed	11:00–11:30	C/gHS	**Generation of Structure under Extreme Conditions: Ultracold Atoms meet Heavy-Ion Collissions** — •Jens Braun
SYEM 1.2	Wed	11:30–12:00	C/gHS	**Strongly Interacting Fermi Gases of Atoms and Molecules** — •Martin Zwierlein
SYEM 1.3	Wed	12:00–12:30	C/gHS	**Towards ultracold RbSr ground-state molecules** — •Florian Schreck
SYEM 1.4	Wed	12:30–13:00	C/gHS	**Multiflavor phenomena and synthetic gauge fields in strongly interacting quantum gases** — •Walter Hofstetter

Sessions

HK 1.1–1.3	Mon	11:30–13:00	T/HS1	**Invited Talks 1**
HK 2.1–2.6	Mon	14:30–16:15	M/HS1	**Instrumentation 1**
HK 3.1–3.7	Mon	14:30–16:30	M/HS2	**Instrumentation 2**
HK 4.1–4.8	Mon	14:30–16:30	M/HS4	**Instrumentation 3**
HK 5.1–5.7	Mon	14:30–16:30	T/HS1	**Heavy Ion Collisions and QCD Phases 1**
HK 6.1–6.7	Mon	14:30–16:30	T/HS2	**Structure and Dynamics of Nuclei 1**

HK 7.1–7.7	Mon	14:30–16:30	T/SR14	**Structure and Dynamics of Nuclei 2**
HK 8.1–8.6	Mon	14:30–16:15	T/SR19	**Hadron Structure and Spectroscopy 1**
HK 9.1–9.6	Mon	14:30–16:30	T/SR25	**Hadron Structure and Spectroscopy 2**
HK 10.1–10.6	Mon	17:00–19:00	K/HS1	**Precision Tests of the Standard Model 1**
HK 11.1–11.6	Mon	17:00–18:45	K/HS2	**Nuclear Astrophysics 1**
HK 12.1–12.6	Mon	17:00–18:45	M/HS1	**Instrumentation 4**
HK 13.1–13.7	Mon	17:00–19:00	M/HS2	**Instrumentation 5**
HK 14.1–14.7	Mon	17:00–19:00	M/HS4	**Instrumentation 6**
HK 15.1–15.7	Mon	17:00–19:00	T/HS1	**Heavy Ion Collisions and QCD Phases 2**
HK 16.1–16.8	Mon	17:00–19:00	T/HS2	**Structure and Dynamics of Nuclei 3**
HK 17.1–17.6	Mon	17:00–18:45	T/SR14	**Structure and Dynamics of Nuclei 4**
HK 18.1–18.6	Mon	17:00–18:45	T/SR19	**Hadron Structure and Spectroscopy 3**
HK 19.1–19.6	Mon	17:00–19:00	T/SR25	**Hadron Structure and Spectroscopy 4**
HK 20.1–20.3	Tue	11:00–13:00	T/HS1	**Invited Talks 2**
HK 21.1–21.7	Tue	14:30–16:30	M/HS1	**Instrumentation 7**
HK 22.1–22.8	Tue	14:30–16:30	M/HS2	**Instrumentation 8**
HK 23.1–23.7	Tue	14:30–16:30	M/HS4	**Instrumentation 9**
HK 24.1–24.5	Tue	14:30–16:15	T/HS1	**Heavy Ion Collisions and QCD Phases 3**
HK 25.1–25.6	Tue	14:30–16:15	T/HS2	**Structure and Dynamics of Nuclei 5**
HK 26.1–26.7	Tue	14:30–16:30	T/SR14	**Structure and Dynamics of Nuclei 6**
HK 27.1–27.7	Tue	14:30–16:30	T/SR19	**Hadron Structure and Spectroscopy 5**
HK 28.1–28.7	Tue	14:30–16:30	T/SR25	**Hadron Structure and Spectroscopy 6**
HK 29.1–29.6	Tue	17:00–18:45	K/HS2	**Nuclear Astrophysics 2**
HK 30.1–30.5	Tue	17:00–18:30	M/HS1	**Instrumentation 10**
HK 31.1–31.8	Tue	17:00–19:00	M/HS2	**Instrumentation 11**
HK 32.1–32.8	Tue	17:00–19:00	M/HS4	**Instrumentation 12**
HK 33.1–33.6	Tue	17:00–19:00	P/H2	**Astroparticle Physics 1**
HK 34.1–34.7	Tue	17:00–19:00	T/HS1	**Heavy Ion Collisions and QCD Phases 4**
HK 35.1–35.5	Tue	17:00–18:30	T/SR14	**Structure and Dynamics of Nuclei 7**
HK 36.1–36.6	Tue	17:00–19:00	T/HS2	**Structure and Dynamics of Nuclei 8**
HK 37.1–37.7	Tue	17:00–19:00	T/SR19	**Hadron Structure and Spectroscopy 7**
HK 38.1–38.6	Tue	17:00–19:00	T/SR25	**Hadron Structure and Spectroscopy 8**
HK 39.1–39.3	Wed	11:00–13:00	T/HS1	**Invited Talks 3**
HK 40.1–40.6	Wed	14:30–16:15	T/SR19	**Hadron Structure and Spectroscopy 9**
HK 41.1–41.7	Wed	14:30–16:30	M/HS1	**Instrumentation 13**
HK 42.1–42.8	Wed	14:30–16:30	M/HS2	**Instrumentation 14**
HK 43.1–43.7	Wed	14:30–16:30	M/HS4	**Astroparticle Physics 2**
HK 44.1–44.7	Wed	14:30–16:30	T/HS1	**Heavy Ion Collisions and QCD Phases 5**
HK 45.1–45.6	Wed	14:30–16:30	T/HS2	**Structure and Dynamics of Nuclei 9**
HK 46.1–46.7	Wed	14:30–16:15	T/SR14	**Structure and Dynamics of Nuclei 10**
HK 47.1–47.8	Wed	14:30–16:30	T/SR25	**Hadron Structure and Spectroscopy 10**
HK 48.1–48.68	Wed	17:00–19:00	C/Foyer	**Poster**
HK 49.1–49.3	Thu	11:00–13:00	T/HS1	**Invited Talks 4**
HK 50.1–50.7	Thu	14:30–16:30	M/HS1	**Instrumentation 15**
HK 51.1–51.7	Thu	14:30–16:30	M/HS2	**Instrumentation 16**
HK 52.1–52.6	Thu	14:30–16:15	M/HS4	**Nuclear Astrophysics 3**
HK 53.1–53.7	Thu	14:30–16:30	T/HS1	**Heavy Ion Collisions and QCD Phases 6**
HK 54.1–54.7	Thu	14:30–16:30	T/SR14	**Heavy Ion Collisions and QCD Phases 7**
HK 55.1–55.6	Thu	14:30–16:15	T/SR19	**Structure and Dynamics of Nuclei 11**
HK 56.1–56.7	Thu	14:30–16:30	T/SR25	**Hadron Structure and Spectroscopy 11**
HK 57.1–57.5	Thu	17:00–18:45	K/HS1	**Astroparticle Physics 3**
HK 58.1–58.7	Thu	17:00–18:45	K/HS2	**Nuclear Astrophysics 4**
HK 59.1–59.7	Thu	17:00–19:00	M/HS1	**Instrumentation 17**
HK 60.1–60.5	Thu	17:00–18:45	M/HS2	**Instrumentation 18**
HK 61.1–61.6	Thu	17:00–19:00	M/HS4	**Astroparticle Physics 4**
HK 62.1–62.7	Thu	17:00–19:00	P/H1	**Nuclear Astrophysics 5**
HK 63.1–63.6	Thu	17:00–18:45	P/H2	**Structure and Dynamics of Nuclei 12**
HK 64.1–64.4	Thu	17:00–18:45	T/HS1	**Heavy Ion Collisions and QCD Phases 8**
HK 65.1–65.8	Thu	17:00–19:00	T/SR14	**Heavy Ion Collisions and QCD Phases 9**
HK 66.1–66.7	Thu	17:00–18:45	T/SR19	**Structure and Dynamics of Nuclei 13**
HK 67.1–67.7	Thu	17:00–19:00	T/SR25	**Hadron Structure and Spectroscopy 12**

HK 68.1–68.3	Fri	11:00–13:00	T/HS1	**Invited Talks 5**
HK 69.1–69.7	Fri	14:30–16:30	M/HS1	**Instrumentation 19**
HK 70.1–70.7	Fri	14:30–16:30	M/HS2	**Instrumentation 20**
HK 71.1–71.5	Fri	14:30–16:15	M/HS4	**Astroparticle Physics 5**
HK 72.1–72.7	Fri	14:30–16:30	P/H1	**Precision Tests of the Standard Model 2**
HK 73.1–73.6	Fri	14:30–16:30	T/HS2	**Heavy Ion Collisions and QCD Phases 10**
HK 74.1–74.6	Fri	14:30–16:15	T/SR14	**Heavy Ion Collisions and QCD Phases 11**
HK 75.1–75.7	Fri	14:30–16:30	T/SR25	**Heavy Ion Collisions and QCD Phases 12**

Annual General Meeting of the Hadronic and Nuclear Physics Division

Donnerstag 19:00 K/HS2

HK 1: Invited Talks 1

Time: Monday 11:30–13:00 Location: T/HS1

Invited Talk HK 1.1 Mon 11:30 T/HS1

Der Doppeltgammazerfall des $11/2^-$ Isomers in ^{137}Ba — •Christopher Walz[1], Tom Aumann[1], Vladimir Ponomarev[1], Norbert Pietralla[1], Ronan Lefol[1,2] und Heiko Scheit[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]University of Saskatchewan, Canada

Der Doppeltgammazerfall eines angeregten Zustands ist ein elektromagnetischer Prozess zweiter Ordnung, der erstmals 1931 von M. Goeppert-Mayer diskutiert wurde. In der Kernphysik wurde er bisher nur für Übergänge nachgewiesen, bei denen der gewöhnliche γ-Zerfall verboten ist [1]. Wir berichten nun von einer ersten Messung [2] des Doppeltgammazerfalls des $11/2^-$ Isomers zum $3/2^+$ Grundzustand in ^{137}Ba in Konkurrenz zum erlaubten γ-Übergang von 662 keV. Mit Hilfe von fünf $LaBr_3$ Detektoren wurde das $\Gamma_{\gamma\gamma}/\Gamma_{\gamma}$-Verzweigungsverhältnis unter zwei Winkeln bestimmt. Aus den gemessenen Winkel- und Energieverteilungsfunktionen konnten die dominant beitragenden Multipole bestimmt werden. Ein Vergleich zu Rechnungen im Rahmen des Quasi-Particle Phonon Models wird präsentiert. Die Ergebnisse werden mit einem ähnlichen Experiment, welches am Brookhaven National Laboratory durchgeführt wurde, verglichen [3].

[1] J. Kramp et al., Nucl. Phys. A474 (1987) 412

[2] C. Walz, Dissertation, TU Darmstadt, 2014

[3] D.J. Millener et al., Bull. Am. Phys. Soc. 56(12), DNP.CF.8 (2011)

*Supported by DFG (SFB 634)

Invited Talk HK 1.2 Mon 12:00 T/HS1

Advances in nuclear matter based on chiral effective field theory* — •Arianna Carbone — TU Darmstadt, Darmstadt, Germany

In recent years, great progress has been made in nuclear matter calculations at zero and finite temperature based on chiral two- and three-nucleon interactions. This is critical for understanding matter in neutron stars and for providing a reliable equation of state for core-collapse supernovae and neutron star mergers. In addition, the properties of nuclear matter, such as the symmetry energy, can constrain density functionals and global predictions of nuclei. In this talk, I will discuss recent advances in ab initio calculations using chiral effective field theory interactions, highlighting the role of three-nucleon forces for predicting realistic nuclear matter properties. In addition, I will discuss the theoretical uncertainties, how they can be improved in the future, and show how reliable nuclear theory constrains matter under astrophysical conditions.

*This work was supported by the DFG through Grant SFB 634.

Invited Talk HK 1.3 Mon 12:30 T/HS1

Exploring the transverse structure of the nucleon at COMPASS — •Rainer Joosten — HISKP, Universität Bonn

In recent years, considerable theoretical and experimental progress has been made to study the partonic structure of nucleons beyond the standard collinear approach, accounting for transverse degrees of freedom. In the present theoretical framework, eight transverse momentum dependent parton distribution functions (TMDs) are required at leading twist for each quark flavor. They describe all possible correlations between the transverse momentum and spin of the quarks, and the spin of the nucleon. When integrating over the quark transverse momentum five of these functions vanish, while three of them give the known collinear density, helicity and transversity distribution functions.

Experimentally, Semi-Inclusive Deep Inelastic Scattering (SIDIS) is the main source of information. Requiring the detection of at least one final state hadron in coincidence with the scattered lepton, the chiral-odd transversity distribution as well as a variety of new TMDs could be accessed. In addition, the use of different targets and hadron identification allows for a flavor separation of the involved TMDs.

COMPASS is a fixed target experiment at the CERN SPS taking data since 2002. SIDIS data have been collected using a 160 GeV longitudinally polarized muon beam and longitudinally or transversely polarized proton and deuteron targets.

In this talk, selected results related to the transverse structure of the nucleon will be presented and the prospects of future COMPASS measurements accessing TMDs and GPDs will be assessed.

HK 2: Instrumentation 1

Time: Monday 14:30–16:15 Location: M/HS1

Group Report HK 2.1 Mon 14:30 M/HS1

The Micro Vertex Detector for the $\overline{\text{P}}$ANDA Experiment — •Simone Esch for the PANDA-Collaboration — Forschungszentrum Jülich

The $\overline{\text{P}}$ANDA detector is one of the main experiments at the upcoming Facility for Antiproton and Ion Research (FAIR), which is under construction in Darmstadt, Germany. The fixed-target experiment will explore $\overline{\text{p}}$p annihilations with intense, phase space-cooled beams with momenta between 1.5 and 15 GeV/c. One aim of the detector is to perform high precision measurements of particles like excited charmonium and D mesons.

Essential for background suppression is the tagging of D mesons by measuring their decay point. Therefore, a Micro Vertex Detector (MVD) is planned at $\overline{\text{P}}$ANDA as the innermost tracking detector. The MVD aims to reconstruct vertices with a resolution better than 100 μm to cope with the decay length of the $D^{\pm}$ mesons ($c\tau$=315 μm) produced with a mean $\beta\gamma$=2. The detector consists of silicon pixel and double-sided silicon strip detectors, arranged in four barrel layers and six disk layers.

An overview of the MVD will be given in this talk. Recent developments like laboratory and testbeam results of the current pixel front-end ASIC prototype ToPix 4 will be shown. The concept of the newly developed strip front-end ASIC PASTA will be presented.

This work was supported by BMBF and HIC4FAIR

HK 2.2 Mon 15:00 M/HS1

An improved detector response simulation for the CBM Silicon Tracking System — •Hanna Malygina[1] and Volker Friese[2] for the CBM-Collaboration — [1]Goethe University Frankfurt, Germany — [2]GSI, 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 build from double-sided micro-strip sensors. To achieve realistic simulations 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 new version of the STS digitizer comprises in addition non-uniform energy loss distributions (according to the Urban theory), thermal diffusion and charge redistribution over the read-out channels due to interstrip capacitances.

The improved response simulation was tested with parameters reproducing the anticipated running conditions of the CBM experiment. Two different method for cluster finding were used. The results for hit position residuals, cluster size distribution, as well as for some other parameters of reconstruction quality are presented. The achieved advance is assessed by a comparison with the previous, simpler version of the STS detector response simulation.

Supported by HIC for FAIR and HGS-HIRe.

HK 2.3 Mon 15:15 M/HS1

A custom made wafer probe for strip detector quality assurance of the CBM — •Iaroslav Panasenko for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen — Institute for Nuclear Research, Kiev, Ukraine

The CBM experiment will investigate the properties of nuclear matter at extreme conditions created in ultrarelativistic heavy-ion collisions.

Its key detector — the Silicon Tracking System (STS) — will reconstruct particle tracks with momentum resolution of ∼1% and charged particle multiplicity up to 600 within the detector aperture covering the polar angle between 2.5° and 25°. High track density as well as stringent requirements to the momentum resolution require system with high channel granularity and low meterial budget. The STS will be constructed of about 1300 double-sided silicon microstrip detectors with total area of ∼4 m^2 and have 2.1 million channels. The microstrip sensors with 58 μm pitch and 62×62 mm^2 area will have pad size of 180×60 μm^2.

Due to the large size, the CBM microstrip sensors are not well suited for the characterization at conventional probe stations. Therefore, a custom probe station is beeing developed at Tübingen University. One of the main requirements is a repeatability better than 1 μm to allow an automatic succesive positioning on all 1024 pads of a sensor. The construction of the probestation and first measurements will be presented.

HK 2.4 Mon 15:30 M/HS1

Radiation tolerance of microstrip sensors for the CBM Silicon Tracking System — Minni Singla[1], Pavel Larionov[2], •Ievgeniia Momot[2,3], Tomas Balog[1], Johann Heuser[1], Iurii Sorokin[1,3], and Christian Sturm[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität, Frankfurt — [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 STS will consist of eight planar tracking stations. A response of double-sided silicon micro-strip sensors to the hits by charged particles will be used for the track reconstruction. Radiation load expected in the CBM experiment may significantly influence this response. The development of radiation tolerant prototype STS microstrip sensors irradiated up to 2x10^{14} 1-MeV n_{eq}/cm^2 will be overviewed. Results of charge collection efficiency studies with the latest silicon sensor prototypes with double metallization or external interstrip cables for connecting strips at their edges will be presented.

Supported by HIC for FAIR and HGS-HIRe.

HK 2.5 Mon 15:45 M/HS1

Untersuchung von Silizium-Streifen-Detektoren mit einem automatischen Infrarot-Laser-Teststand* — •Benjamin Wohlfahrt, Kai-Thomas Brinkmann, Martin Kesselkaul, Tommaso Quali und Robert Schnell für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig- Universität Gießen

Am zukünftigen Beschleunigerzentrum FAIR werden Reaktionen von Antiprotonen im HESR-Beschleunigerring mit Protonen eines stationären Targets (Wasserstoff und schwere Kerne) am $\overline{P}$ANDA-Experiment untersucht werden. Der Mikro-Vertex-Detektor wird als Teil des Trackingdetektors hoch auflösendes Tracking und das Erkennen sekundärer Vertizes ermöglichen.
Zur Charakterisierung und Qualitätskontrolle von doppelseitigen Silizium-Streifen-Detektoren für den $\overline{P}$ANDA MVD wurde ein Laserteststand entwickelt. Dieser beinhaltet einen in der xy-Ebene nmverschiebbaren Laserkopf und eine FPGA-gestützte Auslese der APV-ausgelesenen Detektoren. Erste Anwendungsbeispiele dieses Symtems bei der Untersuchung von Streifensensoren werden diskutiert.

* Gefördert durch BMBF und HIC for FAIR.

HK 2.6 Mon 16:00 M/HS1

Development of optical quality assurance procedures for the sensors of Silicon Tracking System (STS) detector of the Compressed Baryonic Matter Experiment (CBM) at FAIR — •Evgeny Lavrik for the CBM-Collaboration — Eberhard-Karls Universität Tübingen, Tübingen, Deutschland

The CBM experiment aims to study the properties of nuclear matter at high net-baryon densities. The 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 3: Instrumentation 2

Time: Monday 14:30–16:30 Location: M/HS2

Group Report HK 3.1 Mon 14:30 M/HS2

The ALICE TPC, a high resolution device for ultra-high particle multiplicities - past, present and future — •Marian Ivanov for the ALICE-Collaboration — Planckstraße 1, 64291 Darmstadt, GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Time Projection Chamber (TPC) of the ALICE apparatus is a large 3-dimensional tracking and particle identification device for ultra-high multiplicity collision events. It has been operated successfully at the Large Hadron Collider (LHC) at CERN, recording data from pp, p-Pb, and Pb-Pb collisions. Presently, LHC is in its first long shutdown (LS1), the next round of data taking will start in summer 2015 at or close to the LHC design energy and luminosity. During the second long shutdown (LS2), LHC will undergo a further increase in the Pb-Pb luminosity together with a major upgrade of ALICE. After the upgrade, the ALICE TPC will operate with Pb-Pb collisions at an interaction rate of 50 kHz. We present the performance in operation, calibration and reconstruction with the ALICE TPC together with ongoing work and plans for the near future and the coming 10 years.

HK 3.2 Mon 15:00 M/HS2

Online Calibration of the ALICE-TPC in LHC-Run 2 — •Ivan Vorobyev for the ALICE-Collaboration — Technische Universität München, Excellence Cluster Universe

The Time Projection Chamber (TPC) is the main tracking detector at the ALICE Experiment at the LHC. Its performance and calibration directly influence the calibration of other detectors in the ALICE central barrel. To address this issue during the first LHC running period, a two-step offline calibration was employed, in which first the TPC and then the other detectors were calibrated. However, such a scheme will not be feasible for the Run 3 period, because the TPC will run in a continuous readout mode, producing a vast amount of data that needs to be significantly compressed on the fly for data storage. This will require the calibration step to run online within the High Level Trigger environment. In this talk, the online calibration concept and the implementation for the ALICE-TPC already in Run 2 will be discussed.

HK 3.3 Mon 15:15 M/HS2

Backtracking algorithm for dilepton reconstruction with HADES — •Patrick Sellheim for the HADES-Collaboration — Goethe-Universität Frankfurt

The High Acceptance Di-Electron Spectrometer (HADES) at the GSI Helmholtzzentrum für Schwerionenforschung investigates dilepton and strangeness production in elementary and heavy-ion collisions. Events recorded in Au+Au collisions at a beam energy of 1.23 GeV/u have the highest multiplicities measured with HADES so far. The track reconstruction and particle identification in the high track density environment are hence very challenging.

In case of dileptons a Ring Imaging Cherenkov detector is essential since it is the most important detector component for single lepton identification. Its main purpose is the separation of electrons and positrons from the large background of charged hadrons produced in heavy-ion collisions. In order to further improve the purity and efficiency of the electron sample, a new backtracking algorithm using information provided by the HADES tracking detectors is applied. This new approach offers gains in efficiency for leptons and especially for detection of partially reconstructed pairs with small opening angle. In this contribution the strategy of the backtracking approach and its performance in Au+Au data will be shown.

This work has been supported by BMBF (05P12RFGHJ), GSI, Helmholtz Alliance EMMI, HIC for FAIR, HGS-HIRe.

HK 3.4 Mon 15:30 M/HS2

Online 4-Dimensional Event Reconstruction in the CBM Experiment — •Valentina Akishina[1,2,3] and Ivan Kisel[1,2,4] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt, Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Joint Institute for Nuclear Research, Dubna, Russia — [4]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

The heavy-ion experiment CBM will focus on the measurement of rare probes at interaction rates up to 10 MHz with data flow of up to 1 TB/s. The free-running data acquisition, delivering a stream of untriggered detector data, requires full event reconstruction and selection to be performed online not only in space, but also in time. The First-Level Event Selection package consists of several modules: track finding, track fitting, short-lived particles finding, event building and event selection.

For track reconstruction the Cellular Automaton (CA) method is used, which allows to reconstruct tracks with high efficiency in a time-slice and perform event building. The time-based CA track finder allows to resolve tracks from a time-slice in event-corresponding groups. The algorithm is intrinsically local and the implementation is both vectorized and parallelized between CPU cores. The CA track finder shows a strong scalability on many-core systems. The speed-up factor of 10.6 on a CPU with 10 hyper-threaded physical cores was achieved.

Supported by FIAS, HICforFAIR and HGS-HIRe for FAIR.

HK 3.5 Mon 15:45 M/HS2

Luminositätsbestimmung mit dem PANDA Luminositätsdetektor — •Stefan Pflüger[1,2], Florian Feldbauer[1,2], Miriam Fritsch[1,2], Prometeusz Jasinski[1,2], Anastasia Karavdina[1], Roman Klasen[1,2], Heinrich Leithoff[1,2], Stephan Maldaner[1,2], Mathias Michel[1,2], Christof Motzko[1,2] und Tobias Weber[1,2] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz Institut Mainz

Das PANDA Experiment, das am neuen Beschleunigerkomplex FAIR in Darmstadt entsteht, ist für Hadronspektroskopie optimiert. Im Vordergrund steht die Suche nach neuen Zuständen und die präzise Vermessung bereits entdeckter Zustände, z.B. des X(3872). Die erforderliche Präzision für diese Messungen kann nur mit Hilfe der Energie-Scan-Methode erreicht werden. Wichtig für die Normierung der Messpunkte untereinander ist die genaue Messung der Luminosität.

Die Luminosität wird bei PANDA mittels elastischer Antiproton-Proton-Streuung, im Winkelbereich von 3-8 mrad gemessen. Der Luminositätsdetektor befindet sich hinter dem PANDA-Spektrometer und besteht aus 4 Ebenen mit Silizium-Pixel-Detektoren (HV-MAPS) die Teilchenspuren registrieren. Im Anschluss an die Spurrekonstruktion der elastisch gestreuten Antiprotonen wird die integrierte Luminosität extrahiert. Systematische Unsicherheiten bei der geometrischen Akzeptanz, Detektorauflösung und Lage und Form des Antiprotonenstrahls sowie des Targetstrahls haben maßgeblichen Einfluss auf die Genauigkeit der Luminositätsmessung und werden in diesem Beitrag vorgestellt.

HK 3.6 Mon 16:00 M/HS2

Survey und Alignment am PANDA-Luminositätsdetektor — •Roman Klasen[1,2], Florian Feldbauer[1,2], Miriam Fritsch[1,2], Prometeusz Jasinski[1,2], Anastasia Karavdina[2], Heinrich Leithoff[1,2], Stephan Maldaner[1,2], Mathias Michel[1,2], Christof Motzko[1,2], Stefan Pflüger[1,2] und Tobias Weber[1,2] für die PANDA-Kollaboration — [1]Helmholtz-Institut Mainz — [2]Johannes-Gutenberg Universität Mainz

Mit dem PANDA-Experiment am Antiproton-Spreicherring HESR an FAIR in Darmstadt sollen Fragen der Hadronenphysik beantwortet werden. Mit der Energy-Scan-Methode werden die Parameter z.B. die Breite oder Linienform bekannter oder bisher unbekannter Resonanzen präzise vermessen. Zur Normierung der einzelnen Messpunkte eines Scans ist die präzise Messung der Luminosität Voraussetzung.

Da die Luminosität anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung bestimmt wird, ist die exakte Kenntnis der Lage der Sensoren des Detektors notwendig. In diesem Vortrag wird ein Überblick über die technischen Herausforderungen bei der Positionsbestimmung der einzelnen Detektorkomponenten gegeben. Außerdem werden die Methoden zur Bestimmung und Korrektur (Alignment) von mechanischen Ungenauigkeiten anhand deren Auswirkung auf die systematische Unsicherheit bei der Bestimmung der Luminosität diskutiert.

HK 3.7 Mon 16:15 M/HS2

Commissioning of the KOALA Experiment by Proton Beam at COSY — •Qiang Hu[1,2], Huagen Xu[2], and James Ritman[2] — [1]Institute of Modern Physics,CAS,Lanzhou,730000,China — [2]Forschungszentrum Juelich,52425 Juelich,Germany

The KOALA Experiment at HESR is dedicated to measure counts of antiproton-proton elastic scattering in a large range of squared 4-momentum transfer, t, from 0.0008 to 0.1 GeV^2. The goal of the KOALA Experiment is to determine the antiproton-proton elastic scattering forward parameters (i.e. σ_{tot}, ρ and b) to save as a calibration for the $\overline{\text{P}}$ANDA luminosity detector. The scattered antiprotons will be measured by tracking detectors in the forward angle region and the recoil protons will be detected with energy detectors near polar angles of 90°. One recoil arm has been built and commissioned at COSY by measuring proton-proton elastic scattering in the beam momentum region from 1.7 to 3.2 GeV/c. The data at beam momentum of 2.8 GeV/c and 3.2 GeV/c have been analyzed. Preliminary results of the analysis will be presented.

HK 4: Instrumentation 3

Time: Monday 14:30–16:30 Location: M/HS4

HK 4.1 Mon 14:30 M/HS4

Characterisation of a Prototype for the Backward End-Cap of the PANDA EMC. — Heybat Ahmadi[1,2], Samer Ahmed[1], Luigi Capozza[1,3], Alaa Dbeyssi[1,3], •Malte Deiseroth[1,2], Bertold Fröhlich[1,3], Dmitry Khaneft[1,2], Dexu Lin[1,3], Frank Maas[1,3], María Carmen Mora Espí[1,3], Cristina Morales Morales[1,3], Oliver Noll[1,2], David Rodríguez Piñeiro[1,3], Roserio Valente[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[1,3] for the PANDA-Collaboration — [1]HIM — [2]UNI-MAINZ — [3]GSI

The PANDA detector at FAIR will be used to study interactions of antiprotons in a fixed target experiment. The electromagnetic calorimeter (EMC) of the target spectrometer, consisting of > 15,000 PWO crystals, with its expected excellent performance and efficiency, will be one of the central components to achieve the physical goals. A first prototype for the Backward End-Capt (BWC) containing 16 crystals has been build and tested during 3 days of beamtime. The test was done with tagged photons in an energy range from about 50 MeV to 700 MeV at the Mainzer Microtron (MAMI). The prototype was desinged to be as close as possible to the final desing of the BWC. This talk will give a short introduction in the design of the prototype and the latest updates, followed by a presentation of the results from the beam time. It will describe the data analysis and the extraction of the energy resolution.

HK 4.2 Mon 14:45 M/HS4

Digitale Echtzeit-Pulsformanalyse für CALIFA — Michael Bendel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, Patrick Remmels und •Max Winkel für die R3B-Kollaboration — Physik Department E12, Technische Universität München

Das elektromagnetische 4π-Kalorimenter CALIFA des R^{3}B-Experiments an FAIR ist strukturell in drei Polarwinkelbereiche mit unterschiedlichen Anforderungen unterteilt. Während in Vorwärtsrichtung schnelle Phoswich-Detektoren verwendet werden um die Gesamtenergie von nicht gestoppten Teilchen zu rekonstruieren, kommen im Bereich größerer Polarwinkel CsI(Tl)-Szintillatoren zum Einsatz.

Um trotzdem ein homogenes System nutzen zu können, wird das von der GSI entwickelte *FEBEX* System als gemeinsame Hardware-Platform genutzt. Durch die Verwendung der neu entwickelten *QPID*, einem universellen Algorithmus zur Pulsformanlyse, können in jedem Bereich identische Hardware- und Firmware-Module verwendet werden.

Gefördert durch BMBF (05P12WOFNF, 05P12WONUE) und GSI

HK 4.3 Mon 15:00 M/HS4

Energiekalibration und Bestimmung der Energieauflösung eines Kalorimeter Prototypen anhand der Analyse einer Teststrahlzeit — •Markus Kuhlmann für die PANDA-Kollaboration — Institut für Experimentalphysik 1 — Ruhr-Universität Bochum

Mit dem PANDA Experiment, das an der im Bau befindlichen Beschleunigeranlage FAIR an der GSI in Darmstadt aufgebaut werden soll, wird die Erforschung einiger Aspekte der starken und schwachen Wechselwirkung, exotischer Materiezustände, sowie der Struktur der Hadronen beabsichtigt. Der PANDA Detektor wird über ein homogenes elektromagnetisches Kalorimeter im Target-Spektrometer verfügen, dessen Bleiwolframat-Szintillatoren (PWO) mit Hilfe von Avalanche-Photo-Dioden (APD) und Vakuum-Photo-Tetroden (VPTT) ausgelesen werden sollen. Dabei sollen Energien von 10 MeV bis etwa 15 GeV messbar sein. Während der Entwicklungsphase der Vorwärts-Endkappe des Kalorimeters, wurden mehrere Teststrahlzeiten mit dem Prototypen durchgeführt. Im August 2014 wurde der Prototyp am ELSA-Beschleuniger (Elektronen-Stretcher-Anlage) der Universität Bonn mit Elektronenstrahlen bei 1,25 GeV, 2,4 GeV und 3,2 GeV getestet. Anhand der aufgezeichneten Daten und mithilfe einer Simulation des gesamten Aufbaus stellt dieser Beitrag vorläufige Ergebnisse der Energiekalibration und Energieauflösung vor.

Gefördert durch das BMBF mit Förderkennzeichen 05P12PCFP5 und das Forschungszentrum Jülich.

HK 4.4 Mon 15:15 M/HS4

Performance of a Prototype for Stimulated Recovery of Radiation Damage for the PANDA EMC Forward Endcap and Barrel — •Till Kuske, Valera Dormenev, Rainer Novotny, and Hans-Georg Zaunick — II. Physikalisches Institut Justus-Liebig Universität

The future Electromagnetic Calorimeter (EMC) of the PANDA detector at FAIR will be based on a new generation of lead tungstate crystals (PWO-II). It is optimized to measure particle energies from 10 GeV down to 10-20 MeV. The operating temperature of the EMC will be -25*C. Due to the operation in a strong radiation environment one of the most critical parameter of PWO-II is radiation hardness. The radiation damage of PWO-II can be compensated by spontaneous relaxation of the color centers via thermo-activation. The process is strongly suppressed at -25°C, which is limiting the energy resolution of the EMC. The recovery process can be accelerated by illumination of the crystal with light even in the infrared region. A prototype implementation of the stimulated recovery for the PANDA EMC forward endcap is shown. Detailed studies concerning flux and intensity for different recovery modes at -25°C are presented. Additionally a concept for the recovery of radiation damage in the barrel part of the EMC will be discussed.

This work has been supported by BMBF and HIC-for-FAIR.

HK 4.5 Mon 15:30 M/HS4

Optimization of the nonuniformity in light collection of tapered $PbWO_4$ crystals and its influence on the energy resolution of the PANDA barrel EMC* — •Stefan Diehl[1], Peter Drexler[1], Valery Dormenev[1], Myroslav Kavatsyuk[5], Svetlana Nazarenko[1], Till Kuske[1], Rainer W. Novotny[1], Christoph Rosenbaum[1], Philippe Rosier[2], Andrej Ryantsev[3], Peter Wieczorek[4], Andrea Wilms[4], and Hans-Georg Zaunick[1] — [1]II. Physics Institute, University Giessen — [2]IPN Orsay, France — [3]IHEP Protvino, Russia — [4]GSI Helmholtzzentr. für Schwerionenforsch., Darmstadt — [5]KVI-CART Groningen, The Netherlands

The barrel part of the electromagnetic (EM) calorimeter of the PANDA detector at the future FAIR facility will consist of 11 crystal geometries with a different degree of tapering. Due to tapering the crystals show a nonuniformity (NUF) in light collection. For the most tapered crystals the light detected by the photosensor is enhanced by a factor 1.4, if the scintillation light is created in the front part of the crystal. Due to the spread and the fluctuations of the EM shower within the crystal, this effect causes a smearing of the response, resulting in a reduced energy resolution. Therefore one lateral side has been depolished for 9 crystals, decreasing the NUF down to $< 5\%$, with only a slighty reduced light yield. The contribution will compare the response of a 3x3 matrix of crystals with one depolished side, with an identical matrix of polished crystals using a tagged photon beam with energies < 1 GeV and the results from GEANT4 simulations, which indicate a significant improvement of the energy resolution. *Supp. by BMBF, GSI, FAIR

HK 4.6 Mon 15:45 M/HS4

Radiation damage and recovery of medium heavy and light inorganic crystalline, glass and glass ceramics materials after irradiation with 150 MeV protons and 1.2 MeV gamma-rays — K.T. Brinkman[1], A. Borisevich[2], •V. Dormenev[1], V. Kalinov[3], M. Korjik[2], D. Kozlov[2], M. Kavatsyuk[4], R.W. Novotny[1], A. Voitovich[3], and H.-G. Zaunick[1] — [1]II. Physikalisches Institut JLU Giessen, Germany — [2]INP BSU, Minsk, Belarus — [3]Institute of Physics of National Academy of Science, Minsk, Belarus — [4]KVI-CART, University Groningen, Netherlands

Further concepts of the detectors at HEP experiments will require using cheap, capable for a mass production and radiation hard materials, especially for application at collider experiments. A set of samples with volume 1-2 cm3 of the middle light and light materials: crystalline BaF2, Y3Al5O12: Ce, Y3Al5O12: Pr, Lu3Al5O12: Ce, LiF and newly developed glass and glass ceramics DSB: Ce and DSL: Ce were irradiated with gamma-quanta with absorbed dose 100 Gy and 150 MeV protons up to fluence 5x10^13 p/cm2. Here we report results of the comparison of the optical transmission damage and recovery after different types of irradiation. A significant acceleration of the induced absorption recovery is observed at the DSB: Ce samples illuminated with visible and IR light. This effect is similar to one observed by us in PWO. It indicates that radiation induced absorption in DSB: Ce scintillation material can be retained at the acceptable level by stimulation with light at the conditions of a strong irradiation environment of the collider experiments.

HK 4.7 Mon 16:00 M/HS4

Digital signal processing applied to fast scintillators response — •Guillermo Fernández Martínez, Anna-Lena Hartig, Ilja Homm, Alexander Ignatov, Thorsten Kröll, and Han-Bum Rhee for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

The future Facility for Antiproton and Ion Research (FAIR) will house the calorimeter and spectrometer CALIFA, whose design, construction and testing are currently being carried out by the R3B collaboration. CALIFA is an array of scintillation crystals arranged in a barrel configuration, which covers a large solid angle. Some of the scintillation materials under consideration ($LaBr_3$(Ce), $LaCl_3$(Ce) and $CeBr_3$) have been developed in the last few years. Their main characteristic is a combination of good energy and time resolution with high efficiency. On the other hand, fast digitisers allow the collection of data at increasingly higher sampling frequencies. They are also much more reliable and easily scalable for large arrays than traditional analog electronics. Our research takes advantage of these features and is therefore focused on the analysis of digitised pulses, which, in addition to energy and time determination, enables particle identification. In this contribution we present results obtained in different campaigns.
This work is supported by BMBF(06DA9040I, 05P12RDFN8), HIC for FAIR and GSI-TU Darmstadt cooperation contract.

HK 4.8 Mon 16:15 M/HS4

Simulations and Measurements of Response of $LaBr_3$(Ce) and $CeBr_3$ — •Han-Bum Rhee, Guillermo Fernández Martínez, Anna-Lena Hartig, Ilja Homm, 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 the future FAIR facility. CALIFA consists of the Barrel covering central angles and the EndCap covering forward angles. We investigated novel scintillation materials ($LaBr_3$(Ce) and $CeBr_3$) as an alternative solution for the EndCap. Scintillators were tested with proton-beam and gamma-rays at different energy ranges. In addition, we have simulated the response of the scintillation detector using the GEANT4 toolkit to understand the measured signals. In this presentation, we show the experimental data and compare them with the simulation results.
This work is supported by BMBF(06DA9040I, 05P12RDFN8) and GSI-TU Darmstadt cooperation contract.

HK 5: Heavy Ion Collisions and QCD Phases 1

Time: Monday 14:30–16:30 Location: T/HS1

Group Report HK 5.1 Mon 14:30 T/HS1

Measurement of the J/ψ production in pp, p–Pb and Pb–Pb collisions with ALICE at LHC — •Julian Book for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

The investigation of the properties of strongly interacting matter under extreme conditions is the aim of the ALICE experiment. Quarkonia, i.e. bound states of heavy (charm or bottom) quarks such as the J/ψ, are expected to be produced in initial hard scattering processes in hadronic collisions. Thus they will provide insights into the earliest and hottest stages of nucleus-nucleus collisions where the formation of a Quark-Gluon Plasma is expected.
We present final results of J/ψ production in pp, p–Pb and Pb–Pb collisions performed by ALICE at the LHC in the first 4 years of data taking. Measurements in p–Pb and pp collisions help to decouple cold nuclear matter effects from hot nuclear effects in Pb-Pb collisions and serve as reference for the interpretation and evaluation of medium induced effects, such as color screening and recombination. Measurements differential in p_{T} and centrality of J/ψ decaying into e^+e^- obtained at mid-rapidity ($|y| < 0.9$) for the different collisions systems will be shown. Clearly less suppression with respect to SPS and RHIC results can be seen in Pb–Pb collisons at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. Results for J/ψ decaying into $\mu^+\mu^-$ measured at forward rapidities ($2.5 < y < 4.0$) will be presented. Furthermore, comparisons to theoretical calculations will be shown and their impact will be discussed.

HK 5.2 Mon 15:00 T/HS1

Status and perspectives of J/ψ analysis in proton-proton collisions with ALICE at the LHC — •Steffen Weber for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

ALICE is an experiment at the Large Hadron Collider especially designed to study the hot and dense matter created in heavy ion collisions. Charmonium mesons, bound states of charm-anticharm quarks, are prominent probes of the hot deconfined created matter.

Measurements in proton-proton collisions provide a necessary baseline for the interpretation of the data in lead-lead and in proton-lead collisions and are as well an important testing ground for perturbative and non-perturbative QCD theory.

The current status of J/ψ analysis in the dielectron decay channel in proton-proton collisions in ALICE will be presented and future opportunities for measurements in the Run2 of LHC data taking will be discussed.

HK 5.3 Mon 15:15 T/HS1

J/ψ Production in Proton-Lead Collisions with the Central Barrel of ALICE at the LHC — •Michael Winn for the ALICE-Collaboration — Physikalisches Institut, Universitaet Heidelberg

The investigation of J/ψ in p-A collisions represents an important reference for heavy-ion collisions, where charmonium production is seen as a key observable for deconfinement. Furthermore, the description of J/ψ production in proton-proton and its nuclear modification in proton-nucleus collisions remains challenging for theory based on perturbative QCD and factorization. The central-barrel detectors of ALICE ($|\eta| < 0.9$) are well suited to detect J/ψ in its dielectron decay channel and the associated charged tracks in the same event with full azimuthal coverage.

Final results of the nuclear modification factor of inclusive J/ψ in proton-lead collisions with the central barrel of ALICE, both integral as well as differential in transverse momentum, will be presented. Model comparisons will be discussed. First results on the multiplicity dependence will be also shown.

HK 5.4 Mon 15:30 T/HS1

D-meson production at ultra-low transverse momentum in pp collisions with ALICE at the LHC — •Christian Möhler for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

The measurement of charm production provides valuable insights into the properties of the Quark-Gluon Plasma, which is expected to be formed in ultra-relativistic heavy-ion collisions at the LHC at CERN. Current ALICE results of D-meson production using an analysis strategy based on the reconstruction of secondary decay vertices are limited to $p_{\mathrm{T}} > 1$ GeV/c, due to the small Lorentz boost at low momentum of the D meson.
We present a new measurement of the p_{T}-differential cross section of prompt D^0 production at mid-rapidity in pp collisions at $\sqrt{s} = 7$ TeV. By giving up the topological selection, the presented analysis extends the measurable p_{T}-range down to zero. The p_{T}-integrated charm production cross section at mid-rapidity in pp collisions, which serves as an essential baseline for Pb–Pb collisions, can thus be given without extrapolation for the first time at the LHC, resulting in a significantly increased precision.

HK 5.5 Mon 15:45 T/HS1

Event-by-event extraction of kinetic and chemical freeze-out properties in the CBM experiment — •Volodymyr Vovchenko[1,2,3,4], Ivan Kisel[1,2,3], and Dmitry Anchishkin[4,5] 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, Darmstadt, Germany — [4]Taras Shevchenko University, Kyiv, Ukraine — [5]Bogolyubov Institute for Theoretical Physics, Kyiv, Ukraine

The future CBM experiment at FAIR is designed to study properties of strongly interacting matter produced in heavy-ion collisions at high baryon densities. It will employ high intensity beams and large acceptance detectors. One important task is to extract the thermal parameters of matter at stages of kinetic and chemical freeze-out from the observed data.

The extraction of thermal parameters is implemented as a package within the CBMROOT framework. The kinetic freeze-out temperature and the inverse slope of charged pions are extracted from their measured momentum spectra with appropriate correction on acceptance and reconstruction efficiency. The parameters of the chemical freeze-out are extracted by fitting the measured particle ratios in the framework of Hadron Resonance Gas model. The procedures can be used to perform analysis on event-by-event as well as on the inclusive spectra level.

Supported by FIAS, HICforFAIR and HGS-HIRe for FAIR.

HK 5.6 Mon 16:00 T/HS1

Transport Coefficients in Yang–Mills Theory and QCD — •Nils Strodthoff[1], Nicolai Christiansen[1], Michael Haas[1], and Jan M. Pawlowski[1,2] — [1]Institut fuer Theoretische Physik, Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, Darmstadt, Germany

We calculate the shear viscosity over entropy density ratio η/s in Yang–Mills theory from the Kubo formula using an exact diagrammatic representation in terms of full propagators and vertices using gluon spectral functions as external input. We provide an analytic fit formula for the temperature dependence of η/s over the whole temperature range from a glueball resonance gas at low temperatures, to a high-temperature regime consistent with perturbative results. Subsequently we provide a first estimate for η/s in QCD.

HK 5.7 Mon 16:15 T/HS1

Shear viscosity from a large-Nc NJL model — •Robert Lang[1], Norbert Kaiser[1], and Wolfram Weise[2,1] — [1]TUM Physik Department, Garching, Germany — [2]ECT* Villa Tambosi, Villazzano (TN), Italy

We calculate the ratio of shear viscosity to entropy density within a large-Nc Nambu–Jona-Lasinio model. A consistent treatment of the Kubo formalism incorporating the full Dirac structure of the quark self-energy from mesonic fluctuations is presented. We compare our results to common approximation schemes applied to the Kubo formalism and to the quark self-energy. This work has been supported by BMBF.

HK 6: Structure and Dynamics of Nuclei 1

Time: Monday 14:30–16:30 Location: T/HS2

Group Report HK 6.1 Mon 14:30 T/HS2

Investigation of mass-dependent prompt fission γ-ray emission — •Stephan Oberstedt[1], Angelique Gatera[1], Matthieu Lebois[2], Andreas Oberstedt[3], and Jonathan Wilson[2] — [1]European Commission, DG Joint Research Centre IRMM — [2]Institut de Physique Nucléaire Orsay, F-91406 Orsay — [3]Fundamental Fysik, Chalmers Tekniska Högskola, S-41296 Göteborg

In recent years we conducted a systematic investigation of fission-fragment de-excitation through prompt neutron and γ-ray emission. For the latter we were able to obtain spectral data for thermal-neutron induced fission on ^{235}U [1] and ^{241}Pu [2] with unprecedented accuracy. The recently installed neutron source LICORNE [3], where neutrons are produced in inverse kinematics, enables us to explore prompt de-excitation also for fast-neutron induced fission and on non-fissile targets. In a next step we started studying the spectral changes as a function of mass and total kinetic energy using the spontaneous fission of ^{252}Cf. By tagging on isomeric γ-decay we are exploring the possibility to identify very neutron-rich isotopes. First results and the new hybrid array, GLANDIS, consisting of $CeBr_3$ and HPGe detectors, is being presented.

[1] A. Oberstedt et al., Phys. Rev. C87, 051602(R), 2013 [2] S. Oberstedt et al., Phys. Rev. C90, 024618, 2014 [3] M. Lebois et al., Nucl. Instr. Meth. A735 (2014) 145-151

HK 6.2 Mon 15:00 T/HS2

A VUV detection system for the direct identification of the fluorescence radiation of ^{229m}Th * — •Benedict Seiferle, Lars v.d. Wense, and Peter G. Thirolf — LMU Munich

In the whole landscape of atomic nuclei, ^{229}Th has the lowest transition energy to its first excited state. The transition energy was indirectly measured to be 7.8(5) eV, which corresponds to ≈160 nm and conceptionally allows to get optical access to the transition. This talk will report on a VUV detection system that aims on the direct detection of the fluorescence radiation of ^{229m}Th. The setup consists of two annular parabolic mirrors (made of MgF_2-coated aluminum) and a phosphorous screen behind a CsI-coated MCP, monitored by a CCD camera. $^{229(m)}$Th will be populated via the α decay of ^{233}U. Therefore a ^{233}U α-recoil source is placed in a buffer-gas stopping cell, where a continuous ion beam is produced by a subsequent RFQ. By using a quadrupole mass separator, $^{229(m)}$Th ions are then separated from other short lived daughter nuclei. The $^{229(m)}$Th ions are collected on a point-like micro electrode (50 μm in diameter) that is placed in the focal spot of the annular parabolic mirror (f=10 mm) which collimates the fluorescence radiation. The parallelized light is then focused by a second annular parabolic mirror (f=2 mm) onto the MCP. To get a high signal to noise ratio, it is important to achieve a small focal spot size on the MCP. Since the optical axis is blocked by the collection electrode, also the alignment of the optics poses a special challenge. The alignment method as well as results from first test measurements will be presented. *Supported by the DFG Grant TH956/3-1

HK 6.3 Mon 15:15 T/HS2

The nuclear isomer transition in Thorium-229: Search for the VUV photon — •Simon Stellmer[1], Matthias Schreitl[1], Koji Yoshimura[2], and Thorsten Schumm[1] — [1]Atominstitut /TU Wien and VCQ, Vienna, Austria — [2]Okayama University, Japan

The isotope ^{229}Th is believed to possess a low-lying nuclear excitation, at an energy of about 7.8(5) eV [1], corresponding to a wavelength of 160(10) nm. Convincing direct evidence of the existence of this state, for instance by observation of its excitation or decay, is still pending.

Optical excitation of the isomer state is an exceptional challenge, as the required wavelength is not known, the transition is believed to be extremely narrow, and the choice of suitable lasers is limited. Instead, we use synchrotron radiation at 29 keV to populate the second excited state, which then decays into the desired isomer state. This state proceeds further into the ground state under emission of the much sought-after VUV photon. This photon is detected in a spectrometer.

The measurements are performed at the SPring-8 facility in Japan; we will report on the latest status of the experiment.

[1] Beck *et al.*, Phys. Rev. Lett. **98**, 142501 (2007).

HK 6.4 Mon 15:30 T/HS2

The new Bucharest multi-detector setup for γ-ray spectroscopy studies — •Sorin Pascu — National Institute for Physics and Nuclear Engineering, Bucharest, Romania

The ROmanian array for SPectroscopy in HEavy ion REactions (ROSPHERE) is a new 4π high-resolution γ-ray detector array which was installed at the Bucharest 9 MV tandem accelerator. The setup consists of up to 25 detectors and it is typically used in a mixed combination of high-purity Ge detectors and fast $LaBr_3$:Ce scintillation detectors. The total efficiency of the array is close to 3%, balanced between the two type of detectors when used in the usual configuration with 14 HPGe ($\epsilon \simeq 1.1\%$) and 11 $LaBr_3$:Ce detectors ($\epsilon \simeq 1.8\%$). The multi-detector setup can be coupled with a state of the art plunger device allowing for lifetime measurements by employing the Recoil Distance Doppler Shift (RDDS) or in-beam Fast Electronic Scintillation Timing (FEST) technique. Two recent experiments illustrating the methods are presented.

HK 6.5 Mon 15:45 T/HS2

Time-dependent nuclear excitation dynamics in coherent gamma-ray fields — •Adriana Pálffy and Hans A. Weidenmüller — Max-Planck-Institut für Kernphysik, Heidelberg

Recent experimental developments in laser physics hold promise to advance the new field of laser-induced nuclear reactions beyond known territory. At the Extreme Light Infrastructure (ELI), efforts are under way to generate multi-MeV zeptosecond coherent laser pulses. Consecutive absorption of many MeV-gamma rays would lead to the formation of a compound nucleus with excitation energy several hundreds MeV above yrast in a so-far totally unexplored parameter regime [1].

We have considered the laser-nucleus interaction in the quasiadiabatic regime, in which the nucleus (almost) attains statistical equilibrium between two subsequent photon absorption processes. The dynamics is described by means of a system of time-dependent master equations that account for the excitation and neutron decay of a chain of nuclei, with the rates involved depending on the total and partial nuclear level densities [2]. Our quantitative estimates predict the excitation path and range of nuclei reached by neutron decay and provide relevant information for the layout of future experiments.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Rev. Lett. 112, 192502 (2014).
[2] A. Pálffy and H. A. Weidenmüller, Nucl. Phys. A 917, 15 (2013).

HK 6.6 Mon 16:00 T/HS2

New excited states in *sd*-shell nucleus ^{33}P — •B. Fu, P. Reiter, K. Arnswald, H. Hess, R. Hirsch, L. Lewandowski, D. Schneiders, M. Seidlitz, B. Siebeck, T. Steinbach, A. Vogt, A. Wendt, and K. Wolf — Institut für Kernphysik, Universität zu Köln

Isospin-symmetry breaking in nuclear physics is mainly described by Mirror-Energy Differences (MED) for mirror nuclei or Triplet-Energy Differences (TED) for isobaric triplets. Modified USD-calculations [1] successfully reproduce MED for $T = 1, 3/2, 2$ *sd*-shell nuclei. Refined tests of theory are given by lifetime measurements in order to deduce transition-strength values. In order to study the mirror pair ^{33}Ar and ^{33}P, the fusion-evaporation reaction ^{13}C + ^{26}Mg at 46 MeV was measured at the Cologne tandem accelerator and the HORUS spectrometer employing the Doppler-Shift-Attenuation-Method (DSAM). First results yielded new γ-ray transitions in ^{33}P and ^{33}S. The level scheme of ^{33}P was extended up to excitation energies of 10 MeV. Spins and parities of the new levels were determined exploiting $\gamma\gamma$-angular correlations. Together with values from the proton-rich $T_z = -3/2$ partner, the levels are compared to shell model calculations, describing excitation energies of *sd* -shell mirror pairs.

[1] A. Wendt et al.; Phys. Rev. C 90 (2014) 054301

HK 6.7 Mon 16:15 T/HS2

Study of the background observed with PreSPEC — •Giulia Guastalla[1], Magdalena Górska[1], Jürgen Gerl[1], Ivan Kojuharov[1], Norbert Pietralla[2], Stephane Pietri[1], Damian Ralet[1], and Hans Jürgen Wollersheim[1] — [1]GSI, Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany — [2]Technische Universität Darmstadt, D-64289 Darmstadt, Germany

Relativistic rare isotope beams allow investigation of unexplored re-

gions of exotic nuclei, however the large amount of background radiation present in such measurements is a great challenge for the analysis process. Even after a detailed analysis and the application of strict conditions, a large component of the background can remain in the γ-ray energy spectra and often hamper the observation of the γ-transition under study. Hence, a dedicated and detailed analysis has been performed in order to better disentangle several components of the background that affects γ-ray energy spectra, and understand their nature and origin. Analyzing the correlations between more than 20 observables provided the by PreSPEC setup, different classes of background events were identified and characterized. This information will help to reduce the presence of background events and, therefore, facilitate and improve the study of new phenomena in fast-beam experiments on exotic nuclei at FAIR.

HK 7: Structure and Dynamics of Nuclei 2

Time: Monday 14:30–16:30 Location: T/SR14

Group Report HK 7.1 Mon 14:30 T/SR14

Three-nucleon forces: From oxygen to calcium* — •Johannes Simonis[1,2], Kai Hebeler[1,2], Jason D. Holt[3], Javier Menéndez[1,2,4], 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, by the DFG through Grant SFB 634, by the BMBF under Contract No. 06DA70471, and by the Helmholtz Alliance HA216/EMMI.

HK 7.2 Mon 15:00 T/SR14

Renormalization Group Approach to Density Functional Theory* — •Sandra Kemler and Jens Braun — Institut für Kernphysik, TU Darmstadt

We study a two-point particle irreducible (2PPI) approach to many-body physics which relies on a renormalization group (RG) flow equation for the associated effective action. This approach relates to Density Functional Theory and can in principle be used to study ground-state properties of non-relativistic many-body systems from microscopic interactions, such as (heavy) nuclei. We apply our formalism to a 0+1-dimensional model, namely the quantum anharmonic oscillator and use the well-known exact solution to benchmark our approximations of the full RG flow. Moreover, we present flow equations for specific types of 1+1-dimensional field theories which allow us study the ground-state properties of self-bound systems of spinless fermions which can also be viewed as toy models of nuclei.

* Supported by the Deutsche Forschungsgemeinschaft (DFG) through contract SFB 634.

HK 7.3 Mon 15:15 T/SR14

From nuclear matter to finite nuclei* — •Thomas Krüger[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

Infinite neutron matter is a unique benchmark system for testing chiral effective field theory iteractions since all many-body forces are predicted to N^{3}LO. However, in finite nuclei shell and surface effects play an important role. These cannot be studied in infinite matter. Combining infinite neutron matter and neutron drops therefore provides important constraints for energy density functionals. For that we use the optimized effective potential method 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, the ERC Grant No. 307986 STRONGINT, and by the Helmholtz Alliance HA216/EMMI.

HK 7.4 Mon 15:30 T/SR14

In-Medium Similarity Renormalization Group for Nuclei — •Klaus Vobig, Sven Binder, 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 through an efficient SRG flow-equation approach.

Based on nucleon-nucleon and three-nucleon interactions derived from chiral effective field theory that are transformed through the free-space SRG for improving the convergence behavior, we use the IM-SRG for systematic studies of closed-shell nuclei up to ^{132}Sn. Comparisons with the most advanced Coupled Cluster and No-Core Shell Model calculations are used to validate this new many-body approach. We explore extensions of the IM-SRG framework to other observables and excited states.

Supported by DFG (SFB634), HIC for FAIR and BMBF (06DA7047I).

HK 7.5 Mon 15:45 T/SR14

Towards Full N^{3}LO Calculations of Asymmetric 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 an improved method for including three-body forces (3N) in many-body calculations of infinite nuclear matter. We present first results for the equation of state for arbitrary isospin asymmetries based on chiral NN, 3N and 4N forces and study in detail the symmetry energy including contributions beyond the quadratic expansion. In addition, we perform first calculations of neutron matter at N^{3}LO that include the subleading 3N forces beyond the Hartree-Fock approximation.

*This work was supported by the ERC Grant No. 307986 STRONGINT and the Helmholtz Alliance HA216/EMMI.

HK 7.6 Mon 16:00 T/SR14

Second random-phase approximation with chiral two- plus three-body interactions — •Richard Trippel and Robert Roth — Institut für Kernphysik, Technische Universität Darmstadt

The random-phase approximation (RPA) is a standard tool for the description of collective excitations in nuclei. Its extension, the second RPA (SRPA) is applied to a number of doubly-magic nuclei using chiral interactions.

For the calculations we use normal-ordered two- plus three-body interactions derived from chiral effective field theory, which have successfully been applied to medium-mass nuclei in various frameworks. These bare interactions are transformed by means of the similarity renormalization group (SRG) to improve convergence. The calculations are performed for interactions with and without initial three-nucleon forces. From the solution of the SRPA problem we compute various electric transition strengths and examine the impact of second-order contributions. An investigation of the convergence properties of the results w.r.t. our model-space truncations is made. We compare the induced and initial three-nucleon forces with each other and with experimental values.

Supported by DFG (SFB 634), HIC for FAIR and BMBF (06DA7047I).

HK 7.7 Mon 16:15 T/SR14

Towards chiral three-nucleon forces in heavy nuclei * — •Victoria Durant[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 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 the triton and for normal-ordered matrix elements in calculations of medium-mass nuclei.

*This work was supported by HIC for FAIR, the Helmholtz Alliance HA216/EMMI and the ERC Grant No. 307986 STRONGINT.

HK 8: Hadron Structure and Spectroscopy 1

Time: Monday 14:30–16:15 Location: T/SR19

Group Report HK 8.1 Mon 14:30 T/SR19

Compton Scattering Asymmetries at MAMI to Extract Proton Polarizabilities — •Philippe Martel — Institut für Kernphysik, Universität Mainz, Mainz, Germany — Department of Physics, Mount Allison University, Sackville, Canada

The internal structure of the proton is described by various fundamental quantities such as the mass, charge, and anomalous magnetic moment. The proton scalar and spin polarizabilities appear at second and third order, respectively, in the energy expansion of the Compton scattering amplitude. While the scalar polarizabilities have previously been determined, albeit with large uncertainties, the spin polarizabilities have only been extracted in various linear combinations.

A Compton scattering program in the A2 Collaboration at MAMI has sought to extract these fundamental quantities through measurements of the beam asymmetry, Σ_3, below either π^0 or $2\pi^0$ production threshold, and two beam-target asymmetries, Σ_{2x} and Σ_{2z}, also below $2\pi^0$ production threshold. All of the experiments made use of the Crystal Ball and TAPS detectors, while Σ_3 used a liquid hydrogen target and both Σ_{2x} and Σ_{2z} used a frozen-spin butanol target. The current results of these experiments as well as future plans will be discussed in this talk.

HK 8.2 Mon 15:00 T/SR19

Measurement of the Proton Scalar Polarizabilities at MAMI — •Vahe Sokhoyan for the A2-Collaboration — Institut für Kernphysik, Universität Mainz

The scalar polarizabilities α_{E1} and β_{M1} are fundamental properties related to the internal dynamics of the nucleon. They play a crucial role not only in our understanding of the nucleon, but also in other areas such as precision atomic physics and astrophysics. At the MAMI accelerator facility in Mainz, the proton polarizabilities were measured using a linearly polarized photon beam below pion photopoproduction threshold. The photons impinged on a liquid Hydrogen target and the reaction products were detected in the Crystal Ball and TAPS 4π spectrometer setup. The beam asymmetry Σ_3 was measured for the first time below pion threshold. In this talk the results on the beam asymmetry Σ_3, their significance and influence on the extraction of the scalar polarizabilities will be discussed.

HK 8.3 Mon 15:15 T/SR19

update on Kramers-Kronig relation for proton — •Oleksii Gryniuk[1,2], Franziska Hagelstein[1], and Vladimir Pascalutsa[1] — [1]JGU, Mainz, Germany — [2]KNU, Kyiv, Ukraine

New evaluation of the Baldin sum rule and forward Compton scattering amplitude, as well as higher order sum rules, was made with updated data for proton total photoabsorption cross-section. Stability of resulting values, comparison to previous evaluations and consequences of results for higher order sum rules are discussed.

HK 8.4 Mon 15:30 T/SR19

Feasibility studies of time-like proton electromagnetic form factors at PANDA-FAIR — •Alaa Dbeyssi[1], Luigi Capozza[1], Malte Deiseroth[1], Bertold Froehlich[1], Dmitry Khaneft[1], Frank Maas[1,2,3], Dominique Marchand[4], Maria Carmen Mora Espi[1], Oliver Noll[1], David Rodriguez Pineiro[1], Egle Tomasi-Gustafsson[4], Roserio Valente[1], Ying Wang[4], Manuel Zambrana[1], and Iris Zimmerman[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany — [4]Institut de Physique Nucléaire, Orsay, France

Electromagnetic form factors are fundamental quantities which describe the intrinsic electric and magnetic distributions of hadrons. Time-like proton form factors are experimentally accessible through the annihilation processes $\bar{p} + p \leftrightarrow e^+ + e^-$. Their measurement in the time-like region had been limited by the low statistics achieved by the experiments. This contribution reports on the results of Monte Carlo simulations for future measurements of electromagnetic proton form factors at PANDA (antiProton ANnihilation at DArmstadt). In frame of the PANDARoot software, the statistical precision at which the proton form factors will be determined is estimated. The signal ($\bar{p}+p \to e^+ + e^-$) identification and the suppression of the main background process ($\bar{p}+p \to \pi^+ + \pi^-$) are studied. Different methods have been used and/or developed to generate and analyse the processes of interest. The results show that time-like proton form factors will be measured at PANDA with unprecedented statistical accuracy.

HK 8.5 Mon 15:45 T/SR19

Feasibility studies for the measurement of the time-like electromagnetic form factors of the proton in reactions of $\bar{p}p \to \mu^+\mu^-$ at the PANDA-experiment at FAIR. — •Iris Zimmermann, Alaa Dbeyssi, Dmitry Khaneft, Frank Maas, Manuel Zambrana, Maria Carmen Mora Espi, Cristina Morales Morales, Dexu Lin, Bertold Fröhlich, Luigi Capozza, Oliver Noll, Malte Deiseroth, Samer Ahmed, Heybat Ahmadi, Roserio Valente, and David Rodriguez Pineiro for the PANDA-Collaboration — Helmholtz-Institut Mainz / GSI Darmstadt

The measurement of the time-like electromagnetic form factors (TL em FF), G_E and G_M, using reactions of $\bar{p}p \to l^+l^-$ (l=e,μ) gives access to the structure of the proton. It will be the first time measurement of TL em FF of the proton accessing the muons in the final state. 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 $\bar{p}p \to e^+e^-$. Feasibility studies for the individual extraction of G_E and G_M out of the measured angular distribution are in progress for the muonic channel using the software package PANDARoot. Due to the strong hadronic background, mainly reactions of $\bar{p}p \to \pi^+\pi^-$, a very good signal-to-background separation is needed. For the analysis of both signal and background channel different multivariate classification methods are used. The current status of the studies will be presented.

HK 8.6 Mon 16:00 T/SR19

Two-photon exchange corrections in elastic lepton-proton scattering — •Oleksandr Tomalak and Marc Vanderhaeghen — Johannes Gutenberg Universität Mainz, Germany

The measured value of the proton charge radius from the Lamb shift of energy levels in muonic hydrogen is in strong contradiction, by 7-8 standard deviations, with the value obtained from electronic hydrogen spectroscopy and the value extracted from unpolarized electron-proton scattering data. The dominant unaccounted higher order contribution in scattering experiments corresponds to the two photon exchange (TPE) diagram. The elastic contribution to the TPE correction was studied with the fixed momentum transfer dispersion relations and compared to the hadronic model with off-shell photon-nucleon vertices. A dispersion relation formalism with one subtraction was proposed. Theoretical predictions of the TPE elastic contribution to the unpolarized elastic electron-proton scattering and polarization transfer observables in the low momentum transfer region were made. The TPE formalism was generalized to the case of massive leptons and the elastic contribution was evaluated for the kinematics of upcoming muon-proton scattering experiment (MUSE).

HK 9: Hadron Structure and Spectroscopy 2

Time: Monday 14:30–16:30 Location: T/SR25

Group Report HK 9.1 Mon 14:30 T/SR25

Partial Wave Analyses of Antiproton-Proton Annihilations in Flight — •Julian Pychy, Helmut Koch, Bertram Kopf, and Ulrich Wiedner — Institut für Experimentalphysik I, Ruhr-Universität Bochum

To investigate important aspects for the upcoming $\overline{\mathrm{P}}$ANDA experiment, partial wave analyses (PWA) of $\overline{\mathrm{p}}$p-annihilation processes are carried out using data from the Crystal Barrel (LEAR) experiment. A coupled channel analysis of the three reactions resulting in the final states $\mathrm{K^+K^-}\pi^0$, $\pi^0\pi^0\eta$ and $\pi^0\eta\eta$ at a beam momentum of 900 MeV/c is currently in progress. Preliminary results on the determination of resonance contributions and of the spin density matrix (SDM) of different light mesons are presented. The elements of the SDM provide important information about the production process. Furthermore, results of the analyses of the channels $\omega\pi^0$, $\omega\pi^0\eta$ and $\pi^+\pi^-\pi^0\pi^0$ are discussed. These studies are focused on the determination of the contributing angular momenta of the $\overline{\mathrm{p}}$p-system as well as of the SDM of the ω meson. Significant spin-alignment effects depending on the production angle are visible here. These results are compared with those for the $\phi(1020)$ in the $\mathrm{K^+K^-}\pi^0$ channel. All analyses have been performed using PAWIAN, a common, object-oriented and easy-to-use PWA software that is being developed at the Ruhr-Universität Bochum.
This presentation summarizes recent activities of the Crystal Barrel (LEAR) Collaboration.
Supported by the BMBF.

Group Report HK 9.2 Mon 15:00 T/SR25

The BGO-OD experiment: status — •Jürgen Hannappel for the BGO-OD-Collaboration — Physikalisches Institut der Universität Bonn

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

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.

An overview of the BGO-OD detector is presented. Preliminary data from the first data takings will be shown and discussed.

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

HK 9.3 Mon 15:30 T/SR25

Constraint analysis for the interaction of the vector-meson octet with the baryon octet in effective field theory — Ayse Kücükarslan[1], Stefan Scherer[2], and •Yasemin Ünal[2] — [1]Canakkale Onsekiz Mart University, Canakkale, Turkey — [2]Institut für Kernphysik, JGU, Mainz

We investigate the interaction of the vector-meson octet with the baryon octet in a derivative expansion. At leading order, SU(3) symmetry allows for two independent couplings G_F and G_D proportional to the f and d symbols of SU(3). The vector-meson Lagrangian is given by a massive Yang-Mills theory with coupling constant g. Using a Dirac constraint analysis, we show that the interaction is consistent at the classical level, leading to no relation among the three coupling constants. In the next step, we consider the three- and four-point functions VVV and $VVVV$ at the one-loop level. By demanding renormalizability in the sense of effective field theory, i.e., all ultraviolet divergences can be canceled in terms of the most general effective Lagrangian, we obtain the universality relations $G_F = g$ and $G_D = 0$ for the renormalized coupling constants.

HK 9.4 Mon 15:45 T/SR25

Strangeness photoproduction at the BGO-OD experiment — •Thomas Jude for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn, Nussallee 12, Bonn

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

The BGO-OD is ideal for investigating the photoproduction of hadrons of non-zero strangeness. The high momentum resolution at forward angles covers a kinematic region where t-channel exchange mechanisms play a dominant role. This is complemented by the neutral and charged particle identification in the BGO calorimeter for the identification of hyperon decays.

The first part of an extensive physics programme includes measurements of the differential cross section at forward angles for $\gamma p \to K^+\Lambda$ and, using linearly polarised photons, the beam asymmetry, Σ, for $\gamma p \to K^0\Sigma^+$. This latter measurement is focussed on the K^* threshold region where a cusp-like structure was recently observed in the total cross section.

Analysis of these reaction channels for both real and simulated data is presented.

Supported by DFG (SFB/TR-16).

HK 9.5 Mon 16:00 T/SR25

Observation of a new narrow axial-vector meson $a_1(1420)$ 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 to perform a partial-wave analysis with the largest wave set used so far consisting of 88 waves in bins of the squared four-momentum transfer t' from the beam to the target.

Based on this partial-wave decomposition, resonance parameters can be extracted by disentangling resonant and non-resonant parts of the partial waves in mass-dependent fits. The additional information obtained from the division in bins of the squared four-momentum transfer t', allows for a better separation of resonant and non-resonant parts, as they exhibit different t'-dependences.

Using this method, the resonance parameters of a new axial-vector state, the $a_1(1420)$, observed only in the $f_0(980)\,\pi$ decay mode, have been extracted.

We will present extensive studies that have been performed in order to investigate the systematic uncertainties of the resonance parameters, due to the applied fit model, the correlation with other waves or the event selection.

Supported by BMBF, MLL and the Excellence Cluster Universe.

HK 9.6 Mon 16:15 T/SR25

Hunting for $\mathbf{K^{*+}(892)}$ in 3.5 GeV pp reactions — •Dimitar Mihaylov — For the HADES collaboration — E12, Physics department, TU München — Excellence Cluster "Universe", Boltzmannstr. 2, 85748 Garching, Germany

The production of the kaon excitation state $K^{*+}(892)$ has not been previously investigated for pp collisions at energies near to the production threshold. The data provided by the HADES spectrometer for pp collisions at 3.5 GeV provide a great opportunity to investigate this state. This has been achieved by reconstruction of the decay channel $K^{*+}(892) \to K^0_S\pi^+ \to \pi^+\pi^-\pi^+$ and performing a single differential analysis in the p_T, p_{CM}, $cos\theta_{CM}$ and rapidity variables.

Apart from extending our current knowledge of the $K^{*+}(892)$ state, the result of this analysis will serve as a valuable reference for a future analysis of the available pNb data at the same energy, which will focus on investigating pn reactions, scattering reactions inside the nucleus and production of the $K^{*+}(892)$ through secondary processes (e.g. $\pi N \to K^{*+}\Lambda$).

The analysis of the pp data is in its final stages and preliminary results of the total production cross section, the dominant production channel and spin alignment properties of the $K^{*+}(892)$ are available.

This work is supported by the Excellence Cluster "Universe".

HK 10: Precision Tests of the Standard Model 1

Time: Monday 17:00–19:00 Location: K/HS1

Group Report HK 10.1 Mon 17:00 K/HS1

Development and status of the MAGIX experiment — •Sabato Stefano Caiazza — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

One of the most relevant energy scales to solve several scientific puzzles in modern nuclear and particle physics is that between 10 and 100 MeV. For example, in this energy range, we might find a solution of the g-2 discrepancy and we can perform more precise measurements to address the proton radius puzzle.

To perform competitive research in any of those fields it is very important to have a dedicated machine with an high performance experiment, optimized for its environment. We will , therefore, present the status and the development plans of the MAGIX (MesA Gas Internal target eXperiment) experiment, currently under design, to be installed on the Mainz energy recovery superconductive accelerator (MESA) recirculating beam. This experiment features a high resolution, twin-arm magnetic spectrometer, interfaced without windows with an internal gas target and will be completed in the upcoming years.

Group Report HK 10.2 Mon 17:30 K/HS1

The Ultra-Cold Neutron Laboratory at the FRM II — •Stephan Wlokka[1], Andreas Frei[1], Peter Fierlinger[2], and Stephan Paul[2] — [1]Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II), Technische Universität München, Lichtenbergstraße 1, D-85748 Garching — [2]Physik-Department E18, Technische Universität München, James-Franck-Straße 1, D-85748 Garching

Ultra-cold neutrons (UCN) are neutrons which are totally reflected from a given material surface. Typical energies of UCN are below 300 neV and velocities below 8 $\frac{\mathrm{m}}{\mathrm{s}}$. Thus they can be stored in material or magnetic bottles for several hundreds of seconds. As such, UCN are excellent laboratories to study fundamental parameters, e.g. the free neutron lifetime or the electric dipole moment of the neutron.
At the Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II) a new source for UCN is currently being built. This talk will give an overview over the experimental facilities foreseen for this new source, aswell as the current efforts for a complete test setup at the Maier-Leibnitz-Labor (MLL).
The talk will also highlight a current experiment designed to study the irradiation effects on solid Deuterium during the operation of the UCN source.
This work was funded by the DFG Excellenz-Cluster EXC153 "Origin and Structure of the Universe" and the Maier-Leibnitz-Laboratorium (MLL) of the TU and LMU Munich.

HK 10.3 Mon 18:00 K/HS1

Detector studies for a high precision determination of the weak mixing angle at the future P2-experiment in Mainz — •Kathrin Gerz[1], Sebastian Baunack[1], Dominik Becker[1], Jürgen Diefenbach[1], Boris Gläser[1], Yoshio Imai[1], Thomas Jennewein[1], Frank Maas[1,2,3], and David Rodriguez[2] for the A4-Collaboration — [1]Institut für Kernphysik, Johannes-Gutenberg-Universität Mainz — [2]Helmholz-Institut Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität, 55099 Mainz

The P2 experiment at the upcoming MESA accelerator in Mainz aims for a high precision determination of the electroweak mixing angle:

The 2% measurement of the parity violating asymmetry in elastic electron-proton scattering will allow for a determination of $sin^2(\theta_W)$ of 0.15%. The experimental setup is currently being designed and will employ the use of an integrating, large solid angle magnetic solenoid spectrometer with quartz bars for the detection of elastically scattered electrons.

The low-energy and high-statistics experiment places high demands on detector performance and radiation hardness of all materials used in the setup.

We are going to present the current status of the development of the experiment, feasibility calculations and simulations. We will put an emphasis on technology and design of a Cherenkov detector.

HK 10.4 Mon 18:15 K/HS1

The neutron lifetime experiment PENeLOPE — •Wolfgang Schreyer for the PENeLOPE-Collaboration — Technische Universität München

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.

The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

HK 10.5 Mon 18:30 K/HS1

CsI-Silicon heavy-ion telescope for storage rings — •Mohammad Ali Najafi[1,4], Iris Dillmann[2,3,4], Fritz Bosch[2], Michael Böhmer[1], Thomas Faestermann[1], Bingshui Gao[2], Roman Gernhäuser[1], Christophor Kozhuharov[2], Sergey A Litvinov[2], Yuri A Litvinov[2], Ludwig Maier[1], Fritz Nolden[2], Ulrich Popp[2], Mohammad Shahab Sanjari[2], Uwe Spillmann[2], Markus Steck[2], Thomas Stöhlker[2], and Helmut Weick[2] — [1]TU München — [2]GSI Darmstadt — [3]TRIUMF Vancouver — [4]JLU Giessen

A multi-purpose particle detector was developed for heavy-ion experiments at the ESR in GSI Darmstadt, and also as a prototype for future ILIMA and EXL experiments at FAIR. The detector was designed and developed at the TU München, and was used successfully for the measurement of the decay rate of ^{142}Pm ions in October 2014. The detector has an active area of 60×40 mm^2 and includes a stack of six silicon pad detectors, a DSSD, and a CsI scintillator (24×24×10 mm^3) that stops the beam after a passive degrader. The excellent resolution of the detector allows an unambiguous identification of the incident particles. The relative resolution (FWHM) of the detector is 1% for the energy deposit (ΔE), and 0.9% for the residue energy (E_{csi}), and 0.8% for the total summed energy. We report on the design, development, and the preliminary results from the experiment.

This project was funded by the Helmholtz Association via the Young Investigators Grant VHNG 627 and the Germany BMBF via the project 05P12RGFNJ-06GI7118.

HK 10.6 Mon 18:45 K/HS1

Messung des Wirkungsquerschnittes für ^{x}Ge(n,jn)^{68}Ge Reaktionen mit quasi monoenergetischen Neutronen im Energiebereich 20..100 MeV — •Alexander R. Domula[1], Andy Buffler[2], Emmanael Musonza[3], Ralf Nolte[3], F.D. Smit[4], Peane Maleka[4], Anton Wallner[5] und Kai Zuber[1] — [1]TU-Dresden, Dresden, Germany — [2]UCT, Cape-Town, South Africa — [3]PTB, Braunschweig, Germany — [4]iThemba LABS, Somerset West, South Africa — [5]VERA Laboratory, Vienna, Austria

Die Suche nach dem neutrinolosen Doppelbetazerfall ist ein großes Ziel der modernen Physik. Großexperimente wie GERDA oder MAJORANA untersuchen diesen besonders seltenen Zerfall am Germaniumisotop ^{76}Ge. GERDA untersucht diesen Zerfall mit HP-Ge-Kristallen aus angereichertem Germanium, die in flüssigem Argon betrieben werden. Der Messuntergrund, insbesondere die Aktivierung von Detektorkomponenten durch kosmogene Neutronen, spielt bei solchen Experimenten eine zentrale Rolle. Für den Messuntergrund in GERDA ist ^{68}Ge ein problematisches Nuklid, das durch Reaktionen mit schnellen, kosmogenen Neutronen in den HP-Ge Kristallen selbst erzeugt wird.
Im Rahmen von Untergrundstudien werden die Wirkungsquerschnitte für die erzeugenden ^{x}Ge(n,jn)^{68}Ge Reaktionen im dafür interessanten Energiebereich En=20..100 MeV durch Nutzung der Aktivierungssondentechnik mit quasi-monoenergetischen Neutronen gemessen. Die Messung des Wirkungsquerschnittes ^{70}Ge(n,3n)^{68}Ge bei En=35,9 MeV im Beschleunigerlabor iThemba LABS (Südafrika) wird vorgestellt.

HK 11: Nuclear Astrophysics 1

Time: Monday 17:00–18:45 Location: K/HS2

Group Report HK 11.1 Mon 17:00 K/HS2

Investigation of proton- and α-capture reactions for the astrophysical γ process via in-beam γ-ray spectroscopy — •Lars Netterdon[1], A. Endres[2], J. Mayer[1], P. Scholz[1], and A. Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institute for Applied Physics, Goethe University Frankfurt am Main

The p nuclei, about 30 to 35 neutron-deficient stable nuclei, are bypassed by the s and r process. It is believed, that the majority of these nuclei is produced via photodisintegration reactions and subsequent β decays during the γ process. Reaction rates for the γ-process reaction network are to a large extent calculated within the scope of the Hauser-Feshbach statistical model. The nuclear-physics input, such as optical-model potentials and γ-ray strength functions, must be constrained experimentally in order to reduce the uncertainties of reaction-rate calculations. A dedicated setup for in-beam nuclear astrophysics experiments aiming at the aforementioned input parameters using the γ-ray spectrometer HORUS will be introduced [1]. The ^{112}Sn(α,γ)^{116}Te reaction will be presented, being the first successful in-beam α-capture experiment on a heavy nucleus to date. In addition, an experiment on the ^{89}Y(p,γ)^{90}Zr reaction is presented, where special emphasis is put on the partial cross-sections. With the aid of partial cross-sections, a method is shown which allows an experimental constraint on the γ-ray strength function in the compound nucleus ^{90}Zr. Supported by the ULDETIS project within the UoC Excellence Initiative institutional strategy.

[1] L. Netterdon *et al.*, Nucl. Instr. Meth. A **754** (2014) 94

HK 11.2 Mon 17:30 K/HS2

Untersuchung der Reaktion ^{90}Zr(p,γ) mit In-beam Gammaspektroskopie — •Philipp Erbacher[1], Anne Endres[1], Jan Glorius[1], Lars Netterdon[2], Kerstin Sonnabend[1], Benedikt Thomas[1] und Andreas Zilges[2] — [1]Institut für Angewandte Physik, Goethe Universität Frankfurt am Main — [2]Institut für Kernphysik, Universität zu Köln

Nach dem aktuellen Stand der Forschung wird der p-Kern ^{92}Mo zum größten Teil durch Photodesintegrationsreaktionen in Typ II Supernovae produziert. Netzwerkrechnungen zeigen jedoch, dass dieses Produktionszenario alleine nicht ausreicht, um die solare Häufigkeit von ^{92}Mo zu erklären. Als zusätzliches Produktionsszenario wurden daher Protoneneinfangreaktionen während Typ Ia Supernovae vorgeschlagen. Um diese Annahme zu überprüfen, ist eine genaue Kenntnis der relevanten Wirkungsquerschnitte notwendig. Aus diesem Grund wurde ein zu 97.65% angereichertes ^{90}Zr-Target mit Protonen mit Energien von 2.5 MeV bis 5.1 MeV bestrahlt, um die Wirkungsquerschnitte der Reaktion in den Grundzustand und das Isomer von ^{91}Nb zu bestimmen. Die Messungen wurden am Horus-Spektrometer an der Universität zu Köln durchgeführt. Die Ergebnisse des Experiments werden vorgestellt und diskutiert.

gefördert durch DFG (SO907/2-1) und HIC for FAIR.

HK 11.3 Mon 17:45 K/HS2

Neutron-Capture Rates with the R^{3}B-CaveC Setup — •Marcel Heine for the R3B-Collaboration — TU, Darmstadt

Recent research has shown that the (n,γ) transition-rates on light nuclei can have an influence on the neutron-balance during the r-process. Especially neutron-rich carbon isotopes play an important role in r-process nucleosynthesis network calculations which include light nuclei, since these nuclei are aligned along major flow-paths. In particular ^{18}C is of interest, because it can be interpreted as a waiting point. The ^{17}C(n,γ)^{18}C rate could so far only be estimated theoretically and has an uncertainty of a factor of ten [1]. At the R^{3}B-CaveC setup at GSI we have measured the time reversed reaction, i.e. ^{18}C(γ,n)^{17}C *via* the Coulomb dissociation of ^{18}C beam. The kinematically complete measurement allows extracting exclusive energy dependent neutron-capture cross section with respect to the excitation energy by using the invariant-mass method. Experimental results will be presented in comparison to theoretical calculations and the influence on r-process nucleosynthesis products will be discussed. This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and the BMBF project 05P12RDFN8

[1] T. Sasaqui et al., APJ 634 (2005) 1173

HK 11.4 Mon 18:00 K/HS2

Neutroneneinfangsquerschnitte von ^{85}Kr — •Stefan Fiebiger[1], Ulrich Giesen[2], Tanja Heftrich[1], René Reifarth[1], Stefan Schmidt[1], Zuzana Slavkovská[1], Benedikt Thomas[1] und Mario Weigand[1] — [1]Goethe-Universität Frankfurt — [2]Physikalisch-Technische Bundesanstalt, Braunschweig

Neutroneneinfang und β^--Zerfall sind zwei konkurrierende Reaktionen in der s-Prozess Nukleosynthese des ^{85}Kr, was es zu einem wichtigen Verzweigungspunkt macht. Die Kenntnis des Neutroneneinfangsquerschnitts von ^{85}Kr ist deswegen ein essentielles Werkzeug, um die Modelle der stellaren Nukleosynthese besser zu verstehen. Ziel ist es ^{85}Kr(n,γ) mit der Flugzeitmethode zu messen.
Dazu werden zunächst Methoden zur Produktion von ^{85}Kr untersucht. Eine davon ist die Bestrahlung einer ^{82}Se Probe mit einem α-Strahl, wobei das produzierte ^{85}Kr in der Kristallstruktur gefangen bleibt. Aufgrund von technischen Schwierigkeiten und geringen Ausbeuten dieser Methode besteht weiterhin die Möglichkeit, reaktorproduziertes ^{85}Kr zu verwenden.
Für zukünftige Messungen des Neutroneneinfangsquerschnitts von ^{85}Kr an FRANZ (Frankfurter Neutronenquelle am Stern-Gerlach-Zentrum) ist das Ziel, möglichst isotopenreine Proben zu verwenden, um den Untergrund bei der Messung zu reduzieren. Hierbei stellt vor allem ^{83}Kr ein Problem dar.

Dieses Projekt wurde unterstützt vom ERC Grant Agreement n. 615126.

HK 11.5 Mon 18:15 K/HS2

Chiral 3N forces in Quantum Monte Carlo calculations* — •Ingo Tews[1,2], Stefano Gandolfi[3], Alexandros Gezerlis[4], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Theoretical Division, Los Alamos National Laboratory — [4]Department of Physics, University of Guelph

Chiral effective field theory (EFT) provides a systematic framework that describes low-energy hadronic interactions and allows calculations with controlled theoretical uncertainties. It explicitly includes chiral physics and, thus, is directly linked to Quantum Chromodynamics. We recently have studied local chiral NN potentials at next-to-next-to-leading order (N^{2}LO) and used this to calculate the energy per particle of neutron matter using the auxiliary-field diffusion Monte Carlo (AFDMC) method. In addition to two-nucleon interactions, chiral EFT naturally predicts consistent many-body interactions. We show how to include the leading chiral 3N forces into an AFDMC calculation and present results for the equation of state of pure neutron matter at N^{2}LO including NN and 3N forces.

*This work was supported in part by the ERC Grant No. 307986 STRONGINT, by the Helmholtz Alliance HA216/EMMI, by NSERC, the US DOE SciDAC-3 NUCLEI project, and the LANL LDRD program. Computations were performed at the Jülich Supercomputing Center and at NERSC.

HK 11.6 Mon 18:30 K/HS2

Study of the ^{22}Ne(p,γ)^{23}Na reaction at LUNA with a 4π BGO summing detector — •Marcell Peter Takács, Daniel Bemmerer, and Tamás Szücs for the LUNA-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), 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 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, recently completed phase of the LUNA ^{22}Ne(p,γ)^{23}Na experiment, selected low-energy resonances were studied with two high-purity germanium detectors. In the present talk, the preparations for the second experimental phase are reported. In this phase, a 4π bismuth germanate summing detector will be used to address the lowest-energy resonances as well as direct capture. — Supported by DFG (BE 4100/2-1) and NAVI (HGF VH-VI-417).

HK 12: Instrumentation 4

Time: Monday 17:00–18:45 Location: M/HS1

Group Report HK 12.1 Mon 17:00 M/HS1

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

The Compressed Baryonic Matter (CBM) experiment, one of the major scientific pillars at FAIR, will explore the phase diagram of strongly interacting matter at the highest net-baryon densities in nucleus-nucleus collisions with interaction rates up to 10 MHz. The Silicon Tracking System is the central detector system of the CBM experiment. Its task is to perform track reconstruction and momentum determination for all charged particles created in beam-target collisions at SIS 100 and SIS 300 beam energies. The technical challenges to meet are a high granularity matching the high track densities, a fast self-triggering read-out coping with high interaction rates, and a low mass to yield high momentum resolution of $\Delta p/p = 1\%$. The detector system acceptance covers polar angles between 2.5 and 25 degrees and will be operated in the 1 T field of a super conducting dipole magnet. We introduce the concept of the STS, being comprised of eight tracking stations employing ∼1300 double-sided silicon microstrip sensors on modular structures that keep the read-out electronics outside the physics aperture. Ultra-thin-multiline micro-cables will be used to bridge the distance between the microstrip sensors and the readout electronics. Infrastructure such as power lines and cooling plates will be placed at the periphery of the stations. The status of the STS development is summarized in the presentation, including an overview on sensors, read-out electronics, prototypes, and system integration.

HK 12.2 Mon 17:30 M/HS1

Quality assurance database for the CBM Silicon Tracking System — •Anton Lymanets for the CBM-Collaboration — Physikalisches Institut, Universität Tübingen

The Silicon Tracking System is a main tracking device of the CBM Experiment at FAIR. Its construction includes production, quality assurance and assembly of large number of components, e.g., 106 carbon fiber support structures, 1300 silicon microstrip sensors, 16.6k readout chips, analog microcables, etc. Detector construction is distributed over several production and assembly sites and calls for a database that would be extensible and allow tracing the components, integrating the test data, monitoring the component statuses and data flow.

A possible implementation of the above-mentioned requirements is being developed at GSI (Darmstadt) based on the FAIR DB Virtual Database Library that provides connectivity to common SQL-Database engines (PostgreSQL, Oracle, etc.). Data structure, database architecture as well as status of implementation will be discussed.

*Supported by EU-FP7 HadronPhysics3 and BMBF.

HK 12.3 Mon 17:45 M/HS1

Development of carbon fiber staves for the strip part of the PANDA Micro Vertex Detector — •Tommaso Quagli[1], Kai-Thomas Brinkmann[1], Vincenzo Fracassi[2], Dirk Grunwald[2], and Eberhard Rosenthal[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig Universität Gießen, Gießen, Germany — [2]ZEA-1, Forschungszentrum Jülich GmbH, Jülich, Germany

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 is composed of four concentric barrels and six forward disks, instrumented with silicon hybrid pixel detectors and double-sided silicon microstrip detectors; its main task is the identification of primary and secondary vertices. The central requirements include high spatial and time resolution, trigger-less readout with high rate capability, good radiation tolerance and low material budget.

Because of the compact layout of the system, its integration poses significant challenges. The detectors in the strip barrels will be supported by a composite structure of carbon fiber and carbon foam; a water-based cooling system embedded in the mechanical supports will be used to remove the excess heat from the readout electronics. In this contribution the design of the barrel stave and the ongoing development of some hardware components related to its integration will be presented.

Supported by BMBF, HIC for FAIR and JCHP.

HK 12.4 Mon 18:00 M/HS1

Development of a Compton Camera for online ion beam range verification via prompt γ detectio — •S. Aldawood[1,2], S. Liprandi[1], T. Marinsek[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[1,4], I. Castelhano[1,5], R. Lutter[1], G. Dedes[1], R Gernhäuser[3], D. R. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

Precise and preferably online ion beam range verification is a mandatory prerequisite to fully exploit the advantages of hadron therapy in cancer treatment. An imaging system is being developed in Garching aiming to detect promptγ rays induced by nuclear reactions between the ion beam and biological tissue. The Compton camera prototype consists of a stack of six customized double-sided Si-strip detectors ($DSSSD, 50 \times 50 mm^2, 0.5\ mm\ thick, 128 strips/side$) acting as scatterer, while the absorber is formed by a monolithic $LaBr_3$:Ce scintillator crystal ($50 \times 50 \times 30\ mm^3$) read out by a position-sensitive multi-anode photomultiplier (Hamamatsu H9500). The on going characterization of the Compton camera properties and its individual components both offline in the laboratory as well as online using proton beam will be presented.

*This work is supported by the DFG Cluster of Excellence MAP (Munich-Centre for Advanced Photonics)

HK 12.5 Mon 18:15 M/HS1

Development of large area diamond detectors for time of flight measurements of heavy ions — •Fabio Schirru[1], Chiara Nociforo[1], Mladen Kiš[1], Jochen Frühauf[1], Mircea Ciobanu[2], Michael Träger[1], and Robert Visinka[1] — [1]GSI, Darmstadt, Germany — [2]ISS, Bucharest, Romania

The interest in using diamond for radiation detection applications stems from its unique properties. In particular, radiation hardness, low leakage current (no need of cooling), fast rise time of the induced signals (in the order of 100 ps) and high electron/hole saturation velocity (up to 10^7 cm/s) make it an excellent candidate for serving as a high-resolution timing detector.

We present the Time of Flight (ToF) properties of new developed radiation detectors based on two 20x20 mm^2 and 0.3 mm thick polycrystalline diamonds. Electrodes were fabricated in house at GSI by depositing on both sides of the diamond samples Cr/Au layers of thickness 50/100 nm respectively.

Strip diamond detectors, irradiated with ^{197}Au beam at 1 GeV/u and coupled with integrated electronics, showed very good timing performances of ∼50 ps over a particle path of flight of ∼34 m. It is the first time that timing properties of diamond sensors are evaluated at experimental conditions very similar to those expected at the in-flight separator Super-FRS[1], under construction at FAIR.

[1] - M. Winkler et al., Nucl. Instr. and Meth. B 266 (2008) 4183.

HK 12.6 Mon 18:30 M/HS1

Development of a Compton Camera for online ion beam range verification via prompt γ detectio — •S. Aldawood[1,2], S. Liprandi[1], T. Marinsek[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[4], I. Castelhano[5], R. Lutter[1], G. Dedes[1], R. Gernhäuser[3], D. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

A real-time ion beam verification in hadron-therapy is playing a major role in cancer treatment evaluation. This will make the treatment interuption possible if the planned and actual ion range are mismatched. An imaging system is being developed in Garching aiming to detect promptγ rays induced by nuclear reactions between the ion beam and biological tissue. The Compton camera prototype consists of a stack of six customized double-sided Si-strip detectors ($DSSSD, 50 \times 50 mm^2, 128 strips/side$) acting as scatterer, while the absorber is formed by a monolithic $LaBr_3$:Ce scintillator crystal ($50 \times 50 \times 30 mm^3$) read out by a position-sensitive multi-anode pho-

tomultiplier (Hamamatsu H9500). The study of the Compton camera properties and its individual component are in progress both in the laboratory as well as at the online facilities.

HK 13: Instrumentation 5

Time: Monday 17:00–19:00 Location: M/HS2

Group Report HK 13.1 Mon 17:00 M/HS2

Status of the ALICE TPC upgrade for high-rate operation — •Piotr Gasik for the ALICE-Collaboration — TU München, Physik Department E12, Excellence Cluster "Universe", D-85748, Garching, Germany

A large Time Projection Chamber (TPC) is the main device for tracking and charged particle identification in the ALICE experiment at the CERN LHC. After the second long shutdown in 2018/2019, the LHC will deliver Pb beams colliding at an interaction rate of about 50 kHz, which is about a factor of 100 above the present readout rate of the TPC. This will result in a significant improvement on the sensitivity of rare probes that are considered key observables to characterise the hot and dense QCD matter created in such collisions. In order to make full use of this luminosity, a major upgrade of the TPC is required. It is foreseen to replace the existing MWPC-based readout chambers by Gas Electron Multiplier (GEM) detectors to overcome the rate limitations imposed by the present gated readout scheme.

An extensive R&D program has been launched to reach the challenging requirements of the upcoming upgrade of the detector. In this presentation the most recent results will be discussed concerning ion backflow suppression, gain stability, energy and $\mathrm{d}E/\mathrm{d}x$ resolution and stability against discharges. The status of the upgrade of the online calibration and data reduction system, which includes advanced techniques for online corrections of space-charge distortions, as well as the development of a new readout electronics will be reported.

HK 13.2 Mon 17:30 M/HS2

Space charge calibration of the ALICE TPC operated with an open gating grid — •Ernst Hellbär[1], Marian Ivanov[2], and Jens Wiechula[3] for the ALICE-Collaboration — [1]Institut für Kernphysik, Goethe-Universität Frankfurt — [2]GSI — [3]Universität Tübingen

The Time Projection Chamber (TPC) is the main particle identification detector of the ALICE experiment at the CERN LHC. High interaction rates of 50 kHz in Pb-Pb during the Run 3 period after 2020 require a major upgrade of the TPC readout. The currently used Multiwire Proportional Chambers (MWPCs) will be replaced by readout chambers (ROCs) based on Gas Electron Multiplier (GEM) technology which will be operated in a continuous mode. While the gating grid of the MWPCs prevents the positive ions of the amplification region from entering the drift volume, the GEM-based ROCs will introduce an ion backflow (IBF) of about 1%. In combination with the high-luminosity environment, this amount of back-drifting ions results in a considerable space charge density which distorts the drift path of the primary ionisation electrons significantly. In order to still provide a high tracking efficiency and cluster-to-track association, an efficient calibration scheme will be implemented. As a test ground for the new calibration scheme, pp collision data was taken during Run 1 with the gating grid operated in a transparent mode allowing the ions to enter the drift volume. The measured space point distortions due to the space charge will be presented together with the corrected data and compared to simulations for Run 3.

Supported by BMBF and the Helmholtz Association.

HK 13.3 Mon 17:45 M/HS2

GEM Setup — •Merter Dülgar für die ALICE-Kollaboration — Physikalisches Institut, Universität Tübingen

Die Time Projection Chamber (TPC) ist der Hauptdetektor zur Teilchenidentifikation im ALICE Experiment am CERN. Nach dem zweiten Long Shutdown 2018 soll eine Kollisionsrate von mehr als 50 kHz erreicht werden. Um die neue Luminosität vollständig nutzen zu können wird ein Upgrade der bisherigen Auslese benötigt. Bisher kommt in der TPC die Vieldrahtkammer zum Einsatz. Durch das Sperrgitter zur Ionenunterdrückung wird die Ausleserate auf wenige kHz eingeschränkt. Das Ziel ist eine kontinuierliche Auslese. Hierfür ist vorgesehen die Vieldrahtkammer durch die Gas Electron Multiplier (GEM) zu ersetzen. Dabei stellt der Ionenrückfluss eine kritische Größe dar und muss gering gehalten werden.

Dazu wurde am Physikalischen Institut in Tübingen ein vier Lagen GEM Detektor aufgebaut. Der Ionenrückfluss wurde anhand der Parameter GEM-Spannung, Transferfeld-Spannung, Folienabstand und Lochdurchmesser/-abstand untersucht. Dir vorläufigen Ergebnisse werden präsentiert.

HK 13.4 Mon 18:00 M/HS2

Ion backflow and energy resolution in micro-pattern gas detectors for the ALICE TPC — •Esther Bartsch, Alexander Grein, Michael Jung, Rainer Renfordt, and Harald Appelshäuser 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 multiwire proportional readout chambers by Gas Electron Multiplier (GEM) stacks. The high interaction rate of 50 kHz foreseen for the Run 3 period of the LHC requires a readout scheme that can accommodate the 100 times higher rates. GEM-based readout chambers that can be operated in continuous mode are the prime candidate. To reduce the backflow of positive ions (IBF) into the detector volume several measures can be taken, such as optimization of the GEM voltages and transfer fields between the foils, and a systematic variation of the hole pitch. As alternative technology Micromegas (MICRO MEsh GAseous Structure) in addition to two GEM foils is also considered for gas amplification. Two dedicated test detectors, one for the characterization of triple and quadruple GEM stacks and one for the characterization of Micromegas, were set up at the IKF in Frankfurt. The results of systematic studies of the IBF and the energy resolution in several arrangements of GEM foils with different pitch sizes and in arrangements of Micromegas and GEM foils will be presented.

Supported by BMBF and the Helmholtz Association.

HK 13.5 Mon 18:15 M/HS2

Entwicklung großflächiger mikrostrukturierter Gasdetektoren für MAGIX — •Pepe Gülker — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

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 anlaufenden Entwicklung.
In diesem Vortrag werden die gesteckten Ziele und der aktuelle Stand der Entwicklungen vorgestellt.

HK 13.6 Mon 18:30 M/HS2

Spatial and Energy-loss Measurements of a PANDA STT Prototype — •Haroutioun Ohannessian, Peter Wintz, and James Ritman for the PANDA-Collaboration — Forschungszentrum Juelich

The PANDA experiment will study charmonium and open charm physics, gluonic excitations and the nucleon structure by means of interaction of antiprotons with protons and nuclei. The PANDA central tracker consists of 4636 straw tube drift detectors, which are arranged in a hexagonal layout. The straws have a diameter of 10 mm and a wall thickness of 27μm and are filled with a mixture of Ar/CO_2 (9:1) gas operating at a high voltage of about 1800 V at a pressure of 2 bar absolute.

The readout system provides drift time information for trajectory reconstruction and momentum determination. Moreover, specific energy-loss information is provided for particle identification (p, K, π separation < 0.8 GeV/c).

The STT prototype consists of 96 straws, which are being tested

by cosmic and beam measurements in the Forschungszentrum Jülich. Measurements are being performed using the COSY accelerator to provide beams of protons and deuterons at momenta in the range of 0.6 - 3 GeV/c. This information will be used for particle identification (p/d separation).

This presentation will show the results of the different measurements that have been taken recently at COSY. In addition, further improvements on the next STT prototype will be discussed.

HK 13.7 Mon 18:45 M/HS2

Charge transfer in Gas Electron Multipliers — •Jonathan Ottnad, Markus Ball, Bernhard Ketzer, Viktor Ratza, and Cina Razzaghi — HISKP, Bonn University, Nussallee 14-16, D-53115 Bonn

In order to efficiently employ a Time Projection Chamber (TPC) at interaction rates higher than $\sim 1\,\mathrm{kHz}$, as foreseen e.g. in the ALICE experiment (CERN) and at CB-ELSA (Bonn), a continuous operation and readout mode is required. A necessary prerequisite is to minimize the space charge coming from the amplification system and to maintain an excellent spatial and energy resolution. Unfortunately these two goals can be in conflict to each other.

Gas Electron Multipliers (GEM) are one candidate to fulfill these requirements. It is necessary to understand the processes within the amplification structure to find optimal operation conditions. To do so, we measure the charge transfer processes in and between GEM foils with different geometries and field configurations, and use an analytical model to describe the results. This model can then be used to predict and optimize the performance.

The talk will give the present status of the measurements and describe the model.

Supported by BMBF and DFG.

HK 14: Instrumentation 6

Time: Monday 17:00–19:00 Location: M/HS4

Group Report HK 14.1 Mon 17:00 M/HS4

The PANDA backward calorimeter — Heybat Ahmadi[1,2], Samer Ahmed[2], •Luigi Capozza[2,3], Alaa Dbeyssi[2,3], Malte Deiseroth[1,2], Bertold Fröhlich[2,3], Dmitry Khaneft[1,2], Dexu Lin[2,3], Frank Maas[2,3], María Carmen Mora Espí[2,3], Cristina Morales Morales[2,3], Oliver Noll[1,2], David Rodríguez Piñeiro[2,3], Roserio Valente[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[2,3] — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH

The PANDA experiment at FAIR is being devised for a broad physics programme in hadron structure and spectroscopy. Full and accurate reconstruction of scattering events, reliable particle identification and an almost complete solid angle coverage are required. An important tool for meeting this requirements will be the electromagnetic calorimeter (EMC). It is required to measure particle energies ranging from some MeVs to several GeVs with a relative resolution of $1\% \oplus 2\%/\sqrt{E/\mathrm{GeV}}$, assuring a compact geometry and radiation hardness at the same time. For these reasons $PbWO_4$ was chosen as scintillation material. The whole calorimeter has been designed in three sections: a forward end-cap, a central barrel and a backward end-cap (BWEC). The BWEC, under development at Mainz, will cover scattering polar angles between 140° and 170° and will be made of 524 $PbWO_4$ crystals. The scintillation light will be detected by large area avalanche photodiodes which will be read out by customised front-end ASIC chips. A status report on the development of the BWEC will be given in this contribution.

HK 14.2 Mon 17:30 M/HS4

Response of a Close to Final Prototype for the Barrel of the PANDA Electromagnetic Calorimeter to Photons at Energies below 1 GeV — •Christoph Rosenbaum[1], Stefan Diehl[1], Valery Dormenev[1], Peter Drexler[1], Myroslav Kavatsyuk[2], Till Kuske[1], Svetlana Nazarenko[1], Rainer W. Novotny[1], Phillippe Rosier[3], Andrej Ryantzev[4], Peter Wieczorek[5], Andrea Wilms[5], and Hans-Georg Zaunick[1] — [1]II. Physikalisches Instiut, University Gießen — [2]KVI Groningen, The Netherlands — [3]IPN Orsay, France — [4]IHEP Protvino, Russia — [5]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The EMC of the PANDA detector is one of the central components to achieve the proposed physical goals. The barrel part of the EMC will consist of more than 11,000 lead tungstate (PWO-II) crystals operated at -25°C to achieve the required performance over the complete energy range. The most recent prototype PROTO120 represents a larger section of a barrel slice, containing the most tapered crystals. The readout is performed with two rectangular large area APDs per crystal, which are read out separately via the specially developed APFEL-ASIC, providing a large dynamic range, low power consumption and optimized shaping. The present contribution will show the response of the PROTO120 to photons in the energy range below 800 MeV. It will focus on the performance of the ASIC under real conditions and describe the analysis procedure including the signal extraction and obtained energy resolution using the information from both APDs. * The Work is supported by BMBF, GSI and HIC for FAIR

HK 14.3 Mon 17:45 M/HS4

Neutral particle identification with the BGO crystal calorimeter of the BGO-OD experiment — •Georg Scheluchin for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, D-53115 Bonn

The aim of the BGO-OD experiment is the systematic investigation of nonstrange and strange meson photoproduction. The setup combines a large aperture forward magnetic spectrometer and a central BGO crystal calorimeter with almost 4π acceptance. The BGO calorimeter consists of 480 scintillator crystals with individual SADC readouts. An additional inner barrel of scintillator strips allows charged particle identification.

Accurate identification of neutral mesons is made by the characterization of electromagnetic showers from decay photons. Multiple particle hits in the BGO calorimeter can lead to overlapping showers, reducing the efficiency in particle identification and accuracy in momentum reconstruction.

An improved algorithm to disentangle overlapping showers with the BGO calorimeter will be presented. The algorithm is tested with both simulated and experimental data.

Supported by DFG (SFB/TR-16).

HK 14.4 Mon 18:00 M/HS4

Background suppression in phoswich detectors — •Anna-Lena Hartig[1], Michael Bendel[2], Guillermo Fernández Martínez[1], Roman Gernhäuser[2], Alexander Ignatov[1], Enrique Nácher[3], Thorsten Kröll[1], Han-Bum Rhee[1], and Olof Tengblad[3] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Physik-Dept. E12, TU München, Germany — [3]CSIC, Madrid, Spain

As part of the R3B set-up, CALIFA is supposed to detect γ-rays as well as light charged particles and will cover the entire target region. While the barrel part is currently assembled, a design for the Endcap was recently proposed. It will be mainly formed out of CsI crystals, whereas the smaller polar angles will be covered by phoswich detectors. These detectors consist of $LaBr_3$(Ce) and $LaCl_3$(Ce) crystals which are optically coupled. A simulation for protons at expected energies makes it possible to apply cuts on the measured kinematics in order to identify significant part of the background stemming from nuclear reactions. The method and the result for the background suppression will be presented for phoswich detectors.

Supported by BMBF under contracts 06DA90240I, 05P12RDFN8, 05P12WOFNF, and by HIC for FAIR.

HK 14.5 Mon 18:15 M/HS4

Aufbau und Betrieb einer Teststation zur Vorkalibration der Detektormodule für die Vorwärtsendkappe des elektromagnetischen Kalorimeters des PANDA - Experimentes — •Matthias Kube, Ulrike Thoma, Christoph Schmidt, Merlin Rossbach und Christoph Wendel für die PANDA-Kollaboration — HISKP, Universität Bonn, Germany

Die Vorwärtsendkappe des im Aufbau befindlichen elektromagnetischen Kalorimeters des PANDA-Experimentes wird aus 3856 $PbWO_4$-II Kristallen bestehen. 16 Kristalle bilden mit ihren Photosensoren,

einer Kohlefaserhaltestruktur und der dazugehörigen Aluminiumhalterung ein Detektorsubmodul. Jedes einzelne der 268 Detektorsubmodule soll vor dem Einbau in die Vorwärtsendkappe einem finalen Funktionstest und einer Vorkalibration mittels Höhenstrahlung unterzogen werden. Dazu wurden zwei Teststationen aufgebaut in denen die Detektorsubmodule unter Experimentbedingungen bei -25°C in einer Klimakammer getestet werden können. Die hierbei verwendeten kompakten Triggerdetektoren bestehen aus Szintillatorplättchen, die in ihrer Größe an die Kristalle angepasst sind und mit SiPMs ausgelesen werden. Die SiPMs bieten hierbei viele Vorteile gegenüber konventionell eingesetzten Photomultipliern, die im Vortrag diskutiert werden. Im Vortrag wird weiterhin auf den Aufbau und Betrieb der Triggerdetektoren, auf die Ergebnisse der durchgeführten Effizienzmessungen sowie auf die ersten Ergebnisse der Detektorsubmodultests eingegangen.

Gefördert durch das BMBF

HK 14.6 Mon 18:30 M/HS4

Das Lichtpulsersystem für das $\bar{P}$ANDA-Kalorimeter — •Patrick Musiol für die PANDA-Kollaboration — Institut für Experimentalphysik 1 — Ruhr-Universität Bochum

Das $\bar{P}$ANDA-Experiment wird an der sich im Bau befindlichen Beschleunigeranlage FAIR am Antiprotonen-Speicherring HESR an der GSI in Darmstadt aufgebaut. Zur Monitorierung der Detektorresponse des mit ca. 16000 Bleiwolframatkristallen bestückten elektromagnetischen Kalorimeters wurde ein Lichtpulsersystem entwickelt. Das System besteht aus drei unterschiedlichen LEDs (blau, rot und grün) um zu unterscheiden, durch welche Komponente (Kristall bzw. Photodetektor und Elektronik) eine Veränderung der Response hevorgerufen wird, wobei die blaue LED Wellenlänge und Pulsform ähnlich dem des Szintillationslichtes von Bleiwolframat erzeugt. Zur Variation der Lichtintensität (entsprechend 10 MeV bis 15 GeV deponierter Energie im Kristall) werden kompakte LCDs der Firma LC-Tec verwendet.
Vorgestellt wird die Funktionsweise des Lichtpulsersystems, Ergebnisse zur Homogenität der Abschwächung und Abschwächungskennlinien der verwendeten LCDs sowie der mechanische Aufbau inkl. Lichtleitfasern.

Gefördert durch das BMBF mit Förderkennzeichen 05P12PCFP5 und das FZ Jülich.

HK 14.7 Mon 18:45 M/HS4

A New Avalanche Photo Diode Based Readout for 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 has proven successful in the measurement of double polarization observables in meson photoproduction off protons and neutrons. To be able to measure purely neutral reactions on 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 is an exchange of the existing PIN photo diode by a new avalanche photo diode (APD) readout. The main advantage of the new readout system is that it will provide timing information which allows a fast trigger signal. The energy resolution will remain compatible to the previous system.

Besides the development of automated test routines for the front end electronics, the characterization of all APDs was successfully accomplished in Bonn. After tests with a 3x3 CsI(Tl) crystal matrix at the tagged photon beam facilities at ELSA and MAMI the first half of the Crystal Barrel was upgraded in 2014. This talk shows the result of the latest test measurements including the gain stabilization of the new APD readout electronics and presents the progress of the ongoing upgrade.

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

HK 15: Heavy Ion Collisions and QCD Phases 2

Time: Monday 17:00–19:00 Location: T/HS1

Group Report HK 15.1 Mon 17:00 T/HS1

Rare hadronic probes from Au+Au collisions at 1.23 AGeV — •Timo Scheib for the HADES-Collaboration — Goethe-Universität Frankfurt

Over the years an extensive amount of data in the 1-2 AGeV energy regime has been collected leading to enormous improvements of our understanding of particle production mechanisms and HIC dynamics. At these beam energies, however, the production of hadrons is observed below or slightly above their free elementary production threshold. Due to this fact a comparison to reference data from elementary collisions is not straightforward and phenomenological models are mandatory.

Through rapidly advancing detector technologies and analysis techniques more and more precise data sets can be recorded and analyzed. In April 2012 HADES took data from Au+Au collisions at 1.23 AGeV with a – for this system size and energy – so far unreached precision and statistics (about 7 billion events). By determining the yields and spectra of a comprehensive set of hadrons produced in this system ($\pi^{+/-}$, $K^{+/-}$, K^0_S, Λ, ϕ) a detailed comparison with phenomenological models can be drawn, allowing to further deepen our understanding of hadron production in HIC.

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

HK 15.2 Mon 17:30 T/HS1

Production of strange particles 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 can provide information about the properties of the hot and dense strongly interacting matter created in ultra-relativistic heavy-ion collisions. Specifically, measurement of strange particles in jets may clarify the role of fragmentation processes in the anomalous baryon to meson ratio at intermediate particle p_{T} that has been observed in Pb–Pb collisions.

In this contribution, measurements of the p_{T} spectra of Λ 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 are presented. The analysis is based on data which was recorded by ALICE at the LHC, exploiting its excellent particle identification capabilities. The baryon/meson ratios of the spectra of strange particles associated with jets are measured in central events in Pb-Pb. A comparison to the ratios obtained for inclusive particles and for particles stemming from the underlying event is shown.

HK 15.3 Mon 17:45 T/HS1

Dynamical K/π, p/π, and K/p fluctuations in Pb-Pb collisions with ALICE — •Mesut Arslandok for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The study of event-by-event fluctuations of identified hadrons may reveal the degrees of freedom of the strongly interacting matter created in heavy-ion collisions and reflect the underlying dynamics of the system. The observable ν_{dyn}, which is given in terms of the moments of identified-particle multiplicity distributions, is used to quantify the magnitude of the dynamical fluctuations in event-by-event measurements of given particle ratios. The ALICE detector at the LHC is well suited for the study of ν_{dyn}, due to its excellent particle identification (PID) capabilities.
Particle identification that is based on the measurement of the specific ionisation energy loss dE/dx works well on a statistical basis, however, suffers from ambiguities when applied on the event-by-event level. A novel experimental technique called the "Identity Method" was recently proposed to overcome such limitations. The method follows a probabilistic approach using the inclusive dE/dx distributions measured in the ALICE TPC, and determines the moments of the multiplicity distributions by an unfolding procedure. In this contribution, dynamical K/π, p/π, and K/p fluctuation analysis that applies the Identity Method to Pb-Pb data from ALICE will be presented.

HK 15.4 Mon 18:00 T/HS1

Charged kaon and ϕ reconstruction in Au+Au-collisions at 1.23 AGeV — •Heidi Schuldes for the HADES-Collaboration — Goethe-Universität Frankfurt

In Au+Au-collisions at 1.23 AGeV incident energy, strangeness is produced below the free nucleon-nucleon threshold. In baryon dominated matter K^+ and K^- mesons exhibit different properties, because K^- can be resonantly absorbed by nucleons.
Although strangeness exchange reactions have been proposed to be the dominant channel for K^- production in this energy regime, the production yield could also be explained in Ar+KCl-reactions at 1.76 AGeV based on a statistical hadronization model fit to the measured particle yields. To guarantee strangeness conservation, strangeness is calculated canonically within R_c in these models, and therefore the ratio of ϕ/K^- is predicted to rise with decreasing beam energies and as a consequence the feed-down of ϕ-mesons to kaons becomes important.
In 2012, 7.3 billion Au(1.23 GeV per nucleon)+Au collisions have been recorded by the HADES detector. In this contribution, we present results on charged kaons and ϕ mesons.
Supported by BMBF (05P12RFGHJ), GSI, HIC for FAIR, HGS-HIRe and H-QM.

HK 15.5 Mon 18:15 T/HS1

Dynamics of K* mesons in heavy-ion collisions — •Andrej Ilner[1,2], Daniel Cabrera[1,2], and Elena Bratkovskaya[1,2] — [1]Institut für theoretische Physik, Johann Wolfgang-Goethe Universität, Frankfurt am Main, Deutschland — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Deutschland

We investigate the dynamics of strange vector resonances (the K* and the anti-K*) in the Parton-Hardon-String Dynamics (PHSD) transport approach. The time evolution of the production of the (anti-)K* resonances in the QGP phase by quark fusion as well as from hadronic sources is presented. We also investigate the effect of final state hadronic interaction (absorption and rescattering) on experimental observables.

HK 15.6 Mon 18:30 T/HS1

Dynamics of strangeness in hot and dense nuclear matter: from hadronic theory to transport — •Daniel Cabrera[1,2], Laura Tolos[2,3], Jörg Aichelin[4], and Elena Bratkovskaya[1,2] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt, 60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies (FIAS), 60438 Frankfurt am Main, Germany — [3]Institut de Ciències de l'Espai (IEEC/CSIC), Campus Universitat Autònoma de Barcelona, Facultat de Ciències, Torre C5, E-08193 Bellaterra, Spain — [4]Subatech, UMR 6457, IN2P3/CNRS, Université de Nantes, École des Mines de Nantes, 4 rue Alfred Kastler, 44307 Nantes cedex 3, France

We present a study of medium effects on the most relevant binary reactions involving strange pseudoscalar mesons close to threshold in heavy-ion collisions at FAIR energies. Our results rely on a self-consistent chiral unitary approach in coupled channels which incorporates the s- and p-waves of the kaon-nucleon interaction including finite temperature and baryonic density effects. Our model provides transition rates and cross sections for reactions such as $\bar{K}N \to \pi\Sigma$, fully off-shell kaon and anti-kaon spectral functions as well as nuclear optical potentials for several hyperon excitations. The latter are essential ingredients to account for within transport simulations of strange hadron dynamics. Additionally, we explore "unconventional" mechanisms for strangeness generation within meson meson and meson baryon interactions and try to give an explanation to puzzling observations in the production of strange hadrons such as ϕ and Ξ.

HK 15.7 Mon 18:45 T/HS1

Measurement of charged jet fragmentation in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE — •Dennis Weiser for the ALICE-Collaboration — Physikalisches Institut, Heidelberg, Deutschland

A Large Ion Collider Experiment (ALICE) is a dedicated heavy-ion experiment at the LHC that is focused on the study of the hot and dense strongly interacting medium created in Pb-Pb collisions, the so-called Quark-Gluon-Plasma (QGP). Prior to the QGP formation hard partons can be created in initial hard scattering processes and form jets by fragmentation into hadrons. Jets can probe the QGP and access its properties via energy loss or, for instance, the modification of jet structure observables.
The measurement of jet structure observables in p-Pb collisions provides an important reference to the measurement in Pb-Pb collisions. To assign possible modifications 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 tracks in charged jets in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV using minimum bias and Transition Radiation Detector (TRD) triggered data. By demanding 3 tracks above 3 GeV/c in any TRD stack an efficient trigger on high p_T jets is realised. Thus the TRD triggered data can be used to extend the range of the measurement towards high p_T.

HK 16: Structure and Dynamics of Nuclei 3

Time: Monday 17:00–19:00 Location: T/HS2

HK 16.1 Mon 17:00 T/HS2

The nuclear structure input to astrophysics — •Nadia Tsoneva[1,2] and Horst Lenske[1] — [1]Institut für Theoretische Physik, Universität Gießen, Heinrich-Buff-Ring 16, D-35392 Gieβen, Germany — [2]Institute for Nuclear Research and Nuclear Energy, 1784 Sofia, Bulgaria

The impact of low-energy multipole excitations and pygmy resonances on radiative neutron and proton capture reactions cross sections in nuclei close to the β-stability line is investigated. For this purpose, a microscopic theoretical approach based on self-consistent density functional theory and QRPA formalism supplemented by multi-phonon degrees of freedom, is implemented in a statistical reaction model. The advantage of the method is the fully microscopic nuclear structure input which incorporates low-energy multiphonon excitations, pygmy resonances and core polarization effects related to giant resonances in a unified way. Of particular interest are the pygmy resonances which are found important for the description of nuclear reaction rates of the nucleosynthesis. Calculations of the cross sections of the reactions ^{85}Kr(n,γ)^{86}Kr, ^{87}Sr(n,γ)^{88}Sr and ^{89}Y(p,γ)^{90}Zr are discussed in comparison with the experiment. For the cross sections of the reactions ^{89}Zr(n,γ)^{90}Zr and ^{91}Mo(n,γ)^{92}Mo theoretical predictions are made.The work is supported by BMBF grant 05P12RGFTE.

HK 16.2 Mon 17:15 T/HS2

Cross section measurements of the elastic electron - deuteron scattering at MAMI — •Yvonne Kohl for the A1-Collaboration — Universität Mainz, Institut für Kernphysik

The electromagnetic form factors of light nuclei provide a sensitive test of our understanding of nuclei. Because the deuteron has spin one, three form factors are needed to fully describe the electromagnetic structure of the deuteron. Especially the deuteron charge radius is a favourite observable to compare experiment and calculation. Recently, an extensive measurement campaign has been performed at MAMI (Mainzer Microtron) to determine the deuteron charge radius using elastic electron scattering - with the aim to halve the error compared to previous such experiments. The experiment took place at the 3-spectrometer facility of the A1-collaboration. Cross section measurements of the elastic electron-deuteron scattering have been performed for 180 different kinematic settings in the low momentum transfer region. From these, the charge form factor can precisely be determined. Fitting the form factor with an appropiate fit function, the radius can then be determined from the slope at zero momentum transfer. The determined radius could then be used as a counterweight to the value obtained from the advanced atomic Lamb shift measurements, thus providing additional insight to the proton radius puzzle.

HK 16.3 Mon 17:30 T/HS2

Yields of hypernuclear fragments in experiments at MAMI — •Florian Schulz, Patrick Achenbach, Konstantin Bob, Anselm Esser, and Josef Pochodzalla — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz

Hypernuclear decay-pion experiments have been performed at the Mainz Microtron MAMI, aimed at the precise measurement of the ground state binding energy of Λ-hypernuclei produced in fragmenta-

tion reactions.

Predictions of the yields of hypernuclear isotopes in this experiments are based on model calculations. Starting with a highly excited state of a Λ-hypernucleus, formed in the electro-production process, the fragmentation is evaluated within a statistical decay model. The excitation energies contributing to the formation of hyperfragments are in the range of 10-50 MeV. The different fragmentation yields and ratios were determined for light target nuclei up to carbon.

By comparing this predictions with the experimentally observed yield ratios, it will be possible to extract information on the initial nucleus and its excitation energy. This can grant a deeper understanding of the whole production process within the model framework.

HK 16.4 Mon 17:45 T/HS2

Antihyperon-Hyperon production in antiproton-proton annihilations with PANDA at FAIR — •Michael Papenbrock for the PANDA-Collaboration — Department of Nuclear Physics and Astronomy, Uppsala University, Uppsala, Sweden

The production of antihyperon-hyperon pairs in antiproton-proton annihilations involves the annihilation of at least one light (u, d) quark-antiquark pair and the creation of a heavier (s, c, b) pair. Production of strange hyperons occur in an energy region in which QCD is difficult to predict. By studying hyperon production we learn about the strong interaction in this energy region, i.e. the confinement domain. It is an open question what the relevant degrees of freedom are: quarks and gluons, or hadrons. Spin observables is an excellent tool in order to better understand the physical processes. These are accessible via the weak, parity violating decay of the hyperon which results in an angular asymmetry of the decay products. The future PANDA experiment at FAIR is going to be ideally suited to study spin physics on hyperons with both high precision and high statistics.

Since hyperons decay weakly and thus have long life-times, their decay vertices are displaced with respect to the production point. This sets high demands on precise track reconstruction. A pattern recognition algorithm is currently under development, with the ability to reconstruct tracks originating in displaced vertices.

Simulation studies done by the Uppsala group as well as the status of the development will be presented and discussed.

HK 16.5 Mon 18:00 T/HS2

Polarization correlations from electron-impact excitation of multipolarity L=3-5 in 208Pb and 89Y nuclei — •Doris Jakubassa-Amundsen — Mathematics Institute, LMU Munich, Germany

The DWBA formalism is used to calculate differential excitation cross sections and to predict spin asymmetries for the scattering of spin-polarized electrons from heavy nuclei. Polarization correlations between the incoming and the scattered electron are a sensitive tool to study the various nuclear models inherent in the transition densities. By selecting the lowest 3- and 5- states of 208Pb it is found that the spin asymmetries for elastic and inelastic electron scattering are comparably large as long as the contribution from the current-current interaction is negligible. The investigation of the 89Y nucleus with its large magnetic transition densities shows, however, a strong quenching of the transverse polarization correlations at backward scattering angles.

HK 16.6 Mon 18:15 T/HS2

Thermodynamics of the symmetry energy and the equation of state of isospin-asymmetric nuclear matter — •Corbinian Wellenhofer[1], Jeremy W. Holt[2], Norbert Kaiser[1], and Wolfram Weise[1,3] — [1]Physik Department, Technische Universität München — [2]Department of Physics, University of Washington, Seattle — [3]ECT*, Villa Tambosi, Trento

Knowledge of the thermodynamic properties of the nuclear symmetry energy is essential for the study of heavy-ion collisions and a multitude of astrophysical phenomena. In this work, we investigate the density and temperature dependence of the symmetry energy using many-body perturbation theory with microscopic chiral nuclear forces. The calculational methods and nuclear force models are benchmarked against empirical constraints for isospin-symmetric nuclear matter and the virial expansion of low-density neutron matter. It is found that whereas the symmetry free energy and entropy both increase uniformly with temperature, the symmetry energy exhibits almost universal behavior.

Moreover, we show results for the equation of state of isospin-asymmetric nuclear matter, obtained from the parabolic approximation. The different thermodynamic instabilities at subsaturation densities are examined, and we construct the equation of state corresponding to an equilibrium liquid-gas phase transition by means of the generalized Maxwell construction for two-component fluids.

This work is supported in part by DFG and NSFC (CRC 110).

HK 16.7 Mon 18:30 T/HS2

High resolution electron scattering on ^{96}Zr — •Christoph Kremer, Sergej Bassauer, Andreas Krugmann, Anna Maria Krumbholz, Norbert Pietralla, Maxim Singer und Peter von Neumann-Cosel — Institut für Kernphysik TU Darmstadt

The low-energy structure of the nucleus ^{96}Zr is interesting for numerous reasons - especially the strong octupole correlation leading to an excitation of the prominent 3^-_1 state with the largest known ground-state transition strength ($B(E3, 3^+_1 \rightarrow 0^+_1) = 57(4) W.u.$) of all nuclei. Even though this nucleus is a good testing ground for nuclear structure theories [1] some low-energy observables are known with insufficient precision. Especially the transitions strenghts of low-lying 2^+ states, which are important for the identification of mixed-symmetry states, have large uncertainties. Electron scattering at low impulse transfer has been shown to be capable of obtaining these $B(E2)$ values with high precision [2]. A ^{96}Zr(e,e') experiment has recently been performed at the superconducting electron linear accelerator S-DALINAC at Darmstadt using the high-resolution LINTOTT spectrometer. The experiment and preliminary results will be presented.

[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)

This work is supported by the DFG under contract SFB 634.

HK 16.8 Mon 18:45 T/HS2

Identifizierung des Proton-Paarungsvibrationszustands in 208Pb — •Andreas Heusler — Gustav-Kirchhoff-Str. 7/1, 69120 Heidelberg

Der Proton-Paarungsvibrationszustands in ^{208}Pb wird bei $E_x = 5667$ keV identifiziert.

Die Kriterien zur Identifzierung beruhen auf Daten aus den Reaktionen ^{208}Pb(p,p') und ^{208}Pb(d,d'), die mit dem Q3D Magnetspektrografen am MLL in Garching gewonnen [1] wurden sowie der Feststellung, dass nur Zustände mit natürlicher Parität bei ^{208}Pb(α, α') angeregt werden.

Nach Rechnungen von Blomqvist el al. [2, 3] ergibt sich aus der Anregungsenergie des 0^+ Zustands bei $E_x = 5667$ keV die Mischungsmatrix der drei ersten angeregten 0^+ Zustände in ^{208}Pb. Der Proton-Paarungsvibrationszustand is demnach zu 90% rein, während der Neutron-Paarungsvibrationszustand und der Doppeloktupol-Vibrationszustand im Verhältnis 1:2 gemischt sind.

[1] A. Heusler, T. Faestermann, R. Hertenberger, H.-F. Wirth, P. von Brentano Phys. Rev. C 89:024322 (2014) [2] J. Blomqvist. Phys. Lett. B33:541 (1970) [3] P. Curutchet, J. Blomqvist, R.J. Liotta, G.G. Dussel, C. Pomar, S.L. Reich Phys. Lett. B208:331 (1988)

HK 17: Structure and Dynamics of Nuclei 4

Time: Monday 17:00–18:45 Location: T/SR14

Group Report HK 17.1 Mon 17:00 T/SR14

Sensitive lifetime measurement of excited states of low-abundant isotopes via the (p,p′γ) reaction — •Andreas Hennig[1], Vera Derya[1], Milena N. Mineva[2], Pavel Petkov[1,2], Simon G. Pickstone[1], Mark Spieker[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]INRNE, Bulgarian Academy of Sciences, Sofia

Absolute transition matrix elements are valuable observables in

nuclear-structure physics since they are directly related to the nuclear wave functions. A key ingredient to determine transition matrix elements is the measurement of lifetimes of excited states. In a recent experiment, we extracted the lifetimes of 30 excited states of the low-abundant isotope ^{96}Ru utilizing the Doppler-shift attenuation method (DSAM) in an inelastic proton-scattering experiment and taking advantage of the proton-γ coincidence technique [1]. In contrast to the DSAM technique following inelastic neutron scattering [2], which was frequently performed to extract comprehensive lifetime information in the sub-picosecond regime, the (p,p$'\gamma$) reaction requires a much less amount of target material and is thus especially suited to investigate low-abundant isotopes. In this contribution, the (p,p$'\gamma$) method for lifetime measurements is presented and the results of recent experiments on ^{96}Ru, ^{94}Zr, and ^{112,114}Sn are shown. Supported by the DFG (ZI-510/4-2) and the Bulgarian Science Fund (DFNI-E 01/2).

[1] A. Hennig *et al.*, Phys. Rev. C **90** (2014) 051302(R)
[2] T. Belgya *et al.*, Nucl. Phys. A **607** (1996) 43

HK 17.2 Mon 17:30 T/SR14

Lifetime measurements of N = Z nuclei ^{44}Ti, ^{48}Cr and ^{52}Fe — •Konrad Arnswald, Michael Seidlitz, Andreas Vogt, Peter Reiter, Benedikt Birkenbach, Andrey Blazhev, Thomas Braunroth, Alfred Dewald, Christoph Fransen, Bo Fu, Andreas Hennig, Rouven Hirsch, Lars Lewandowski, Julia Litzinger, Claus Müller-Gatermann, Dawid Rosiak, Nima Saed-Samii, David Schneiders, Burkhard Siebeck, Tim Steinbach, Kai Wolf, and Karl-Oskar Zell — Institut für Kernphysik, Universität zu Köln

Reduced transition strengths expressed with $B(E2)$ values are good signatures to describe collective excitations of atomic nuclei and are indispensable to understand nuclear shell structures. Along the $N = Z$ line in the *pf* shell they provide stringent tests of recent shell model interactions, e.g. [1]. So far, $B(E2, 2_1^+ \rightarrow 0_1^+)$ 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 for the $2_1^+ \rightarrow 0_1^+$ transition. Excited states in the nuclei of interest were populated with fusion-evaporation reactions. γ rays were detected by an array of 12 HPGe detectors, positioned at favourable forward and backward angles with respect to the beam axis. First results on ^{44}Ti, ^{48}Cr and ^{52}Fe will be presented.

[1] S. M. Lenzi, F. Nowacki, A. Poves, and K. Sieja, Phys. Rev. C 82, 054301 (2010).

HK 17.3 Mon 17:45 T/SR14

Combined analysis of Coulex and lifetime measurements: Neutron-rich Xe isotopes — •Corinna Henrich, Stoyanka Ilieva, Thorsten Kröll, and Sabine Bönig — 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 of the nuclear structure in this region, we studied the even-even neutron-rich $^{138-142}$Xe isotopes. Two experiments were carried out. "Safe" Coulomb excitation was done at REX-ISOLDE (CERN, Geneva) using the MINIBALL spectrometer (IS411 campaign). In addition, picosecond lifetimes of excited states, populated following the neutron-induced fission of ^{235}U and ^{241}Pu, were directly measured at the experimental reactor of ILL (Grenoble) using the EXILL&FATIMA spectrometer. The obtained lifetimes can be used for a more comprehensive analysis of the data available from the Coulex experiment. Therefore, not only the B(E2) transition probability can be determined, but also the quadrupole moments of the 2^+ excited states, which are otherwise not accessible for short-lived states. Thus, the evolution of quadrupole collectivity above Z=50 and N=82 is studied and the results are compared with the predictions by several theoretical models.

Supported by BMBF under contracts 06DA9036I, 05P12RDCIA and 05P12RDNUP, by the EU under contracts EURONS 506065 and ENSAR 262010, by ILL and by HIC for FAIR.

HK 17.4 Mon 18:00 T/SR14

Fast-Timing Lebensdauermessung von ^{152}Gd — •Johannes Wiederhold[1], Norbert Pietralla[1], Volker Werner[1], Cesar Lizarazo[1], Ralf Kern[1], Nicu Marginean[2], Dan Gabriel Ghita[2], Raluca Marginean[2], Cristina Roxana Nita[2], Razvan Lica[2], Nicoleta Florea[2], Sorin Gabriel Pascu[2], Dorel Bucurescu[2], Dan Mihai Filipescu[2], Constantin Mihai[2] und Radu Mihai[2] — [1]Institut für Kernphysik, TU-Darmstadt, Deutschland — [2]IFIN-HH, Bucharest, Rumänien

Am 9MV Tandem Beschleuniger des IFIN-HH bei Bukarest wurde eine Lebensdauermessung an ^{152}Gd mittels der Fast-Electronics-Scintillation-Timing (FEST) Methode durchgeführt. Angeregte Zustände von ^{152}Gd wurden mittels der ^{149}Sm(α,n)-Reaktion bevölkert. Von besonderem Interesse für eine Beschreibung des Formphasenübergangs in den Gadolinium-Isotopen ist die Lebensdauer des ersten angeregten 0^+-Zustands von ^{152}Gd. Darüberhinaus dienen die Daten einem Test einer theoretisch erwarteten Relation zwischen M1- und E2-Übergangsstärken. Für die Bestimmung von Lebensdauern wurden zunächst die Energien und Zeiten der 11 verwendeten Cerium dotierten Lanthanbromid ($LaBr_3$(Ce))- und 15 hochreinen Germanium (HPGe)-Detektoren mit einer ^{152}Eu-Quelle kalibriert. Im Anschluss wurden Time-Walk-Korrekturen für die $LaBr_3$-Detektoren durchgeführt. Lebensdauern des ersten angeregten 2^+-Zustands von ^{152}Sm und des ersten angeregten 0^+-Zustands von ^{152}Gd konnten bestimmt werden. Diese Arbeit wurde im Rahmen des SFB 634 der DFG gefördert.

HK 17.5 Mon 18:15 T/SR14

Messung von reduzierten Übergangsstärken aus Zustands-Lebensdauern in $^{82,84,(86)}$Se — •Julia Litzinger für die KÖLN-LNL-Kollaboration — Institut für Kernphysik, Köln

Die Ermittlung von reduzierten Übergangsstärken aus Zustandslebensdauern in neutronenreichen $^{82,84,(86)}$Se-Isotopen erlaubt Rückschlüsse über die Kernstruktur sowie die Entwicklung der Kollektivität im Bereich des N=50 Neutronenschalenabschluss. Während bei den magischen Kernen der N=50 Isotonenkette Einteilchenanregungen dominieren, spielen in Nachbarkernen bereits kollektive Effekte eine Rolle. Zur näheren Untersuchung der Kernstrukturen dieser Region wurde ein Recoil Distance Doppler Shift Experiment am LNL, Italien durchgeführt. Mit einem 577MeV ^{82}Se Strahl auf einem ^{238}U-Target konnten über tief-inelastische Kernreaktionen angeregte Zustände von oben genannten Selen-Isotopen erzeugt werden. Der Aufbau kombinierte einen Kölner-Plunger für die RDDS-Technik, den PRISMA-Fragmentseparator für eine event-by-event Teilchenidentifikation, sowie den AGATA-Demonstrator für eine effiziente Messung der γ-Strahlung. In 6 Tagen Strahlzeit wurden γ-Spektren bei drei Abständen zwischen Target und Degrader gemessen. Es konnten Zustände bis Spin 8^+ beobachtet und deren Niveaulebensdauer bestimmt werden. Die Mess- und Auswertemethode sowie vorläufige Ergebnisse für die Kerne ^{82,84}Se werden vorgestellt und im Fall von ^{84}Se im Rahmen von Schalenmodellrechnungen diskutiert. Teilweise gefördert durch die DFG: DE1516/3-1 und die EU: ENSAR.

HK 17.6 Mon 18:30 T/SR14

Bestimmung der Lebensdauern von angeregten Zuständen der Grundzustandsbande von ^{128}Ce — •Johann Reinhard[1], Volker Werner[1,2], C. Zhou[2], Norbert Pietralla[1], T. Ahn[2], C. Bernards[2,4], N. Cooper[2], M. Hinton[1,3], G. Ilie[2], O. Möller[1], T. Thomas[2,4] und E. Willams[2] — [1]TU Darmstadt — [2]Yale University — [3]University of Surrey — [4]Universität zu Köln

In einem Recoil Distance Doppler Shift (RDDS) Experiment am ESTU Tandem Beschleuniger des Wright Nuclear Structure Laboratory der Yale University wurden die Lebensdauern der angeregten J = 2^+ bis 10^+ Zustände der Grundzustandsbande bestimmt. Die γ-Zefälle der bei einer Energie von 85 MeV durch die Reaktion ^{116}Sn(^{16}O,4n)^{128}Ce bevölkerten angeregten Zustände wurden durch zwei Detektoren unter 45.5 und 134.5^o registriert und die Lebensdauern mittels der Differential Decay Curve Method (DDCM) bestimmt. Dopplerverschobene und -unverschobene γ-Quanten aus den ^{128}Ce Kernen, die eine Geschwindigkeit von $v/c = 0.01$ aufwiesen, wurden bei 15 Abständen von 7 bis 3200 μm zwischen der ^{116}Sn Target- und der ^{197}Au Stopperfolie gemessen. ^{128}Ce liegt mit einem sogenannten P-Faktor von $(N_p N_n)/(N_p + N_n) = 4.8$ möglicherweise am Phasenübergang von spärischen zu wohldeformierten Kernen. Die aus den Lebensdauern bestimmten B(E2) Übergangsstärken werden in diesem Zusammenhang mit den Vorhersagen des Confined Beta Soft (CBS) Modells verglichen. Gefördert unter U.S.DOE Grant No. DE-FG02-91ER40609 und DFG Grant SFB 634.

HK 18: Hadron Structure and Spectroscopy 3

Time: Monday 17:00–18:45 Location: T/SR19

Group Report HK 18.1 Mon 17:00 T/SR19

Status of the GPD program @ COMPASS II — •Matthias Gorzellik, Horst Fischer, Philipp Jörg, Kay Königsmann, Steffen Landgraf, Christopher Regali, Katharina Schmidt, Stefan Sirtl, Tobias Szameitat, and Johannes ter Wolbeek — for the COMPASS collaboration, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

The COMPASS-II experiment is a fixed target experiment situated at CERN. A tertiary myon beam from the SPS scattered of protons from a liquid hydrogen target is used to measure Deeply Virtual Compton Scattering (DVCS) and Hard Exclusive Meson Production (HEMP).

Both processes open a unique window to constrain Generalized Parton Distributions, which are related to the total angular momentum of quarks, antiquarks and gluons in the nucleon. An upgrade of the previous experiment was started in 2012. The major parts of the upgrade for the measurement of exclusive reactions are the recoil proton detector (CAMERA) and an additional Electromagnetic Calorimeter.

The close to final setup allows for a measurement of exclusive reactions with very low cross sections in a wide kinematic range. A pilot run, covering five weeks of data taking, was performed at the end of 2012. In this talk we will present first results from the analysis.

Supported by BMBF and EU FP7 (Grant Agreement 283286).

HK 18.2 Mon 17:30 T/SR19

Eperimental 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] — [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 "measured" cross sections with the simulations are used to test QCD factorization at the leading order by measuring scaling laws and fitting angular distributions.

HK 18.3 Mon 17:45 T/SR19

Odd moments of nucleon charge and magnetization distribution in ChPT — •Nadiia Krupina and Vladimir Pascalutsa — Institut für Kernphysik, JGU Mainz

We consider the predictions of Chiral Perturbation Theory (ChPT) for the third Zemach moment and Zemach radius and confront them with empirical values. We look at implications of these results for the Lamb shift and hyperfine structure of (muonic) hydrogen.

HK 18.4 Mon 18:00 T/SR19

Measuring the proton form factor at very low Q^2 — •Adrian Weber — Institut für Kernphysik, Johannes Gutenberg Universität Mainz

The proton is a fundamental constituent of matter. Yet the determination of its radius via interaction with electrons and muons seems to yield different radii leading to the so called proton radius puzzle.

To bring new insight into the observed discrepancy a novel electron scattering experiment at MAMI (Mainz Microtron) was performed aiming to determine the electric form factor of the proton at Q^2 as low as $1-3\cdot10^{-4}(GeV/c)^2$, by using a method based on initial state radiation. The goal of the experiment is to obtain the electric form factor with an accuracy of 1% and extract a new value for the proton charge radius. In this presentation a brief overview of the experiment will be presented together with the underlying theory. Then the present status of the analysis and preliminary results will be discussed.

HK 18.5 Mon 18:15 T/SR19

Measurement of the $e^+e^- \to \bar{p}p$ cross section at BESIII using the untagged-initial state radiation technique — •Christoph Rosner[1], Samer Ali Nasher Ahmed[1], Alaa Dbeyssi[1], Paul Larin[1], Dexu Lin[1], Frank Maas[1,2,3], and Cristina Morales[1] — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

Electromagnetic form factors are fundamental quantities which describe the structure and the internal dynamics of hadrons. In the timelike region, proton form factors are experimentally accessible through the $e^+ + e^- \leftrightarrow \bar{p} + p$ channels. 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 $e^+ + e^- \to \bar{p} + p + \gamma$ analysis for proton form factor measurements at the Beijing Spectrometer III (BESIII/BEPC-II). The case of untagged ISR photon is presented. Monte Carlo simulations for signal and background processes at center of mass energies 4.23, 4.26 and 4.36 GeV, are described.

HK 18.6 Mon 18:30 T/SR19

Search for polarization effects in the antiproton production process — •Dieter Grzonka — Forschungszentrum Jülich GmbH, 52425 Jülich, Germany

for the P349 collaboration

Polarized antiproton beams would allow more detailed studied in various topics of low and high energy antiproton physics experiments. There are a number of proposals how polarized antiprotons could be produced but mostly the expected intensity or polarization is very low or feasibility studies would require an enormous effort. A rather simple method for the preparation of a polarized antiproton beam would be the production process itself if it creates some polarization. In order to investigate polarization effects in the antiproton production process the angular distribution of elastically scattered antiprotons is measured which are produced in the interaction of the 24 GeV/c PS proton beam at CERN with a solid target. The measurement is done in the CNI region at small forward scattering angles for which the analyzing power is rather well known by reconstructing the tracks of primary and scattered antiprotons. The experimental setup will be presented and preliminary results will be shown.

HK 19: Hadron Structure and Spectroscopy 4

Time: Monday 17:00–19:00 Location: T/SR25

Group Report HK 19.1 Mon 17:00 T/SR25

Precision Hadron Spectroscopy at COMPASS — •Alexander Austregesilo — Physik-Department E18, Techische Universität München

COMPASS is a fixed-target experiment at the CERN SPS, investigating the structure and the dynamics of hadrons. The experimental setup features a modern spectrometer with acceptance over a wide kinematic range and precise momentum resolution for charged-track reconstruction. Furthermore, particle identification and calorimetry make it an ideal tool to access a broad range of final states. In 2008 and 2009, a world leading data set was recorded with 190 GeV/c hadron beams impinging on a liquid hydrogen target.

Precision studies of the light-quark meson spectrum are pursued by the means of partial-wave analysis. As additional input, the dependence of the partial waves on the squared four-momentum transfer t is used to differentiate between resonant and non-resonant contributions.

Furthermore, a novel method to extract information about the $\pi^+\pi^-$ subsystem in multi-pion final states was developed. We will present selected results on exotic mesons and glueball candidates formed in diffractive dissociation and central production reactions.

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

Group Report HK 19.2 Mon 17:30 T/SR25

Circularly polarized photons at the BGO-OD experiment* — •Thomas Zimmermann for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment, presently starting data taking at the electron accelerator ELSA at the University of Bonn, is intended for the systematic investigation of the photo-production of mesons and the structure and dynamics of nucleon excitations. To disentangle the different contributions to the measured observables, linearly and circularly polarized photons are used.

This talk describes the production of circularly polarized photons at the BGO-OD experiment and how the degree of polarization is determined using a Møller polarimeter. First results using circular polarization will be presented.

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

HK 19.3 Mon 18:00 T/SR25

Measuring two-hadron azimuthal asymmetries on a longitudinally polarized proton target — •Stefan Sirtl, Horst Fischer, Matthias Gorzellik, Philipp Jörg, Kay Königsmann, Steffen Landgraf, Christopher Regali, Katharina Schmidt, Tobias Szameitat, and Johannes ter Wolbeek — for the COMPASS collaboration, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

In recent years, measuring azimuthal asymmetries on polarized targets emerged as a powerful tool to investigate the nucleon spin structure, one of the main goals of the COMPASS physics program. COMPASS is a fixed target experiment, located at the SPS/CERN and is characterized by a two-stage spectrometer with large acceptance and excellent particle identification. By scattering a tertiary longitudinally polarized μ^+ beam on a transversely or longitudinally polarized ammonia target, it suits the experimental requirements for asymmetry measurements. Two-hadron azimuthal asymmetries were already studied at COMPASS using transversely polarized protons. In this talk we present first measurements of two-hadron azimuthal asymmetries scattering a 160 GeV/c, respectively 200 GeV/c, μ^+ beam off longitudinally polarized protons. Supported by BMBF, DFG and EU FP7 (Grant Agreement 283286).

HK 19.4 Mon 18:15 T/SR25

Modifications of the $D_{33}(1700)$ resonance in the nuclear medium — •Vahe Sokhoyan for the A2-Collaboration — Institut für Kernphysik, Universität Mainz

Despite the progress in particle and nuclear physics, the origin of the mass being a fundamental property of matter is not fully understood. The modification of the mass and lifetime of hadrons in the nuclear medium is an important aspect which concerns the origin of the mass directly. At the MAMI accelerator facility in Mainz the modifications of the $D_{33}(1700)$ resonance will be studied in the reaction $\gamma p \to p\pi^0\eta$ close to the production threshold where the dominance of this resonance is established. The new approach to study in-medium modifications of baryon resonances by the determination of polarization observables in addition to unpolarized cross-sections will be discussed in this talk. The measurements will be performed with circularly polarized photons and a set of different targets (^{12}C, ^{40}Ca, ^{93}Nb and ^{208}Pb) using the Crystal Ball/TAPS 4π spectrometer setup.
This work is supported by the Carl-Zeiss-Stiftung.

HK 19.5 Mon 18:30 T/SR25

Spectroscopy of final states with neutral particles in COMPASS — •Sebastian Uhl[1] and COMPASS Collaboration[2] — [1]Technische Universität München — [2]CERN

In order to study the spectrum of light hadrons, the COMPASS experiment at CERN has collected a huge data set with a negative pion beam impinging on a liquid hydrogen target. Resonances are diffractively produced at squared four-momentum transfers to the target between 0.1 and 1 $(\mathrm{GeV}/c)^2$. The two-stage magnetic spectrometer with two electromagnetic calorimeters allows to study in particular channels with neutral particles in the final states. We will report on recent results.

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 19.6 Mon 18:45 T/SR25

On the nature of the $a_1(1420)$ — •Mikhail Mikhasenko, Bernhard Ketzer, and Andrey Sarantsev — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The resonance-like signal with axial-vector quantum numbers in the $f_0(980)\pi$ system, recently observed by the COMPASS and VES experiments at a mass of 1420 MeV, is discussed. We interpret it as a "pseudo resonance" due to a logarithmic singularity arising in the reaction $a_1^-(1260) \to K^{\star-}K^0 + K^{\star 0}K^- \to f_0(980)\pi^-$. The triangle diagram corresponding to this process is calculated. The structure of the imaginary part of the amplitude is investigated by employing the Cutkosky cutting rules. The result exhibits a peak in the intensity of the $a_1(1260) \to f_0\pi$ P-wave with a sharp phase motion with respect to the dominant $\rho\pi$ S-wave decay, in good agreement with data. The branching ratio for the decay of $a_1(1260) \to f_0(980)\pi$ is estimated and compared to the $a_1(1260) \to \rho\pi$ decay.

HK 20: Invited Talks 2

Time: Tuesday 11:00–13:00 Location: T/HS1

Invited Talk HK 20.1 Tue 11:00 T/HS1

Cold nuclear matter effects studied in p-Pb collisions at the LHC — •Alberica Toia — Goethe University Frankfurt — GSI Darmstadt

The properties of strongly interacting matter at extreme conditions of temperature and energy densities are studied with heavy ion collisions at LHC. While the comparison of measurements performed in Pb-Pb collisions with the same measurements in proton-proton collisions had been quite successful, proton-nucleus collisions provide a reference to disentangle signatures of the formation of a deconfined hot medium, from those already present in cold nuclear matter, due to the complex structure of the colliding nuclei.

While most of the benchmarks from the control experiment indicate that initial state effects do not play a role in the observed suppression of hadron production observed in heavy ion collisions, several measurements of particle production in the low and intermediate momentum region indicate the presence of coherent and collective effects.

This presentation reviews in details the experimental results in ultra-relativistic p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV obtained recently at the CERN LHC, with special emphasis on the discovered collective phenomena compared with the measurements in p-p and Pb-Pb collisions at similar energies.

Invited Talk HK 20.2 Tue 11:40 T/HS1

Messungen mit den schwersten Kernen und weitere interessante neue Resultate — •Kirill Lapidus for the HADES-Collaboration — Physik-Department E12, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Deutschland — Exzellenzcluster Universe, Boltzmannstr. 2, 85748 Garching, Deutschland

HADES is a fixed-target experiment located at the GSI Helmholtzzentrum für Schwerionenforschung and operating at the SIS18 accelerator in the range of beam energies of 1-2 GeV/u for nucleus-nucleus collisions, up to 3.5 GeV in proton-induced reactions. HADES explores properties of the strongly-interacting matter in the regime of high baryonic densities and moderate temperatures, as probed in heavy ion reactions. Besides, proton- and pion-nucleus collisions are studied in order to quantify the effects of cold nuclear matter. Two pillars of the HADES physics programme are di-electron and strangeness measurements. The talk will be devoted to the fresh results harvested

by HADES in the recent years. A heavy-ion run with Au+Au collisions at 1.23 GeV/u has been accomplished in 2012 and a number of interesting analyses both in the dilepton and in strange sectors will be discussed. In 2014 HADES measured particles produced in pion-induced reactions, employing light (carbon, polyethylene) and heavy (tungsten) nuclear targets. Of special interest here is the in-medium behaviour of strange hadrons and the physics of nucleon resonances. First results from this beam time will be presented as well. Supported by BMBF 05P12WOGHH and the Excellence Cluster "Universe".

Invited Talk HK 20.3 Tue 12:20 T/HS1
Pygmy Dipole Resonances - Status and Perspectives — •Vera Derya — Institute for Nuclear Physics, University of Cologne

The so-called pygmy dipole resonance (PDR) appears as a concentration of $E1$ strength below the well-known isovector giant dipole resonance and was observed in medium-heavy and heavy neutron-rich nuclei [1]. Growing interest in the PDR is driven by its implications for fundamental questions concerning, e.g., the equation of state of nuclear matter under isospin asymmetric conditions as present in neutron stars, the origin and abundance of the elements in the universe, and isospin symmetry breaking. To approach a comprehensive understanding of the structure of the PDR throughout the nuclear landscape, different experimental techniques are applied using complementary probes on stable and unstable nuclei. An overview of recent results and future perspectives will be presented.

Supported by the DFG (ZI 510/4-2) and EURONS.

[1] D. Savran, T. Aumann, and A. Zilges, Prog. Part. Nucl. Phys. 70 (2013) 210.

HK 21: Instrumentation 7

Time: Tuesday 14:30–16:30 Location: M/HS1

Group Report HK 21.1 Tue 14:30 M/HS1
Der PANDA-Luminositätsdetektor — •Christof Motzko[1,2], Miriam Fritsch[1,2], Florian Feldbauer[1,2], Prometeusz Jasinski[1,2], Anastasia Karavdina[2], Roman Klasen[1,2], Heinrich Leithoff[1,2], Stephan Maldaner[1,2], Mathias Michel[1,2], Stefan Pflüger[1,2] und Tobias Weber[1,2] für die PANDA-Kollaboration — [1]Helmholtz-Institut Mainz — [2]Johannes-Gutenberg Universität Mainz

Das PANDA-Experiment, welches im Antiproton-Speicherring HESR an der Beschleunigeranlage FAIR in Darmstadt stehen wird, ist für Fragen der Hadronenphysik optimiert. Mit dieser Anlage wird es möglich sein, neue Zustände zu entdecken und die Linienform dieser wie auch bereits bekannter Zustände sehr präzise zu vermessen. Zur Normierung der dafür verwendeten Energie-Scan-Messungen wird die Kenntnis der Luminosität benötigt.

Die Luminosität wird bei PANDA anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung bestimmt. Zur Minimierung der Unsicherheit in der Bestimmung der Luminosität durch Kleinwinkelstreuung und Modellannahmen werden die 4 Sensorebenen des Luminositätsdetektor 11 m strahlabwärts vom Wechselwirkungspunkt nahe der Strahlachse (Polarwinkelbereich 3-8 mrad) im Vakuum platziert. Die Ebenen sind verfahrbar montiert und mit HV-MAPS bestückt, die auf hochwärmeleitenden CVD-Diamantscheiben aufgebracht werden. Angestrebt ist eine absolute Messgenauigkeit von 3 %. Das Konzept des Luminositätsdetektors wird vorgestellt und dabei technische Aspekte wie Vakuumsystem, Kühlung und Elektronik diskutiert.

HK 21.2 Tue 15:00 M/HS1
Quality Assurance of double-sided silicon microstrip sensors for the Silicon Tracking System in the CBM experiment at FAIR — •Pavel Larionov for the CBM-Collaboration — Goethe Universität, Frankfurt

The Silicon Tracking System (STS) is the core tracking detector of the CBM experiment at FAIR. The system's task is to reconstruct the trajectories of the charged particles produced in the beam-target interactions, provide their momentum determination, and enable the detection of decay topologies. The STS will comprise 1220 double-sided silicon microstrip sensors. After production each sensor will go through a number of Quality Assurance procedures to verify their validity for performance in the STS and also to confirm the manufacturer's data. In this talk, results of the quality assurance procedures that are being applied to the latest STS prototype sensors, including detailed tests of the quality of each single strip, long-term stability and preparations for volume tests during series production, will be presented. Supported by HIC for FAIR, HGS-HIRe and H-QM.

HK 21.3 Tue 15:15 M/HS1
Characterization of silicon micro-strip sensors with a pulsed infra-red laser system for the CBM experiment at FAIR — •Pradeep Ghosh[1,2] and Jürgen Eschke[2,3] for the CBM-Collaboration — [1]Goethe University, Frankfurt am Main — [2]GSI Helmholtz Center for Heavy Ion Research GmbH, Darmstadt — [3]Facility for Anti-proton and Ion Research, GmbH, Darmstadt

The Silicon Tracking System (STS) of the CBM experiment at FAIR is composed of 8 tracking stations comprising of 1292 double-sided silicon micro-strip sensors. A Laser Test System (LTS) has been developed for the quality assurance of prototype sensors. The aim is to scan sensors with a pulsed infra-red laser driven by step motor to determine the charge sharing in-between strips and to measure qualitative uniformity of the sensor response over the whole active area. Several prototype sensors with strip pitch of 50 and 58 μm have been tested, as well as a prototype module with realistic mechanical arrangement of sensor and read-out cables. The LTS is designed to measure sensor response in an automatized procedure across the sensor with focused laser beam (spot-size $\approx$ 12 μm , wavelength = 1060 nm). The pulse with duration ($\approx$ 10 ns) and power ($\approx$ 5 mW) of the laser pulses is selected such, that the absorption of the laser light in the 300 μm thick silicon sensors produces a number of about 24000 electrons, which is similar to the charge created by minimum ionizing particles (MIP) in these sensors. Results from laser scans of prototype sensors and detector module will be reported.

The work is supported by HGS-HIRe, H-QM and HIC-for-FAIR.

HK 21.4 Tue 15:30 M/HS1
Radiation hardness of CMOS Monolithic Active Pixel Sensors manufactured in a 0.18 μm CMOS process* — •Benjamin Linnik for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

CMOS Monolithic Active Pixels Sensors (MAPS) are considered as the technology of choice for various vertex detectors in particle and heavy-ion physics including the STAR HFT, the upgrade of the ALICE ITS, the future ILC detectors and the CBM experiment at FAIR.
To match the requirements of those detectors, their hardness to radiation is being improved, among others in a joined research activity of the Goethe University Frankfurt and the IPHC Strasbourg.
It was assumed that combining an improved high resistivity ($1-8$ kΩcm) sensitive medium with the features of a 0.18 μm CMOS process, is suited to reach substantial improvements in terms of radiation hardness as compared to earlier sensor designs. This strategy was tested with a novel generation of sensor prototypes named MIMOSA-32 and MIMOSA-34. We show results on the radiation hardness of those sensors and discuss its impact on the design of future vertex detectors.
*This work has been supported by BMBF (05P12RFFC7), GSI, HGS-HIRe and HIC for FAIR.

HK 21.5 Tue 15:45 M/HS1
Next generation digitizer for CMOS MAPS — •Philipp Sitzmann für die CBM-MVD-Kollaboration — Goethe-Universtiät Frankfurt

Mit Hilfe des CBM-Experiment an der FAIR Beschleunigeranlage in Darmstadt soll hadronische Materie bei hohen Nettobaryonendicht untersucht werden. Hierzu sollen seltene Sonden wie Open-Charm und Di-Leptonen zum Einsatz kommen. Der Micro-Vertex-Detektor (MVD) von CBM soll den den kombinatorischen Hintergrund für bei der Rekonstruktion dieser Teilchen reduzieren. Die Simulationssoftware für den MVD und die ihm zugrunde liegenden CMOS Monolithic Active Pixel Sensoren wird kontinuierlich verbessert, um einen Test der zu entwickelnden Datenanalyse-Algorithmen zu ermöglichen und die Konsequenzen von Designentscheidungen abzuschätzen. Hierzu wurde ein sehr modularers Softwarepaket entwickelt, welches die

Eigenschaften der Sensoren sowie des MVD im Detail darstellt und mit geringem Aufwand an die Fortschritte der Sensor- und Detektorentwicklung angepasst werden kann. Das Modell und erste Ergebnisse werden vorgestellt und diskutiert.

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

HK 21.6 Tue 16:00 M/HS1

Mosaic diamond based detector for MIPs detection, T0 determination and triggering in HADES. — Jerzy Pietraszko and •Wolfgang Koenig for the HADES-Collaboration — GSI Helmholtzzentum für Schwerionenforschung GmbH, Darmstadt

The CVD based diamond detectors were successfully used for HI detection in HADES already in 2001. In the following experiments the polycrystalline diamond material showed very good performance (time resolution below 50 ps sigma) and stable long term operation.

Detection of the minimum ionising particles (MIPs) by means of the diamond detectors is a challenging task mainly because of very small energy deposit in the diamond material. In this case the single crystalline CVD diamond material has to be used which is well known for its excellent charge collection efficiency (almost 100 %) and for its very good timing properties. For pion induced experiments at HADES a large area, segmented, position sensitive, operated in vacuum detector was developed. The construction of the detector will be presented along with the requirements and the obtained performance.

*This work has been supported by BMBF (06 FY 9100 I), HIC for FAIR, EMMI and GSI

HK 21.7 Tue 16:15 M/HS1

A tracking system for a secondary pion beam at the HADES spectrometer — •Joana Wirth[1,2], Laura Fabbietti[1,2], Rafal Lalik[1,2], and Ludwig Maier[1] for the HADES-Collaboration — [1]Physik Deparment of the TUM (E12), Garching — [2]Exellence Cluster "Universe", Garching

For the secondary pion beam campaign with the HADES spectrometer at GSI, Darmstadt, a beam tracking system has been developed, in order to achieve the momentum measurement of each individual pion with a momentum resolution below 0.5%. A primary Nitrogen beam impacting on a Beryllium production target produces a secondary pion beam strongly defocused in position and momentum, which is transported along the chicane to the experimental area. The overall spread in momentum is only limited by the beamline acceptance, leading to momentum offsets up to 8% of the central beam momentum.

The system is based on two tracking stations consisting each of a double-sided silicon strip detector read out by the self-triggered n-XYTER ASCI chip, completed by the TRB3 board on which the trigger logic is implemented.

In this talk we are showing the performance of our beam detectors during the proton test beam of 1.9 GeV in the terms of the momentum reconstruction of known momentum, set by the accelerator, as well as the recent result accomplished throughout the pion beam campaign.

* supported by BMBF 05P12WOGHH and Excellence Cluster "Universe"

HK 22: Instrumentation 8

Time: Tuesday 14:30–16:30 Location: M/HS2

HK 22.1 Tue 14:30 M/HS2

Development of GEM-based readout chambers for the upgrade of the ALICE TPC — •Alexander Deisting for the ALICE-Collaboration — Universität Heidelberg/Gesellschaft für Schwerionenforschung GmbH

The ALICE experiment at the LHC is designed to examine lead-lead (Pb-Pb) collisions in order to probe genuine multi-particle aspects of QCD. Its main tracking detector is a time projection chamber (TPC), being equipped with a multi wire proportional chamber (MWPC) based readout. Since the rate in Pb-Pb collisions will increase to up to 50kHz in LHC Run3 it is necessary to adapt the TPC to this new environment. A change from the current measurement mode with a gating grid and MWPCs to a continuous readout with new readout chambers is hence forseen.

To match the requirements for Run3 the new chambers should be able to cope with the higher rates and thereby preserve the momentum and $\mathrm{d}E/\mathrm{d}x$ resolution of the current chambers. In addition the ion back flow (IBF) from the amplification stage into the drift volume should be less then 1%. A solution has been found based on 4 gas electron multiplier foils (GEMs) stacked onto each other.

Extensive R&D studies of 4 GEM stacks were performed. In this talk different experimental setups to examine the performance of quadruple GEM stacks in terms of IBF, energy resolution and $\mathrm{d}E/\mathrm{d}x$ will be presented. Emphasis will be put on the simultaneous optimisation of the energy resolution and the IBF while studying different kinds of GEM foils in a stack.

HK 22.2 Tue 14:45 M/HS2

Spatial Resolution Studies of a GEM-TPC.* — •Martin Berger for the GEM-TPC-Collaboration — TU München, 85748 Garching, Germany

A GEM-TPC can exploit the intrinsic suppression of back drifting ions from the amplification stage of the GEM (Gas Electron Multiplier) foils to overcome the problem of drift-field distortions in an ungated operation. To explore the possibility of such a continuously running TPC (Time Projection Chamber) a large-size detector was built. This detector, with a drift length of 728 mm and a radius of 308 mm and a total of 10254 electronic channels, was designed as an upgrade for the FOPI experiment at GSI (Darmstadt, Germany) to improve the secondary vertex resolution especially for K^0_S- and Λ-reconstruction and the PID capabilities. After commissioning a large statistics of cosmic data and beam-target reactions has been collected [1] 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 the clustering algorithm, the cluster error calculation and the tracking resolution will be discussed in this contribution.

[1]L. Fabbietti et al., Nucl. Instr. and Meth. A, 628 204-208 (2011)

*Supported by BMBF, TUM Graduate School and Excellence Cluster “Universe”.

HK 22.3 Tue 15:00 M/HS2

Energy resolution studies of an IROC GEM prototype for the ALICE TPC — •Andreas Mathis for the ALICE-Collaboration — TU München, Physik Department E12, Excellence Cluster "Universe", D-85748, Garching, Germany

The ALICE collaboration (A Large Ion Collider Experiment) is planning an upgrade of its central barrel detectors, to be able to cope with the increased LHC luminosity beyond 2018. In order to fully exploit the increase in collision rate to about 50 kHz in Pb−Pb, the TPC is foreseen to be operated in an ungated mode with continuous readout. This demands for a replacement of the currently used, gated MWPC by GEM-based readout chambers, while retaining the present tracking and particle identification capabilities of the TPC via measurement of the specific energy loss ($\mathrm{d}E/\mathrm{d}x$).

The present baseline solution for the TPC upgrade consists of a stack of four large-sized GEM foils as amplification stage, containing both Standard (S, 140 μm) and Large Pitch (LP, 280 μm) GEM foils arranged in the order S-LP-LP-S. This arrangement has been proven as advantageous in terms of ion backflow and energy resolution.

A prototype of an ALICE IROC (Inner Readout Chamber) was equipped with such a quadruple GEM stack, installed inside a field cage and exposed to a beam of electrons and pions from the CERN PS. The performance of the prototype in terms of energy resolution has been evaluated and will be presented.

This work has been supported by BMBF 05P12WOGHH and DFG Cluster of Excellence Origin and Structure of the Universe.

HK 22.4 Tue 15:15 M/HS2

Online tracking with GPUs at the PANDA Experiment — •Ludovico Bianchi, Andreas Herten, James Ritman, and Tobias Stockmanns for the PANDA-Collaboration — Forschungszen-

trum Jülich

The PANDA experiment is a next generation particle detector planned for operation at the FAIR facility, that will study collisions of antiprotons with beam momenta of 1.5–15 GeV/c on a fixed proton target. Signal and background events at PANDA will look very similar, making a conventional hardware-trigger based approach unfeasible. Instead, data coming from the detector are acquired continuously, and event selection is performed in real time. A rejection factor of up to 1000 is needed to reduce the data rate for offline storage, making the data acquisition system computationally very challenging. Our activity within the PANDA collaboration is centered on the development and implementation of particle tracking algorithms on Graphical Processing Units (GPUs), and on studying the possibility of performing tracking for online event filtering using a multi-GPU architecture. Three algorithms are currently being developed, using information from the PANDA tracking system: a Hough Transform, a Riemann Track Finder, and a Triplet Finder algorithm. This talk will present the algorithms, their performance, and studies for GPU data transfer methods based on so-called message queues for a deeper integration of the algorithms with the FairRoot and PandaRoot frameworks.

HK 22.5 Tue 15:30 M/HS2

Optimization of Local On-line Tracking in the ALICE TRD — •Hannah Klingenmeyer for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

The Transition Radiation Detector (TRD) at the LHC (CERN) provides electron identification in the central barrel of ALICE as well as trigger contributions for electrons and jets. More than 65,000 multi-chip modules allow a fast on-detector reconstruction of chamber-wise track segments, which include position, angle and PID information. These track segments are then merged into tracks which provide information on transverse momenta and electron identification.

This talk will focus on the optimization of the reconstruction of the track segments to improve the PID and trigger performance. The settings in the multi-chip modules are varied to study their impact on the performance. In particular, the parameters for cluster finding and fitting will be discussed, as these determine the efficiency and resolutions of the local on-line tracking, which in turn strongly influence the trigger performance. The optimization of the performance for the triggers is foreseen for LHC Run 2.

HK 22.6 Tue 15:45 M/HS2

Kalman Filter based algorithms for PANDA@ FAIR — •Elisabetta Prencipe[1], James Ritman[1], and Johannes Rauch[2] for the PANDA-Collaboration — [1]IKP - Forschungszentrum Juelich — [2]E18 - Technische Universität München

$\overline{\text{P}}$ANDA at the future FAIR facility in Darmstadt is an experiment with a cooled antiproton beam in a range between 1.5 and 15 GeV/c, allowing a wide physics program in nuclear and particle physics. High average reaction rates up to $2{\cdot}10^7$ interactions/s are expected. $\overline{\text{P}}$ANDA is the only experiment worldwide, which combines a solenoid field and a dipole field in an experiment with a fixed target topology. The tracking system must be able to reconstruct high momenta in the laboratory frame. 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 first three of those, are inserted in a solenoid homogeneous magnetic field (B=2T), the latter two are inside a dipole magnetic field (B=2Tm), The offline tracking algorithm is developed within the PandaRoot framework, which is a part of the FAIRRoot project. The algorithm is based on a tool containing the Kalman Filter equations and a deterministic annealing filter (GENFIT). The Kalman-Filter-based routines can perform extrapolations of track parameters and covariance matrices. In GENFIT2, the Runge-Kutta track representation is available. First results of an implementation of GENFIT2 in PandaRoot are presented. Resolutions and efficiencies for different beam momenta and different track hypotheses are shown.

HK 22.7 Tue 16:00 M/HS2

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], björn spruck[1], and hua ye[2] for the PANDA-Collaboration — [1]II.Physikalisches Institut, Giessen University, 35392, Germany — [2]Institute of High Energy Physics, Beijing, 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 tracking algorithm is composed by two parts, a road finding module followed by an iterative helix parameter calculation module. A performance study using C++ and the status of the VHDL implementation will be presented.

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

HK 22.8 Tue 16:15 M/HS2

Alpha Spectroscopy — Kai Zuber, •Heinrich Wilsenach, and Felix Krueger — IKTP TU-Dresden, Dresden, Germany

Alpha decays from long living isotopes are one of the limiting backgrounds for experiments searching for rare decays with stringent background constrains, such as neutrinoless double beta decay experiments. It is thus very important to accurately measure the half-lifes of these decays, in order to properly model their background contribution. Therefore, it is important to be able to measure half-lifes from alpha decays of the order of 1×10^{15} yr. 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. There is also a more general interest in such long living half-life measurements, as their value depends crucially on the underlying nuclear model.

This talk presents a new ionisation chamber for alpha-spectroscopy that has been built from radio pure materials for the purpose to investigate long lived alpha decays. The analysis makes use of pulse shape analysis to discriminate between signal and background. The design and performance of the chamber will be presented here. A background rate of 10 counts per day in the energy region of 1-8 MeV has been achieved. A detailed investigation of Sm-isotopes was performed using high precision alpha- and gamma spectroscopy. The results of which will also be presented here as well as some results obtained with calibration sources or varying thickness.

HK 23: Instrumentation 9

Time: Tuesday 14:30–16:30 Location: M/HS4

Group Report HK 23.1 Tue 14:30 M/HS4

Charged Particle ID with DIRCs in PANDA at FAIR — •Georg Schepers for the PANDA Cherenkov Group of the PANDA-Collaboration — GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany

The PANDA detector at FAIR, the new international accelerator facility for antiprotons and ions in Darmstadt, will address open questions of hadronic physics. Experiments concerning charmonium spectroscopy are performed with antiproton beams colliding with hydrogen or nuclear targets. The beam momentum range between 1.5 GeV/c and 15 GeV/c allows tests of the predictions by perturbation theory, but will also reveal deviations originating from strong QCD. Excellent charged particle identification over a large momentum range is necessary for all these experiments. In the target spectrometer this will be accomplished by two Cherenkov counters using the DIRC principle, reducing the size of the solenoid and calorimeter. Both counters have to work in a strong magnetic field and withstand high event rates. The concept of the Barrel DIRC, covering the polar angles between 22 and 140 degrees, is based on the successful BaBar DIRC. It uses focusing optics with lenses and fast photon timing. The Endcap Disc DIRC works with a novel radiator geometry and covers the angular

range from 5 to 22 degrees. In addition to a fast electronic readout it employs a compact photon detection system. Prototypes were tested with particle beams at GSI, CERN, DESY, and MAMI to validate the design choices. The results achieved and the status of the PANDA DIRC detectors will be presented.

HK 23.2 Tue 15:00 M/HS4

DIRC-based PID for the EIC Central Detector — •Roman Dzhygadlo[1], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the DIRC at EIC RD-Collaboration — [1]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

One of the key requirements for the central detector of a future Electron-Ion Collider (EIC) is to provide radially compact Particle Identification (PID) (e/π, π/K, K/p) over a wide momentum range. It is expected that the PID system will need to include one or more Cherenkov counters to achieve this goal. With a radial size of only a few cm, a DIRC counter (Detector of Internally Reflected Cherenkov light) is potentially an attractive option.

The DIRC@EIC R&D Collaboration was formed by groups in the United States and Germany in 2011 with funding from DOE to investigate ways to extend the momentum coverage of DIRC counters for the EIC detector by up to 50% beyond the current state of the art. Possible design improvements include a complex focusing system, multi-anode sensors with smaller pixels, a time-based reconstruction algorithm, and chromatic dispersion mitigation.

Both Geant and ray-tracing simulations are used to optimize the design configuration of the DIRC counter in terms of the performance and the best integration with the EIC detector.

We will discuss the current status of the design studies and the possible improvements to the Cherenkov angle resolution and the photon yield.

HK 23.3 Tue 15:15 M/HS4

Simulation and Reconstruction of the PANDA Barrel DIRC — •Roman Dzhygadlo[1], Klaus Götzen[1], Grzegorz Kalicy[1,2], Harphool Kumawat[1,3], Maria Patsyuk[1,2], Klaus Peters[1,2], Carsten Schwarz[1], Jochen Schwiening[1], and Marko Zühlsdorf[1,2] for the PANDA Cherenkov Group of the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt — [3]Bhabha Atomic Research Centre

Hadronic particle identification (PID) in the barrel region of the PANDA experiment at the new Facility for Antiproton and Ion Research in Europe (FAIR) at GSI, Darmstadt, will be provided by a DIRC (Detection of Internally Reflected Cherenkov light) counter. The design goal of the Barrel DIRC is to provide clean separation between pions and kaons with at least three standard deviations for momenta between 0.5 and 3.5 GeV/c and polar angles between 22° and 140°. To achieve this performance and reduce the detector cost, detailed simulations of the different design elements, such as the width of the radiators, the shape of the expansion volume and the type of focusing system, were performed using Geant. Custom reconstruction algorithms were developed to match the detector geometry. We will discuss the latest achievements in single photon resolution and photon yield as well as the PID performance for different design options of the Barrel DIRC detector.

Work supported by BMBF 05E12CD2, EU FP7 227431, HGS-HIRe.

HK 23.4 Tue 15:30 M/HS4

Prototype tests with the 3D Barrel DIRC of PANDA — Roman Dzhygadlo[1], Andreas Gerhardt[1], Grzegorz Kalicy[1,2,3], Marvin Krebs[1,2], Harphool Kumawat[1,4], Dorothe Lehmann[1], Maria Patsyuk[1], Klaus Peters[1,2], Georg Schepers[1], •Carsten Schwarz[1], Jochen Schwiening[1], and Marko Zühlsdorf[1,2] for the PANDA Cherenkov Group of the PANDA-Collaboration — [1]GSI, Darmstadt, Germany — [2]Goethe University, Frankfurt, Germany — [3]Jefferson Lab, Newport News, Virginia, USA — [4]Bhabha Atomic Research Centre, Mumbai, India

The prototype tests of the Barrel DIRC counter, under development for the future PANDA experiment at FAIR, aim at the improvement of the original design, applied successfully by BABAR. Subjects of the R&D for this 3D Cherenkov counter include the focusing system and fast photon timing as well as the width of the radiators and the shape of the expansion volume.

A modular prototype was built which allows an easy exchange of all key components under investigation. Prototype radiators from several optical companies, were tested in hadronic particle beams at CERN and at GSI. Data were recorded with narrow bars as well as with wide plates, coupled via an optional focusing lens system to a large solid fused silica prism, used as expansion volume.

We present a study of the performance of the prototype in several configurations with a focus on the single photon Cherenkov angle resolution and photon yield. Work supported by BMBF 05E12CD2, EU FP7 227431, HGS-HIRe.

HK 23.5 Tue 15:45 M/HS4

Detector performance tests for the CBM TRD — •Martin Kohn — WWU Münster Insitut für Kernphysik, Wilhelm-Klemm-Str. 9 48149 Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. With the construction phase of the detector nearing, we will present results of the detector obtained with a close to final prototype. These results will be compared to simulation benchmarks in terms of pion rejection capabilities and spatial resolution.

HK 23.6 Tue 16:00 M/HS4

Upgrade of the ALICE Transition Radiation Detector Pre-Trigger System — •Sebastian Klewin for the ALICE-Collaboration — Physikalisches Institut, Heidelberg

The ALICE TRD pre-trigger system has been designed and built to provide an early wake-up signal for the TRD front-end electronics (FEE). This signal has to arrive 1.15 μs before the Level-0 trigger, which is generated by the Central Trigger Processor (CTP). This independent generation of the signal had during RUN1 some probability of not being confirmed by the CTP L0, which lead to some dead-times.

To avoid this, an upgrade strategy has been worked out in which a level-minus-1 (LM) trigger signal, generated by the CTP, replaces the pre-trigger signal. Several efforts had to be made to achieve the ambitious timing: cables had to be rerouted and some electronics had to be relocated to minimize the latency. Additionally a new device had to be developed, which mixes the LM into the TTC protocol and modifies it to a stream suitable for the TRD FEE. Further this device checks the timing of the signals, takes care of the busy handling and provides additional monitoring capabilities. In standalone mode it is also able to generate the necessary signals to trigger the TRD without the CTP. A standard CTP Local Trigger Unit (LTU) was used as hardware, for which a new firmware has been developed to provide these functionalities.

HK 23.7 Tue 16:15 M/HS4

The PANDA Endcap Disc Dirc and its opto-mechanical system — •Erik Etzelmüller[1], Klim Biguenko[1], Michael Düren[1], Klaus Föhl[1,2], Avetik Hayrapetyan[1], Benno Kröck[1], Oliver Merle[1], Julian Rieke[1], and Mustafa Schmidt[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland — [2]CERN, Genf, Schweiz

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.

The concept of a Disc DIRC will be explained with an emphasis on the optics which play a major role for the detector design. Different types of optical components have to fulfill a number of requirements to allow a precision measurement. Further challenges arise from the necessity of an exact and robust alignment. Solutions will be presented and discussed along with the possibilities for an in-house quality assurance.

HK 24: Heavy Ion Collisions and QCD Phases 3

Time: Tuesday 14:30–16:15 Location: T/HS1

Group Report HK 24.1 Tue 14:30 T/HS1

The CBM Experiment at FAIR — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) is being constructed at the Facility for Antiproton and Ion Research FAIR. Using nucleus-nucleus collisions at beam energies up to 14 A GeV during the first stage and up to 45 AGeV in a second stage, the key objective of CBM is to investigate the QCD phase diagram in the region of high net-baryon-densities. At this region a first order phase transition from hadronic to partonic matter as well as a chiral phase transition is expected, 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 which will allow to study extremely rare probes with high precision which have not been accessible by previous nucleus-nucleus experiments at this energy regime. To achieve the high rate capability CBM will be equipped with fast and radiation hard detectors readout by free-streaming electronics. The high-speed data acquisition system will transport data volumes up to 1 TB/s to a large scale computer farm providing a first level event selection. An overview on the CBM experiment as well as the progress on the detector projects will be given.

Supported by BMBF and HICforFair.

Group Report HK 24.2 Tue 15:00 T/HS1

Investigating Heavy-Ion Collisions with Neutral Mesons in the ALICE Calorimeters — •Baldo Sahlmüller for the ALICE-Collaboration — Goethe-Universität Frankfurt

One of the main purposes of the LHC is the investigation of the quark-gluon plasma produced in heavy-ion collisions. In order to interpret such measurements, the initial state of such collisions, i.e. the lead nucleus, and its effects on observables such as the modification of hadron transverse momentum spectra have to be understood. This initial state is studied in p-Pb collisions. Furthermore, pp collisions function as baseline measurement for the aforementioned larger systems and are necessary to extract fundamental parameters such as fragmentation functions.

The π^0 and η mesons can be measured in electromagnetic calorimeters via their two-photon decays. In the first run of the LHC, ALICE comprised two different calorimeters, PHOS and EMCAL, that offer different advantages and the possibility of two independent measurements of the same observables such as the transverse momentum distribution of neutral mesons.

We will present the status of ALICE measurements of neutral mesons with the EMCAL and PHOS detectors. The focus will be on technical aspects of the analyses and present results from pp and p-Pb collisions. Furthermore, we will give an outlook to future measurements in the second LHC run that will start in 2015.

Supported by BMBF and the Helmholtz Association.

HK 24.3 Tue 15:30 T/HS1

Separation of the Charm- and Beauty Production in pp- and Pb–Pb Collisions Using ALICE — •Martin Völkl for the ALICE-Collaboration — Universität Heidelberg

In heavy ion collisions the energy loss of heavy quarks is an interesting quantity for the investigation of the properties 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. The heavy quarks form hadrons which may have electrons as decay products. An approach for the measurement of the energy loss of heavy quarks in the QGP is the comparison of the spectra of such electrons from heavy-ion collisions with those from proton-proton collisions. The implications for the understanding of the QGP can then be analyzed via comparison with theoretical predictions and models. For this, the difference in the result for beauty- and charm quarks is of particular interest due to expected differences in their energy loss. In the analysis presented here, these contributions are separated statistically using their different impact parameter distributions. The impact parameter for electrons from hardons containing a beauty quark is typically larger due to the larger decay length ($c\tau \approx 500\mu$m) of the hadrons. The excellent particle identification properties of ALICE allow for a very clean selection of electrons. Here, the current results of the analysis are presented for pp at $\sqrt{s} = 7$TeV and Pb–Pb at $\sqrt{s_{NN}} = 2.76$TeV.

HK 24.4 Tue 15:45 T/HS1

Multiplicity dependence of D^{*+}-meson production in p–Pb collisions with ALICE — •Jeremy Wilkinson for the ALICE-Collaboration — Physikalisches Institut, Ruprecht-Karls Universität Heidelberg, Deutschland

The heavy-ion programme at ALICE (A Large Ion Collider Experiment) facilitates the study of the hot, high-density state of matter formed in high-energy nuclear collisions. A key probe of this system is the production of heavy quarks, namely charm and beauty. Charm and beauty quarks are produced in the earliest stages of the collision, and experience the full evolution of the system. As well as studying the production of leptons from heavy-flavour decays, ALICE's excellent tracking, vertexing, and particle identification capabilities also allow it to fully reconstruct the hadronic decays of open-charmed D mesons.

Control measurements are made in p–Pb collisions in order to disentangle experimental outcomes arising in the hot and dense medium from those occurring due to initial-state effects. One interesting measurement that can be made in this system is the production of certain particle species as a function of the overall multiplicity of charged particles. Such measurements allow us to investigate the role of multi-parton interactions in particle collisions at LHC energies, in particular when compared with similar results in pp collisions.

In this talk, the ALICE measurements of D^{*+}-meson production as a function of charged-particle multiplicity in p–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV will be presented, along with comparisons with D^0 and D^+ results in p–Pb and pp.

HK 24.5 Tue 16:00 T/HS1

Measurement of electrons from semi-leptonic heavy-flavour hadron decays in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV with the ALICE TRD — •Martin Fleck for the ALICE-Collaboration — Heidelberg University, Deutschland

Heavy quarks (charm and beauty), only produced in the initial hard scattering processes, constitute an important way to probe features of the Quark-Gluon Plasma. However, suppression effects that are seen in Pb–Pb collisions in comparison to p–p results can be regarded as a property of the Quark-Gluon Plasma after non-QGP nuclear effects in the study of proton-nucleus collisions have been quantified. For this purpose the ALICE TPC and TRD were used to measure semi-leptonic decays of heavy-flavoured hadrons, where especially the TRD electron identification capability contributes to the results. The procedure of the analysis of p–Pb LHC data of 2013 is explained and first results are shown.

HK 25: Structure and Dynamics of Nuclei 5

Time: Tuesday 14:30–16:15 Location: T/HS2

Group Report HK 25.1 Tue 14:30 T/HS2

Magnetic dipole strength in ^{128}Xe and ^{134}Xe in the spin-flip resonance region — R. Massarczyk[1,2], G. Rusev[2], •R. Schwengner[1], F. Dönau[1], C. Bathia[3], M.E. Gooden[4,5], J.H. Kelley[4,5], A.P. Tonchev[6], and W. Tornow[4,7] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Los Alamos National Laboratory, Los Alamos, NM 87545, USA — [3]McMaster University, Hamilton, Ontario L8S4L8, Canada — [4]Triangle Universities Nuclear Laboratory, Durham, NC 27708, USA — [5]North Carolina State University, Raleigh, NC 27695, USA — [6]Lawrence Livermore National Laboratory, Livermore, CA 94550, USA — [7]Duke University, Durham, NC 27708, USA

The magnetic dipole strength in the energy region of the spin-flip resonance is investigated in ^{128}Xe and ^{134}Xe using quasimonoenergetic and linearly polarized γ-ray beams at the High-Intensity γ-Ray Source facility in Durham, North Carolina, USA. Absorption cross sections were deduced for the magnetic and electric and dipole strength distributions separately for various intervals of excitation energy, including the strength of states in the unresolved quasicontinuum. The magnetic dipole strength distributions show structures resembling a resonance in the spin-flip region around an excitation energy of 8 MeV. The electric dipole strength distributions obtained from the present experiments are in agreement with the ones deduced from an earlier experiment using broad-band bremsstrahlung instead of a quasimonoenergetic beam. The experimental magnetic and electric dipole strength distributions are compared with model predictions.

HK 25.2 Tue 15:00 T/HS2

Dipole polarizability of neutron rich nuclei and the symmetry energy — •Andrea Horvat[1], Thomas Aumann[1,2], Konstanze Boretzky[2], Jacob Johansen[1], Kenjiro Miki[1], Fabia Schindler[1], and Philipp Schrock[1] for the R3B-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany

As a part of a systematic investigation of the dipole response of stable up to very neutron rich tin isotopes, nuclear and electromagnetic excitation of ^{124}Sn - ^{134}Sn has been investigated at relativistic energies in inverse kinematics induced by carbon and lead targets at the LAND-R3B setup at GSI in Darmstadt. The electric dipole response and the nuclear reaction cross section, total and charge-changing, will be obtained from the kinematically complete determination of momenta of all particles on an event by event basis. The dipole polarizability will be extracted from the Coulomb excitation interaction channel, in order to make use of relevant correlations of this observable with nuclear matter properties such as the symmetry energy at saturation density (J) and it's slope (L). The systematics of the low-lying "pygmy" dipole strength, the giant dipole resonance (GDR) and the neutron skin thickness will be determined with respect to increasing isospin asymmetry. This talk will also discuss the correlations and sensitivities of these variables and observables obtained within the framework of nuclear energy density functional theory.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, NAVI and the BMBF project 05P12RDFN8.

HK 25.3 Tue 15:15 T/HS2

Dipole strength distribution of ^{50}Ti * — •Udo Gayer, Tobias Beck, Jacob Beller, Laura Mertes, Haridas Pai, Norbert Pietralla, Philipp Ries, Christopher Romig, Volker Werner, and Markus Zweidinger — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt

A first nuclear resonance fluorescence (NRF) experiment with a 68% isotopically enriched ^{50}Ti target has been performed at the superconducting Darmstadt electron linear accelerator S-DALINAC to investigate particle-bound dipole excitations in this nucleus. The target was irradiated with an unpolarized bremsstrahlung photon beam at endpoint energies of 7.5 MeV and 9.7 MeV. The observed excited states are analyzed with respect to their excitation energies, spin quantum numbers and transition strengths. A complementary NRF experiment with polarized photons will be conducted at the High Intensity gamma-ray Source in Durham, NC, USA to determine the polarity of the dipole transitions. Data will be analyzed with regard to the Pygmy Dipole Resonance, a weakly-collective electric dipole excitation which starts to form in nuclei of this mass region. The measured transition strengths will be compared to microscopic calculations in the quasiparticle-phonon model. The investigation of the magnetic dipole strength distribution will focus on strong spin-flip transitions between the p,f spin-orbit partners expected in the nuclear shell model. First results of the measurements and the evaluation will be presented and discussed.

* Supported by the DFG under contract No. SFB 634

HK 25.4 Tue 15:30 T/HS2

Dipolstärkeverteilung von ^{54}Cr bei Energien unterhalb von 9,7 MeV* — •Philipp Ries, Tobias Beck, Jacob Beller, Udo Gayer, Laura Mertes, Haridas Pai, Norbert Pietralla, Christopher Romig, Volker Werner und Markus Zweidinger — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt

In den letzten Jahren genossen elektrische und magnetische Dipolstärken ($E1$ und $M1$) unterhalb der Neutronenseparationsschwelle, insbesondere die Anregung der Pygmy Dipol Resonanz (PDR), erhebliche Aufmerksamkeit. Durch Messungen von Anregungsstärken und Paritäten von J=1 Zuständen in leichteren Kernen um A=50 soll die Systematik der PDR nun in jener Massenregion erweitert werden, in der die PDR erstmals auftritt. Mittels am supraleitenden Darmstädter Elektronenlinearbeschleuniger S-DALINAC erzeugter Bremsstrahlung mit Photonenenergien von bis zu 9,7 MeV wurde der Kern ^{54}Cr zum ersten Mal mit der Methode der Kernresonanzfluoreszenz untersucht. Dabei wurden zahlreiche Zustände, die meisten zum ersten Mal, beobachtet. Die Paritäten dieser Zustände werden an der High Intensity Gamma-ray Source des Triangle Universities Nuclear Laboratory in Durham, NC, USA, bestimmt werden. Die Ergebnisse werden vorgestellt und im Vergleich mit Experimenten, die auf gleiche Weise an Kernen rund um den N=28 Schalenabschluss (^{50}Cr, ^{52}Cr [1] und ^{50}Ti) durchgeführt wurden, diskutiert.

*Unterstützt von der DFG im Rahmen des SFB 634.

[1] H. Pai *et al.*, Phys. Rev. C **88**, 054316 (2013)

HK 25.5 Tue 15:45 T/HS2

Pygmy Dipol Resonanz in instabilen Sn Isotopen — •Joachim Tscheuschner for the DALI-LaBr RIBF-Collaboration — TU Darmstadt

Um die Pygmy Dipol Resonanz (PDR) in den instabilen Isotopen Sn-128 und Sn-132 zu untersuchen, wurden am RIKEN (Japan) alpha-Streuexperimente durchgefuehrt. Die Photonen aus dem Zerfall der angeregten Zustände wurden mit einem Detektor hoher Effizient bestehend aus NaJ Kristallen (DALI2) sowie in Vorwärtsrichtung großvolumigen LaBr Kristallen (HECTOR) nachgewiesen.

In der alpha-Streuung werden hauptsaechlich isoskalare Moden angeregt, was durch Vergleich mit Ergebnissen aus der Coulomb Anregung eine Aussage über die isoskalaren und isovektoriellen Anteile der PDR erlaubt. Ziel der Experimente ist, die Entwicklung der PDR als Funktion des Neutronenüberschusses zu untersuchen. In diesem Beitrag werden die alpha-Streuexperimente und Ergebnisse aus ersten Analyseschritten vorgestellt.

Dieser Beitrag ist unterstuetzt durch HIC for FAIR, GSI-TU Darmstadt Kooperation, und BMBF project 05P12RDFN8.

HK 25.6 Tue 16:00 T/HS2

Low-lying dipole strengths of ^{50}Cr* — •H. Pai, T. Beck, J. Beller, U. Gayer, L. Mertes, N. Pietralla, P. Ries, C. Romig, V. Werner, and M. Zweidinger — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt

Low-lying electric and magnetic dipole strengths ($E1$ and $M1$, respectively), particularly Pygmy Dipole Resonance (PDR) and Spin-flip $M1$ excitations, of atomic nuclei have drawn considerable attention in the last decade. The low-lying dipole strengths of ^{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. Twenty-four spin-1 states were observed between 3.0 and 9.7 MeV excitation energy, 17 of those for the first time. The excited states' parities will be determined through polarized photon scattering at the High Intensity gamma ray Source (HIγS), Triangle Universities Nuclear Laboratory (TUNL) in Durham, NC, USA. Microscopic calculations within the quasiparticle-phonon nuclear model will be performed to interpret the dipole strength distribution of ^{50}Cr. The experimental results of ^{50}Cr will be compared to data on its closed-shell N = 28 isotone ^{52}Cr [1] and may provide information on the onset of the PDR in atomic nuclei.

*Supported by the DFG under contract No. SFB 634 and by the Helmholtz International Center for FAIR.

[1] H. Pai *et al.*, Phys. Rev. C **88**, 054316 (2013).

HK 26: Structure and Dynamics of Nuclei 6

Time: Tuesday 14:30–16:30 Location: T/SR14

Group Report HK 26.1 Tue 14:30 T/SR14

Experimente mit T-REX und MINIBALL bei REX-ISOLDE — •Stefanie Hellgartner[1], Dennis Mücher[1], Roman Gernhäuser[1], Reiner Krücken[2] und Katharina Nowak[1] — [1]Technische Universität München — [2]TRIUMF, Vancouver

Das Ziel von T-REX ist es, Neutronen-Transfer-Reaktionen an REX-ISOLDE zu untersuchen. Durch die Messung der ausgehenden leichten Transfer-Produkte, die über die T-REX $\Delta E - E$ Silizium Teleskope identifiziert werden, können Rückschlüsse auf die Einteilchenzustände im Kern gezogen werden. Für eine präzise Bestimmung der bevölkerten Energieniveaus im Endkern werden die emittierten Gammas mit dem MINIBALL-Spektrometer nachgewiesen. Jüngste Ergebnisse der Transfer-Experimente werden im Vortrag vorgestellt.

Nach einigen leichten Modifikationen von T-REX lassen sich auch Coulex Experimente durchführen. Dieser neue Aufbau verfügt über einen einstellbaren Abstand zwischen dem Target und dem vorwärts gerichteten Silizium-Detektor, so dass auch hohe Strahlintensitäten bewältigt werden können. Dies wird am Beispiel der mehrfachen Coulomb Anregung von einem ^{72}Zn Strahl demonstriert. Der Vorteil dieses Coulex-Setups liegt in den Detektoren in Rückwärtsrichtung, die es erlauben das Quadrupolmoment vom 2_1^+ Zustand in ^{72}Zn präzise zu bestimmen.

Am Ende des Vortrags wird noch kurz auf ein mögliches Upgrade des T-REX Aufbaus im Hinblick auf HIE-ISOLDE eingegangen.

Gefördert durch BMBF (05P12WOFNF), DFG (Cluster of Excellence: Origin and Structure of the Universe) und ENSAR.

HK 26.2 Tue 15:00 T/SR14

Quadrupole decay strength of the $M1$ scissors mode of ^{156}Gd* — •T. Beck[1], J. Beller[1], V. Derya[2], U. Gayer[1], J. Isaak[3,4], B. Löher[3,4], L. Mertes[1], H. Pai[1], N. Pietralla[1], P. Ries[1], C. Romig[1], D. Savran[3,4], M. Scheck[1,5,6], W. Tornow[7], H.R. Weller[7], V. Werner[1], and M. Zweidinger[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

The isovector low-lying $J_K^\pi = 1_1^+$ scissors mode of deformed nuclei has been studied extensively in (*e*,*e*') and (γ,γ') experiments over the last 30 years with the main focus on strong $M1$ transitions to the ground state band. In the framework of the semiclassical two-rotor-model it has its origin in quadrupole deformation. A considerable $E2$ matrix element between the rotational band of the scissors mode and the ground band is predicted which has not been addressed experimentally. A photon-scattering experiment with linearly-polarized quasi monoenergetic $\vec{\gamma}$-rays has been performed at the High Intensity $\vec{\gamma}$-ray Source (HI$\vec{\gamma}$S) at Duke University, Durham, NC, exploiting the γ^3 setup. We have measured an $E2/M1$-multipole mixing ratio for the $1_{sc}^+ \to 2_1^+$ transition for the first time. The Alaga rule is applicable and delivers a first estimate of the transition strength $B(E2: 2_{sc}^+ \to 0_1^+)$. A candidate for a $2_{sc}^+ \to 2_1^+$ transition will be discussed.

⋆ Supported by the DFG within the scope of SFB 634

HK 26.3 Tue 15:15 T/SR14

Identifikation niederenergetischer isovektorieller Oktupol-Zustände in ^{144}Nd — •Michael Thürauf und Thorsten Kröll für die EXILL-Kollaboration — Institut für Kernphysik, TU Darmstadt

Kürzlich wurden erste Kandidaten für tiefliegende isovektorielle Anregungen, sog. „mixed-symmetry" Zustände, im Oktupolsektor vorgeschlagen. Diese Klasse von Zuständen wurde im Rahmen des Interacting-Boson-Modells (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^--Zustand bei 2778 keV ein guter Kandidat für einen solchen „mixed-symmetry" Oktupol-Zustand. Um die Natur dieses Zustandes zu klären, wurde 2012 im Verlauf der (n,γ)-Kampagne mit dem EX@ILL-Aufbau am ILL, Grenoble, ein Experiment ^{143}Nd$(n,\gamma)^{144}$Nd durchgeführt. Nach dem Einfang eines Neutrons werden 3^--Zustände vom Einfangszustand aus bevölkert. EX@ILL bietet die Möglichkeit, die Multipolmischungsverhältnisse der Übergänge $3_i^- \to 3_1^-$ zu bestimmen und damit die Natur der 3_i^--Zustände festzulegen. Für den Übergang von einem „mixed-symmetry" Oktupol-Zustand in den symmetrischen 3_1^--Zustand erwartet man eine starke $M1$-Komponente. Erste vorläufige Spektren und Winkelverteilungen werden hierzu gezeigt.

Gefördert durch die DFG (KR 1796/2-1).

HK 26.4 Tue 15:30 T/SR14

Low-lying quadrupole collectivity in ^{136}Xe — •Christian Stahl[1], Jörg Leske[1], Dino Bazzacco[2], Enrico Farnea[2], Andres Gadea[3], Andrea Gottardo[4,5], Philipp Rudolf John[2,5], Caterina Michelagnoli[2,5], Norbert Pietralla[1], Michael Reese[1], and Jose Javier Valiente-Dobon[4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Istituto Nazionale di Fisica Nucleare, Sezione di Padova, Padova, Italy — [3]Instituto de Fisica Corpuscular, CSIC-Universitat de Valencia, Valencia, Spain — [4]Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Legnaro, Legnaro, Italy — [5]Dipartimento di Fisica e Astronomia dell'Universita degli Studi di Padova, Padova, Italy

We present recent results from our investigation of low-lying quadrupole collectivity in the semi-magic N=82 nucleus ^{136}Xe. An experiment was performed at the Legnaro National Laboratory employing the AGATA demonstrator. Level-lifetimes and B(E2, $0_1^+ \to 2_i^+$)-values were determined from Coulomb excitation and by the continuous-angle DSA method exploiting AGATA's position resolution. 2_i^+ - states up to i=7 were excited and analyzed. This work was supported by the BMBF under grants No. 05P09RDFN4 and 06P12RDFN8.

HK 26.5 Tue 15:45 T/SR14

Relativistic Coulomb Excitation of ^{88}Kr — •Kevin Moschner, Andrey Blazhev, Jan Jolie, Nigel Warr, and Andreas Wendt for the PreSPEC-Collaboration — IKP, Universität zu Köln, 50937 Köln

Within the scope of the PreSPEC campaign we performed a Coulomb-excitation experiment to determine absolute E2 transition strengths to 2^+ states in the radioactive nucleus ^{88}Kr. The aim of our studies was to identify the one quadruple-phonon mixed-symmetry $2_{\rm MS}^+$ state in order to extend our knowledge on these states to lighter $N = 52$ isotones and to track their evolution over different proton shells.

The investigated ions were provided through projectile fission of a 650 MeV ^{238}U beam on a primary target consisting of 0.6 g/cm^2 ^{9}Be and subsequent separation and identification of the reaction products via the FRS at GSI. The secondary target consisted of 0.4 g/cm^2 ^{197}Au. De-exciting γ radiation was detected by the PreSPEC array, consisting of 15 EUROBALL Cluster detectors. The Lund-York-Cologne-CAlorimeter LYCCA was used for particle identification after the secondary target.

Absolute transition strengths of the transitions depopulating the 2_3^+ state in ^{88}Kr which suggest the mixed symmetric character of this state will be presented and discussed within the systematics of the $N = 52$ isotones.

Supported by the German BMBF under grant 05P12PKFNE.

HK 26.6 Tue 16:00 T/SR14

Investigation of two-phonon 1^- states in ^{40}Ca and ^{140}Ce with the γ^3 setup at HIγS — •Julius Wilhelmy[1], Vera Derya[1], Janis Endres[1], Andreas Hennig[1], Bastian Löher[2,3], Deniz Savran[2,3], Werner Tornow[4], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]ExtreMe Matter Institute EMMI and Research Division, GSI, Darmstadt — [3]Frankfurt Institute for Advanced Studies FIAS, Frankfurt — [4]Department of Physics, Duke University, USA

The harmonic coupling of a quadrupole and an octupole vibrational excitation results in a quintuplet of $J^\pi = 1^-$ to 5^- vibrational states at the sum of the constituent excitation energies. Their detailed γ-decay behavior can provide information about their structure. For ^{40}Ca and ^{140}Ce, possible two-phonon $E1$ excitations were studied with the high-efficiency γ^3 setup [1] at the High Intensity γ-ray Source facility at TUNL in Durham, USA. 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. The determination of the $B(E2; 1_1^- \to 3_1^-)$ value

was possible showing a dominant two-phonon character of the 1_1^- state in ^{40}Ca. For the same decay in ^{140}Ce, an upper limit for the reduced transition probability can be given and an unexpected $E1$ decay to the 0_2^+ state was observed. The experimental results will be presented and discussed with regard to systematics and theoretical predictions. Supported by the DFG (ZI 510/4-2) and the Alliance Program of the Helmholtz Association (HA216/EMMI).

[1] B. Löher *et al.*, Nucl. Instr. and Meth. A **723** (2013) 136

HK 26.7 Tue 16:15 T/SR14

Relative Selbstabsorptionsmessung an ^{11}B zur Bestimmung von Grundzustandsübergangsbreiten* — •Laura Mertes, Tobias Beck, Jacob Beller, Udo Gayer, Haridas Pai, Norbert Pietralla, Philipp Ries, Christopher Romig, Volker Werner und Markus Zweidinger — Institut für Kernphysik, Technische Universität Darmstadt

Bei Kernresonanzfluoreszenzmessungen wird häufig der Kern ^{11}B als Kalibrierungsstandard zur Bestimmung des Photonenflusses verwendet. Die hierzu benötigten Übergangsbreiten Γ_0 angeregter Zustände in den Grundzustand wurden mittels einer relativen Selbstabsorptionsmessung an ^{11}B erneut bestimmt, um die bereits bekannten Grundzustandsübergangsbreiten einerseits zu verifizieren und andererseits eine höhere Genauigkeit zu erzielen. Die Selbstabsorptionsmessung wurde am Darmstädter S-DALINAC mit einem kontinuierlichen Photonenspektrum aus Bremsstrahlung bis zu einer Energie von $E_\gamma = 9.7$ MeV durchgeführt. Die Messmethode und erste Ergebnisse werden vorgestellt und diskutiert.

* Gefördert durch die DFG im Rahmen des SFB 634

HK 27: Hadron Structure and Spectroscopy 5

Time: Tuesday 14:30–16:30 Location: T/SR19

Group Report HK 27.1 Tue 14:30 T/SR19

Open-charm Physics Opportunities at PANDA — •Elisabetta Prencipe[1], Lu Cao[1], Andreas Herten[1], James Ritman[1], Donghee Kang[2], and Andreas Pitka[3] for the PANDA-Collaboration — [1]IKP - Forschungszentrum Juelich — [2]Johannes Gutenberg Universität Mainz — [3]Justus-Liebig Universität Giessen

Open-charm physics is of high interest for the weak and the strong interactions. New observations in spectroscopy and the recent constraining limits on CP violation in the D sector strongly motivate the study of open-charm physics. The experiment $\overline{\text{P}}$ANDA at FAIR (Darmstadt) will investigate fundamental questions of hadron and nuclear physics in interactions of antiprotons with nucleons and nuclei. Among other topics, original contributions are planned from $\overline{\text{P}}$ANDA in the open-charm sector. With high average reaction rates up to $2{\cdot}10^7$ interactions/s, and a factor 20 higher mass resolution than attained at B-factories, $\overline{\text{P}}$ANDA is in a privileged position to perform measurements of widths of narrow states, such as the $D_s(2317)^+$ and the $D_s(2460)^+$, and form factors in semileptonic D_s decays. Very rare processes (e.g. $D^0 \to \gamma\gamma$) can be accessible with unprecedented accuracy. In addition, the search for new physics is a challenge that $\overline{\text{P}}$ANDA can take, for example with the study of the mixing in the D sector, analyzing the channel $\bar{p}p \to \psi(3770) \to \overline{D^0}D^0$. $\overline{\text{P}}$ANDA is expected to be decisive to answer on these and second-order open questions. A general overview of the benchmark channels in the D sector with $\overline{\text{P}}$ANDA is given in this report, showing the results of recent PandaRoot simulations.

HK 27.2 Tue 15:00 T/SR19

Lebensdauermessung neutraler D-Mesonen als Benchmark der Vertexrekonstruktion bei $\overline{\text{P}}$ANDA* — •Andreas Pitka und Kai-Thomas Brinkmann für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

Eines der Hauptziele des zukünftigen $\overline{\text{P}}$ANDA Experimentes ist das Studium von D-Mesonen. Die Separation von hadronischen Untergrundkanälen und die Messung von CP-Verletzung in D^0–$\bar{D}^0$-Mischung über eine zeitabhängige Analyse der Zerfallsrate erfordert hierzu zwingend eine akkurate Bestimmung der nur wenige $100\,\mu$m langen Zerfallsstrecke der D-Mesonen innerhalb des Detektors. Im Rahmen einer Simulationsstudie innerhalb des PandaRoot-Frameworks wird exemplarisch anhand des Zerfalls $\bar{p}p \to D^0\bar{D}^0 \to \left(K_S\pi^+\pi^-\right)\left(K^+\pi^-\right)$ eine Abschätzung der zu erwartenden Orts- und Zerfallszeitauflösung vorgenommen und diese effektiv parametrisiert. Als Benchmark für die zu erwartende Leistungsfähigkeit des Mikro-Vertex-Detektors kann aus der rekonstruierten Verteilung der Lebensdauern durch einen Fit die mittlere D^0-Lebensdauer bestimmt werden, zudem wird die Auflösung der zur Messung von D^0–$\bar{D}^0$-Mischung ausschlaggebenden Zerfallszeitdifferenz zwischen D^0- und $\bar{D}^0$-Zerfall abgeschätzt.

*gefördert durch BMBF und HIC for FAIR

HK 27.3 Tue 15:15 T/SR19

simulation of D_s semileptonic decay with the PANDA detector — •Lu Cao[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 proton 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 $D_s^+ \to \eta e^+ \nu_e$. The kinematics of the neutrino have been reconstructed with a complete simulation model of the detector and reconstruction tools. In the reconstruction procedure, we focus on developing the software and evaluating the expected precision. This talk summarizes the simulation and reconstruction 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 27.4 Tue 15:30 T/SR19

Feasibility study on the open charm rare decay at PANDA — •Donghee Kang[1] and Achim Denig[2] for the PANDA-Collaboration — [1]Helmholtz Institut Mainz, Universität Mainz, Germany — [2]Institut für Kernphysik, Universität Mainz, Germany

In the Standard Model (SM), Flavor Changing Neutral Currents (FCNC) are forbidden at the tree level and highly suppressed at the loop level by the GIM mechanism. Studies of such FCNC decay processes provide a sensitive probe of New Physics (NP) beyond the SM. Some of the SM extensions predict that the branching ratios of FCNC decays can be significantly enhanced by NP sources. We investigate the potential of rare charm decays to constrain the extension of the SM. A search for the FCNC decays of neutral D^0 into two photons and two leptons or including radiative photon could be an opportunity to pursue with PANDA since electroweak channels involving photons in the final state are competitive with ongoing experiments. The event selection in the the environment of hadronic reactions is challenging, since the ratio between signal and background of about 10 orders of magnitude requires an effective background rejection. Results on the rare decay modes $D^0 \to \gamma\gamma$ and $D^0 \to \mu^+\mu^-(\gamma)$ will be presented, which were obtained using Monte Carlo simulations of the PANDA experiment. In this presentation, we will perform an evaluation of upper limits of branching ratios incorporating previous experiments in sensitivity.

HK 27.5 Tue 15:45 T/SR19

Test of the $X(3872)$ molecular hypothesis in $\bar{p}A$ collisions — •Alexei Larionov[1,2], Mark Strikman[3], and Marcus Bleicher[1,4] — [1]Frankfurt Institute for Advanced Studies (FIAS), D-60438 Frankfurt am Main, Germany — [2]National Research Center "Kurchatov Institute", 123182 Moscow, Russia — [3]Pennsylvania State University, University Park, PA 16802, USA — [4]Institut für Theoretische Physik, J.W. Goethe-Universität, D-60438 Frankfurt am Main, Germany

The mass of the exotic $c\bar{c}$ state $X(3872)$ deviates by less than 1 MeV

from the $D^0\bar{D}^{*0}$ threshold. It is thus possible that the $X(3872)$ state is the meson molecule with dominating $D^0\bar{D}^{*0} + \bar{D}^0 D^{*0}$ content. Up to now, however, only indirect tests of this hypothesis have been proposed by measuring the $X(3872)$ radiative and isospin-violating decays. Unfortunately, the decay rates are very sensitive to the model details even within the fixed, e.g. charmonium or molecular model setups, (c.f. [1,2] and refs. therein). We show that the $X(3872)$-mediated $\bar{D}^*$ or D production in the antiproton-nucleus reactions results in the narrow light-cone momentum fraction distributions at small transverse momenta. This can serve as an unambiguous test of the molecular picture of the $X(3872)$-state, similar to the deuteron structure tests by neutron stripping reaction at high energies. Thus, we propose to test the molecular hypothesis of the $X(3872)$-structure at PANDA by searching for the D, $\bar{D}^*$ stripping production off nuclear targets

[1] E.S. Swanson, Phys. Lett. B **598**, 197 (2004).
[2] F. Aceti, R. Molina, and E. Oset, Phys. Rev. D **86**, 113007 (2012).

Supported by HIC for FAIR.

HK 27.6 Tue 16:00 T/SR19

Light quark mass dependence and finite volume effects for the X(3872) in an effective field theory — •Maximilian Jansen[1], Hans-Werner Hammer[1,2], and Yu Jia[3,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China — [4]Theoretical Physics Center for Science Facilities, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China

The quark mass and volume dependence of hadrons are an important input for lattice calculations. We investigate the light quark mass dependence of the binding energy of the $X(3872)$ and the $\bar{D}^0 D^{*0}$ scattering length in the $C = +1$ channel to next-to-leading order in an effective field theory for the X (XEFT) where pion interactions are perturbative. At this order, the quark mass dependence is determined by a quark mass-dependent contact interaction in addition to the one-pion exchange. Using naturalness arguments to constrain unknown parameters, we find a moderate sensitivity of the binding energy for quark masses up to twice the physical value while the scattering length is more sensitive. Recent simulations for the X are performed on lattices with spatial box lengths being small compared to the typical length scale of the $\bar{D}^0 D^{*0}$ system. Finite volume corrections are hence essential in order to make reliable predictions for observables of the X. We present our preliminary results for the shift of the the binding energy of the X in a finite volume.

HK 27.7 Tue 16:15 T/SR19

Towards understanding the near-threshold antiproton-proton spectra from J/ψ and ψ' decays by the final-state interaction effects — •Xianwei Kang[1], Johann Haidenbauer[1], and Ulf-G. Meissner[1,2] — [1]Institute for Advanced Simulation and Jülich Center for Hadron Physics, Institute für Kernphysik, Foschungszentrum Jülich,Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics,Universität Bonn

Utilzing the Jost-function approach, we analyze all the existing data for $p\bar{p}$ spectrum up to excess energy of 100 MeV from J/ψ, ψ' decays to γ, π, η or $\omega p\bar{p}$. For the potential used in this analysis, both the chiral potential constructed by us previously and the Jülich model A(OBE) have been considered. We have shown that the near-threshold spectrum can be described by our treatment of the final state interaction effect.

HK 28: Hadron Structure and Spectroscopy 6

Time: Tuesday 14:30–16:30 Location: T/SR25

Group Report HK 28.1 Tue 14:30 T/SR25

Analysis of η-Meson Decays from the WASA Campaign at COSY — •Daniel Lersch for the WASA-at-COSY-Collaboration — Forschungszentrum Jülich, Germany

A $pp \to pp\eta$ data sample has been acquired with the WASA-at-COSY facility at Forschungszentrum Jülich. A proton beam is accelerated with 1.4 GeV kinetic energy within the COSY storage ring towards a liquid hydrogen pellet target producing η-mesons. The η-decay products as well as the forward-scattered projectiles are detected within the 4π WASA-at-COSY detector. A first round of experiments was done with the $pd \to {}^3He\eta$ reaction used for the study of the more abundant η decay channels and to set up the framework for a common analysis. In order to address also rare decays $\sim 10^9$ η-mesons have been collected in the $pp \to pp\eta$ reaction.

The study of η-decays allows to probe symmetry-breaking phenomena (e.g. C- and CP-violation), to test theoretical calculations and to explore the anomalous sector of QCD. The current analysis of the $pp \to pp\eta$ data set is related to the charged decay modes of the η-meson: $\eta \to \pi^+\pi^-\pi^0$ allows to probe quark mass ratios, $\eta \to e^+e^-\gamma$ and $\eta \to e^+e^-e^+e^-$ serve to determine the electromagnetic transition form factor, the C-violating decay $\eta \to \pi^0 e^+e^-$, or the radiative decay $\eta \to \pi^+\pi^-\gamma$ which is (in the chiral limit) sensitive to the box anomaly.

This talk will give an overview about the status of the analyses.

HK 28.2 Tue 15:00 T/SR25

Produktion neutraler Mesonen bei COMPASS — •Tobias Weisrock — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

COMPASS untersucht die Reaktionen von 190 GeV/c Protonen mit einem Flüssigwasserstofftarget. Der Fokus liegt dabei auf der Produktion einzelner neutraler Mesonen, d. h. $pp \to ppM^0$, wobei sowohl pseudoskalare Mesonen ($M^0 = \pi^0, \eta$) als auch Vektormesonen ($M^0 = \omega, \phi$) untersucht werden. Das Verhältnis der Produktionsquerschnitte als Funktion der Feynmanvariable x_F und des Impulsübertrags t' ermöglicht eine Untersuchung der verschiedenen Reaktionsmechanismen. Dies ist ein erster Schritt zur Abtrennung des Untergrundes für eine Partialwellenanalyse.

HK 28.3 Tue 15:15 T/SR25

Electromagnetic transition form factor of the η meson with WASA-at-COSY — •Ankita Goswami for the WASA-at-COSY-Collaboration — Indian Institute of Technology Indore, Indore, India

The aim of this work is to measure the transition form factor of the η meson. The transition form factor describes the internal structure of a particle. The precise determination of the transition form factor of the η meson is possible through the $\eta \to \gamma e^+e^-$ Dalitz decay. When a particle is point-like then its decay rate can be calculated within QED. However, the complex structure of the particle modifies its decay rate. The transition form factor is determined by comparing the lepton-antilepton invariant mass distribution with QED. η mesons are produced using the reaction pp→ppη at a beam kinetic energy of 1.4MeV at the COSY accelerator of Forschungszentrum Jülich and decay particles of the η meson are detected with the WASA detector. In the higher invariant mass region recent theoretical calculations slightly deviate from the the data. With the high statistics dataset we expect precise results in the higher invariant mass region. The status of the analysis will be reported.

∗Supported by the FFE program of Forschungszentrum Jülich.

HK 28.4 Tue 15:30 T/SR25

Towards a new upper limit for 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, WestfälischeWilhelms-Universität Münster, Germany

A major part of the WASA-at-COSY experimental program is dedicated to investigations on symmetries and symmetry breaking to get 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. Here the η-meson is of particular interest. High statistics of η-meson production are required to obtain new limits on the C, P and T symmetry breaking or combinations thereof. The study of rare meson decays also allows to search for physics beyond the standard model like the dark photon.

In this contribution we will present and discuss investigations 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. 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 28.5 Tue 15:45 T/SR25

Measurement of space-like η and η' transition form factors at BESIII — •Michael Diefenbach, Achim Denig, and Christoph Redmer — Institut für Kernphysik, Universität Mainz, Deutschland

Transition form factors of light pseudoscalar mesons are an important ingredient to the calculations of hadronic contributions to the anomalous magnetic moment of the muon. The BESIII experiment at the e^+e^- collider BEPCII in Beijing has collected 2.9 fb^{-1} of data at the center of mass energy of 3.773 GeV. Based on these data two-photon collisions are studied using a single-tag technique. The analysis aims at the determination of the transition form factors of η and η' mesons in a region of momentum transfer below 3 GeV^2. In this presentation we will give an overview of the current status of the analysis.

Supported by DFG (SFB 1044).

HK 28.6 Tue 16:00 T/SR25

Measurement of the hadronic cross section e+e- to pi+pi-pi0pi0 at BES-III — Achim Denig and •Martin Ripka — Kernphysik Uni Mainz

Experimental and theoretical values of the muon anomalous magnetic moment presently show a deviation of more than 3 standard deviations. While the electromagnetic and the weak contributions to its theoretical value are well under control, the QCD contributions have to be obtained from data. Experimental measurements of hadronic cross sections can indeed be used to determine the QCD loop contributions using the optical theorem. This talk is about the contribution of the 2pi2pi0 ISR channel using ISR data from the BESIII experiment in Beijing/China. Preliminary results of the simulated cross section will be shown.

HK 28.7 Tue 16:15 T/SR25

Pseudoscalar transition form factors from rational approximants — •Pablo Sanchez-Puertas — Institut für Kernphysik , Johannes Gutenberg-Universität Mainz

Pseudoscalar Transition Form Factors are analyzed in the space-like region at the low- and intermediate- energy regions with rational approximants in a model-independent way. Low-energy parameters are, then, extracted from a fit to such data. The feasibility of the form factors to determine the η and η' mixing is analyzed as well as their implications into the light-by-light contribution to the anomalous magnetic moment and the pseudoscalar decays into a lepton pair.

HK 29: Nuclear Astrophysics 2

Time: Tuesday 17:00–18:45 Location: K/HS2

Group Report HK 29.1 Tue 17:00 K/HS2

Underground nuclear astrophysics at the Dresden Felsenkeller — •Daniel Bemmerer[1], Thomas E. Cowan[1,2], Stefan Gohl[1,2], Marcel Grieger[1,2], Christoph Ilgner[1], Arnd R. Junghans[1], Stefan Müller[1], Tobias P. Reinhardt[2], Stefan Reinicke[1,2], Bernd Rimarzig[1], Marko Röder[1,2], Konrad Schmidt[1,2], Ronald Schwengner[1], Klaus Stöckel[1,2], 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

Favored by the low background underground, accelerator-based experiments are an important tool to study nuclear astrophysics reactions involving stable charged particles. This technique has been used with great success at the 0.4 MV LUNA accelerator in the Gran Sasso laboratory in Italy. However, the nuclear reactions of helium and carbon burning and the neutron source reactions for the astrophysical s-process require higher beam energies, as well as the continuation of solar fusion studies. As a result, NuPECC strongly recommended the installation of one or more higher-energy underground accelerators. Such a project is underway in Dresden. A 5 MV Pelletron accelerator is currently being refurbished by installing an ion source on the high voltage terminal, enabling intensive helium beams. The preparation of the underground site is funded, and the civil engineering project is being updated. The science case, operational strategy and project status will be reported. – Supported by NAVI (HGF VH-VI-417) and by DFG (TU Dresden Institutional Strategy, "support the best").

HK 29.2 Tue 17:30 K/HS2

Wirkungsquerschnitte von (γ,n)-Reaktionen mit quasi-monoenergetischen Photonen — •Taniya Thomas[1], Anne Endres[1], Philipp Erbacher[1], Jan Glorius[1], Rene Reifarth[1], Deniz Savran[2] und Kerstin Sonnabend[1] — [1]Goethe Universität Frankfurt — [2]ExtreMe Matter Institute EMMI, GSI, Darmstadt

Der p-Prozess ist der Überbegriff für Prozesse zur Erzeugung protonenreicher Kerne schwerer als Eisen, die durch andere Nukleosyntheseprozesse nicht synthetisiert werden können. Einer dieser Prozesse ist der γ-Prozess, ein Photodesintegrationsprozess, der in Supernovaexplosionen stattfindet und für die Erzeugung schwerer p-Kerne verantwortlich ist. Dabei werden bereits vorhandene neutronenreiche Kerne photodesintegriert. Um diesen Prozess zu reproduzieren braucht man die Wirkungsquerschnitte der beteiligten Reaktionen. Fünf solcher Wirkungsquerschnitte wurden bei verschiedenen Strahlenergien mit einem Aktivierungsexperiment an der "High Intensity γ-Ray Source HIγS"der Duke University, USA, untersucht. Hierfür wurden natürlich zusammengesetzte Proben von Ytterbium, Thulium und Tellur mit quasi-monoenergetischen Photonen aktiviert. Die aktivierten Proben wurden mit hochreinen Germaniumdetektoren spektroskopiert. Damit können die Wirkungsquerschnitte der Reaktionen ^{170,176}Yb(γ,n), ^{169}Tm(γ,n) und ^{128,130}Te(γ,n) bestimmt werden. Die vorläufigen Ergebnisse werden dazu vorgestellt. Dieses Projekt wird gefördert durch die DFG (SO907/2-1), HIC for FAIR und EMMI.

HK 29.3 Tue 17:45 K/HS2

Activation measurements of α-induced reactions at sub-Coulomb energies — •Philipp Scholz[1], Anne Endres[2], Alfred Dewald[1], Stefan Heinze[1], Jan Mayer[1], Claus Müller-Gatermann[1], Lars Netterdon[1], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institute for Applied Physics, Goethe University Frankfurt am Main

Network calculations of the γ process rely almost completely on theoretically predicted reaction rates within the scope of the Hauser-Feshbach Statistical Model. Especially the prediction of cross sections for (γ,α)-reactions at energies within or close to the astrophysically relevant energy window remains a problem due to the uncertainties in the underlying α-optical-model potentials. Although experimental values far above the Coulomb-barrier are well reproduced, commonly used α-optical potentials often fail to describe the trend at energies comparable to those at astrophysical sites of the γ process. Improvements of the adopted optical-model potentials are hampered by the lack of experimental cross sections at sub-Coulomb energies. In order to enlarge the experimental data base, cross sections of the ^{187}Re(α,n) and ^{108}Cd(α,n) reactions were investigated using the activation technique with the Cologne Clover Counting Setup. Besides recent experimental results, future plans for more sensitive cross-section studies applying Accelerator Mass Spectrometry using CologneAMS will be presented.

Partly supported by the DFG (ZI 510/5-1 and INST 216/544-1) and the ULDETIS project within the UoC Excellence Initiative institutional strategy.

HK 29.4 Tue 18:00 K/HS2

S factor of ^{14}N(p,γ)^{15}O at 0.4 - 1.4 MeV — •Louis Wagner[1,2], Shavkat Akhmadaliev[1], Michael Anders[1,2], Daniel Bemmerer[1], Zoltan Elekes[1], Stefan Gohl[1,2], Arnd Junghans[1], Michele Marta[3], Frans Munnik[1], Tobias Reinhardt[2], Stefan Reinicke[1,2], Marko Röder[1,2], Konrad Schmidt[1,2], Ronald Schwengner[1], Martin Serfling[1,2], Tamas Szücs[1], Marcell Takacs[1,2], Andreas Wagner[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

For solar model calculations precise knowledge of the relevant fusion cross sections is needed. In the solar core the rate of the CNO cycle is dominated by the bottleneck ^{14}N(p,γ)^{15}O reaction, because this is the slowest reaction of the cycle. A proton beam with energies of 0.4 - 1.4 MeV delivered by the 3 MV Tandetron of Helmholtz-Zentrum Dresden-Rossendorf was used to study the non-resonant cross section of ^{14}N(p,γ)^{15}O. The talk presents the characterisation of the used TiN targets with Elastic Recoil Detection Analysis (ERDA), new data for the S factor of ^{14}N(p,γ)^{15}O and a R-Matrix extraplolation for capture to the excited state at 6.79 MeV.

– Supported by the Helmholtz association through the Nuclear Astrophysics Virtual Institute (HGF VH-VI-417).

HK 29.5 Tue 18:15 K/HS2

S-factor measurement of ^{12}C(p,γ)^{13}N in inverse kinematics — •Klaus Stöckel[1,2], Tobias P. Reinhardt[2], Shavkat Akhmadaliev[1], Daniel Bemmerer[1], Stefan Gohl[1,2], Stefan Reinicke[1,2], Konrad Schmidt[1,2], Martin Serfling[1,2], Tamás Szücs[1], Marcell P. Takács[1,2], Louis Wagner[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany

The ^{12}C(p,γ)^{13}N is the second slowest reaction in the CNO cycle. Hence, it affects the reaction rate in the outer parts of the solar core, where due to the lower temperature the CNO cycle has not yet reached its equilibrium. The last comprehensive study of the ^{12}C(p,γ)^{13}N reaction dates back to the 1970s. The reaction has been studied using a ^{12}C beam at the Dresden 3 MV Tandetron, solid hydrogen targets and a lead shielded 60 % HPGe detector. Hydrogen depth profiling with a ^{15}N beam was used for the determination of the target characteristics. The excitation function has been determined down to 152 keV. — Supported by BMBF (05P120DNUG) and by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute NAVI, (HGF VH-VI-417).

HK 29.6 Tue 18:30 K/HS2

Measurement of the ^{26}Si(p,γ)^{27}P cross section via the Coulomb dissociation of ^{27}P. — •Justyna Marganiec[1,2,3], Saul Beceiro-Novo[4], Stefan Typel[3], Christine Wimmer[5], Thomas Aumann[1,3], Dolores Cortina Gil[4], Michael Heil[3], and Klaus Sümmerer[3] for the R3B-Collaboration — [1]TU Darmstadt, Germany — [2]EMMI-GSI Darmstadt, Germany — [3]GSI Darmstadt, Germany — [4]Universidade de Santiago de Compostela, Spain — [5]Goethe-Universität, Frankfurt am Main, Germany

The reaction ^{26}Si(p,γ)^{27}P can, under certain conditions, be significant in the context of the astrophysical *rp* process. Since ^{26}Si has a short half-life, the reaction was investigated via the time-reversed process, the Coulomb dissociation (CD) of ^{27}P into ^{26}Si and proton. The differential CD cross sections can be converted to radiative-capture cross sections via virtual-photon theory and detailed balance. The experiment was performed at the LAND/R^{3}B setup at GSI Darmstadt. The secondary ^{27}P beam was produced by fragmentation of ^{36}Ar and impinged onto a Pb target. The incoming beam particles and outgoing reaction products were identified and tracked event by event. Corrections were applied to select only transitions directly to the ^{26}Si ground state and to remove contributions from nuclear processes and reactions in layers outside the target. The results are compared to potential-model calculations of the CD of ^{27}P. Consequences for the astrophysical *rp* process will be discussed.

This project is supported by NAVI, GSI-TU Darmstadt cooperation, HIC for FAIR, EMMI and BMBF project 05P12RDFN8.

HK 30: Instrumentation 10

Time: Tuesday 17:00–18:30 Location: M/HS1

Group Report HK 30.1 Tue 17:00 M/HS1

Status of the CBM Micro Vertex Detector — •Michal Koziel for the CBM-MVD-Collaboration — Goethe-Universität

The fixed-target experiment CBM at FAIR will explore the phase diagram of strongly interacting matter in the regime of highest net baryon densities with numerous probes, among them open charm. For the reconstruction of open charm hadrons with the CBM experiment a Micro Vertex Detector (MVD) with an excellent spatial resolution of the secondary decay vertex is required. Hence, a material budget of a few 0.1% X0 is mandatory for the individual detector stations positioned downstream in close vicinity to the target. To reduce multiple scattering, the MVD operates in vacuum, which poses challenging requirements on both, the power dissipation of the sensors and the integration concept. Here one should mention the selection of high-performance materials providing the mechanical support and cooling for the 0.05 mm thin sensors, establishing the sensor quality assessment procedures as well as defining the sensor integration. In addition, a substantial progress with respect to sensor development will be reported, mainly to the studies on their radiation hardness. Also, the 2nd generation of the sensor control and read-out based on TRBv3 standard has been commissioned. In this contribution we will highlight several activities that have been successfully accomplished, which enable us to define the start version of the CBM MVD.***This work has been supported by BMBF (05P12RFFC7), GSI, HIC for FAIR, EU-FP7 HadronPhysics3.***

HK 30.2 Tue 17:30 M/HS1

A time digitizer for the microstrip detectors of the PANDA MVD — •Alberto Riccardi[1], Kai-Thomas Brinkmann[1], Valentino Di Pietro[1], Sara Garbolino[2], Angelo Rivetti[2], and Manuel Rolo[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut Justus-Liebig-Universität Giessen, Giessen, Germany — [2]INFN Sezione di Torino, Torino, Italy

In nuclear detectors the information on the energy of the particle is usually obtained by measuring the amplitude of the signal delivered by the sensor. The low voltage power supply used in modern deep submicron technologies constrain the maximum dynamic range of the ADC. Still, the energy information can be obtained with time-based techniques, in which the energy is associated with the duration of the signal through the Time over Threshold method. This work is focused on the PANDA Micro Vertex Detector and explores the possibility of applying a time-based readout approach for the microstip sensors. In PANDA , the strip system must cope with hit rates up to 50 kHz per channel. Therefore, the front-end output must be relatively short, this implies that the clock resolution is not enough to measure the signal duration, so it is necessary to use a Time to Digital Converter. The front-end and the TDC structure are designed in a 0.11μm CMOS process. The TDC chosen is based on an analog clock interpolator because it combines good time resolution with a fairly simple implementation and low power consumption. In the presentation an overview of the analog part of the PASTA (PANDA strip ASIC) will be presented. Supported by BMBF, HIC for FAIR and JCHP.

HK 30.3 Tue 17:45 M/HS1

The Front-End Amplifier for the Silicon Microstrip Sensors of the PANDA MVD — •Valentino Di Pietro[1], Kai-Thomas Brinkmann[1], Alberto Riccardi[1], Angelo Rivetti[2], and Manuel Rolo[2] — [1]II. Physikalisches Institut, JLU Gießen, Germany — [2]INFN Sezione di Torino, Italy

The most common readout systems designed for the nuclear physics detectors are based on amplitude measurements. The information that needs to be preserved is the charge delivered by a particle hitting the sensor. The electronic chain employed in these cases is made from two main building blocks: front-end amplifier and ADC. One of the issues associated with the implementation of such an architecture in scaled CMOS technologies is the dynamic range, because the charge information is extrapolated through the sampling of the peak of the front-end output signal. It is therefore interesting to explore the possibility of using time-based architectures offering better performances from that point of view. In fact, in these topologies the linearity between the charge and the signal duration can be maintained even if some building blocks in the chain saturate. The main drawback is the loss in resolution since a duration measurement involves the difference between two time measurements. This work will present the design of a front-end optimized for fast Time-over-Threshold applications. The circuit has been developed for the microstrip detectors of the PANDA experiment. The key features of the front-end amplifier will be illustrated and both schematic level and post-layout simulations will be discussed. Supported by BMBF, HIC for FAIR and JCHP.

HK 30.4 Tue 18:00 M/HS1

The GBT based readout concept for the Silicon Tracking System of the CBM experiment — •Joerg Lehnert for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Silicon Tracking System (STS) of the CBM experiment at FAIR is designed to handle interaction rates up to 10 MHz with hundreds of tracks in fixed target heavy ion collisions of up to 35 AGeV.

STS data will be read out from 14000 ASICs on 1800 frontend boards (FEBs) with a total of 1.8 million channels operating at rates from below 15 up to 1000 kHz and located in the STS detector box inside the CBM magnet with challenging conditions in terms of available space, radiation, magnetic field and temperature.

ASICs from 1, 2 or 5 FEBs operated at varying sensor potential will be connected via AC-coupled 320 MHz LVDS links to a readout board (ROB) employing radiation hard GBTX and Versatile Link components developed at CERN for data aggregation and optical readout. The approximately 1000 ROBs will be located inside the STS detector box, 4000 optical links will be routed from there to the subsequent FPGA based CBM data processing board (DPB).

The concept of the GBT based readout including connection scheme and custom protocol will be presented and an outlook on the ROB prototype will be given.

HK 30.5 Tue 18:15 M/HS1

Position Sensitive Silicon Detectors in the R^{3}B-Setup — •Ina Syndikus, Stefanos Paschalis, and Marina Petri for the R3B-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt

At the R^{3}B setup at the GSI Helmholtzzentrum für Schwerionenforschung GmbH in Darmstadt kinematically complete measurements of reactions with relativistic radioactive beams are feasible. The kinematically complete measurements require a variety of detection systems, which combined can deliver information on all particles involved in the reaction. An essential part of these measurements is the unambiguous event by event identification and tracking of the incoming beam particles and the outgoing, heavy reaction products. Among others, several position sensitive silicon detectors are used to measure the charge of the particles and the fragments before and after the target as well as their position. We present the results for the position and energy resolution of these detectors from alpha-particle measurement as well as in-beam experiments measured with digital electronics.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and the BMBF project 05P12RDFN8.

HK 31: Instrumentation 11

Time: Tuesday 17:00–19:00 Location: M/HS2

HK 31.1 Tue 17:00 M/HS2

Der Myonen-Detektor des CBM Experiments bei FAIR@SIS100 — •Anna Senger für die CBM-Kollaboration — GSI, Darmstadt, Deutschland

Eine der Herausforderungen des CBM Experiments ist die Messung von Myonenpaaren aus Zerfällen von Low-Mass-Vektormesonen (ρ, ω, ϕ), aus QGP Emission, aber auch aus Zerfällen von J/ψ und ψ', die in Schwerionenstößen erzeugt werden. Die Multiplizität der Myonenpaare (Multiplicität x Branching Ratio) variiert zwischen 10-3 und 10-9 pro zentralem Au+Au Stoß, wobei in jeder Reaktion bis zu 1000 geladene Hadronen emittiert werden. Die Unterdrückung der Hadronen und der Nachweis der Myonen werden durch ein aktives Absorbersystem erreicht, das aus mehreren Lagen Eisen und Detektorebenen besteht um die Spuren aller geladenen Teilchen rekonstruieren. Die Nachweis-Effizienzen und die Signal-zu-Untergrund Verhältnisse werden in Simulationsrechnungen untersucht, basierend auf realistischen Annahmen bezüglich der Teilchenmultiplizitäten und der Detektoreigenschaften. Die Ergebnisse der Simulationen für den FAIR Energien von 4 bis 10 AGeV für realistische Experimentbedingungen werden vorgestellt.

HK 31.2 Tue 17:15 M/HS2

Performance study of the Projectile Spectator Detector for the CBM Experiment — •Ilya Selyuzhenkov[1], Andrej Kugler[2], Vasilij Kushpil[2], Vasily Mikhaylov[2,3], Selim Seddiki[1], and Pavel Tlusty[2] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — [2]Nuclear Physics Institute, Academy of Sciences of the Czech Republic, Řež, Czech Republic — [3]Czech Technical University (CTU), Prague, Czech Republic

The expected performance of the Projectile Spectator Detector (PSD) for the CBM experiment at the future FAIR facility will be presented. The PSD is a compensating lead-scintillator calorimeter designed to measure the energy distribution of the projectile nuclei fragments (spectators) and forward going particles produced close to beam rapidity. The main purpose of the PSD is to provide an experimental estimate of heavy-ion collision centrality and reaction (symmetry) plane orientation.

A sample of heavy-ion collisions simulated with realistic modeling of nuclei fragment production, directed and elliptic flow of produced particles and transported through the GEANT Monte-Carlo of the CBM detector geometry is used to study the PSD performance. The performance of the centrality and reaction plane determination is explored with the PSD as a standalone detector and in a combination with other CBM subsystems.

HK 31.3 Tue 17:30 M/HS2

Symmetric Møller/Bhabha luminosity monitor for the OLYMPUS experiment — Luigi Capozza[2,3], Colton O'Connor[4], Jürgen Diefenbach[6], Boris Gläser[6], •Dmitry Khaneft[1,2], Yue Ma[3,5], Frank Maas[2,3], Roberto Pérez Benito[2,3], and David Rodríguez Piñeiro[2,3] — [1]Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]Helmholtz-Institut Mainz, Mainz, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]Massachusetts Institute of Technology, Cambridge, MA, USA — [5]Currently at Advanced Meson Laboratory, Nishina Centre, RIKEN, Japan — [6]Institut für Kernphysik, Mainz, Germany

The OLYMPUS experiment is motivated by the discrepancy between the proton electric to magnetic form factor ratio measured using unpolarized and polarized electron scattering. This discrepancy can be explained by a two-photon exchange (TPE) contribution in lepton-hadron scattering. Measuring the ratio of electron-proton and positron-proton elastic scattering cross sections the contribution of the TPE can be determined. For this purpose, very precise measurements of the relative luminosity have to be performed. The symmetric Møller/Bhabha luminosity monitor, made of calorimetric lead fluoride (PbF_2) Cherenkov detectors, provides precise data from counting coincidences Møller and Bhabha events. High sensitivity to the geometrical acceptance and alignment requires accurate study of systematic uncertainties.

HK 31.4 Tue 17:45 M/HS2

Simulation Studies for the PANDA Endcap Disc DIRC — •Mustafa Schmidt[1], Klim Biguenko[1], Michael Düren[1], Klaus Föhl[2], Avetik Hayrapetyan[1], Benno Kröck[1], Oliver Merle[1], and Julian Rieke[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland — [2]CERN, Genf, Schweiz

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.

During the design phase, extensive detector simulations have been performed to optimize and evaluate the design. The simulations were done using Geant4 and the PandaRoot framework in addition with a dedicated reconstruction software. An important aspect was the optimization of the imaging while taking the geometrical tolerances of the manufacturing process of the final detector into account. The main focus lies on the optimization process of the cylindrical and polynomial focussing optics at the edges of the detector plate, which has been performed with the merit function of a raytracer called PyOptics, written

by one of the group members.

HK 31.5 Tue 18:00 M/HS2

Development of a CO_2 Cooling System for the CBM Silicon Tracking System — •Jorge Sanchez Rosado[1], Burak Degirmenciler[1], Johann Heuser[1], Anton Lymanets[2], Hans Rudolf Schmidt[2], and Christian Sturm[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Eberhard Karls Universität Tübingen

The demanding requirements of current high-energy physics experiments curiously bring back the idea of using a well-known and present refrigerant in nature: CO_2. As an outcome of previous studies and effort made within the current upgrade programs of detectors like ATLAS or CMS, this refrigerant is the optimum solution. Due to its highest volumetric heat transfer coefficient, it fulfills the requirements in this kind of detectors such as reduction of mass budget and the use of smaller diameter for cooling pipes.

A two-phase (evaporative) CO_2 cooling system is taken as the first choice to extract the 42 kW dissipated by the electronics of the Silicon Tracking System, the central detector of the CBM experiment at FAIR that will be installed in the gap of the 1 T super-conducting dipole magnet in a confined volume of 2 m^3. As a step towards the final design of this a cooling system, a 1 kW cooling unit called TRACI-XL was conceived at GSI in cooperation with CERN. This scaled prototype allows gaining insight into the behavior of the full system with valuable conclusions in terms of thermodynamics, process engineering and automation.

HK 31.6 Tue 18:15 M/HS2

Simulation study of STS-XYTER front-end electronics in overload situations for the Silicon Tracking System in the CBM experiment — •Tomas Balog for the CBM-Collaboration — GSI, Darmstadt, Germany

In high-rate experiments, as the CBM Experiment at FAIR, a situation can occur in which the data rate temporarily exceeds the available bandwidth. With self-triggered front end electronics such overload situations would lead, without further measures, to uncontrolled data losses and potentially a large number of incomplete events. Mechanisms needed to control data losses and to ensure the collection of complete events can be understood via simulations performed with the hardware description language SystemC. Results from simulations of a simplified front-end electronics for the CBM Silicon Tracking System, based on the STS-XYTER ASIC, will be presented. Performed simulations give first insight in the behavior of data flow and data losses in the DAQ system of the CBM experiment. Options and solutions for the data throttling mechanisms at beam conditions required by the CBM experiment will be discussed.

HK 31.7 Tue 18:30 M/HS2

The contribution of cables to the material budget of the CBM-MVD — •Philipp Klaus, Jan Michel, and Joachim Stroth for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro-Vertex Detector (MVD) for the CBM experiment will be used for a very high vertexing resolution. Making the destinction between primary and secondary vertices is crucial to finding rare and quickly decaying particles such as D-mesons.

For three out of four stations, the electrical connections have to placed inside the acceptance of the detector. Those cables make up about 1/3 of the total material budget. This contribution will describe the progress of reducing the material of the MVD detector stations by using Aluminium traces instead of Copper traces for the flat readout cables. The effect of the resulting lower material budget on the physics performance of the detector is being evaluated with simulations and will be shown.

*This work is supported by BMBF (05P12RFFC7), GSI, HIC for FAIR and HGS-HIRe.

HK 31.8 Tue 18:45 M/HS2

Development of an alignment system for the CBM rich — Claudia Höhne, Tariq Mahmoud, and •Jordan Bendarouach for the CBM-Collaboration — Justus Liebig University, Gießen

The Compressed Baryonic Matter (CBM) experiment at the future FAIR complex will investigate the phase diagram of strongly interacting matter at high baryon density and moderate temperatures in A+A collisions from 4-35 AGeV.

One of the key detector components required for the CBM physics program is the RICH detector, which is developed for efficient and clean electron identification and pion suppression. Main detector components are a CO2 gaseous radiator, MAPMT or MCP photo-detectors and spherical glass mirror tiles, used as focusing elements, with spectral reflectivity down to the UV range. An important aspect to guarantee a stable operation of the RICH detector is the alignment and continuous monitor of the mirrors. CLAM (Continuous Line Alignment Monitoring), an alignment procedure developed by the COMPASS experiment, is planned to be used also for the RICH mirror system. A smaller-scale version has been implemented in the CBM RICH prototype detector and tested at the Cern PS/T9 beamline in November 2014.

Using a grid and target dots made of retro-reflective material, it is possible to align the mirrors and monitor their displacements over time by analyzing and applying mathematical calculations on photographic images of the grid and targets reflected on the mirrors. The concept, first data and results of image processing will be presented and discussed.

HK 32: Instrumentation 12

Time: Tuesday 17:00–19:00 Location: M/HS4

HK 32.1 Tue 17:00 M/HS4

Silicon Photomultiplier readout of NeuLAND — •Stefan Reinicke[1,2], Daniel Bemmerer[1], Thomas E. Cowan[1,2], Stefan Gohl[1], Klaus Heidel[1], Tobias P. Reinhardt[2,1], Marko Röder[1], Daniel Stach[1], Andreas Wagner[1], David Weinberger[1], and Kai Zuber[2] for the R3B-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]TU Dresden

Recent developements in the field of Silicon Photomultipliers indicate that they could be a potential alternative to the use of photomultiplier tubes for the detection of scintillation light at upcoming large neutron time-of-flight detectors like NeuLAND at FAIR.

With a focus on timing resolution, Silicon Photomultipliers from various manufacturers with active surfaces ranging from $1\,x\,1\,mm^2$ to $6\,x\,6\,mm^2$ were studied using inhouse developed preamplifier boards and a picosecond laser system. Tests were performed with small and large scale scintillators at the electron accelerator ELBE. The data are compared with Monte Carlo simulations.

— Supported by NupNET NEDENSAA (05 P09 CRFN5) and by GSI F&E (DR-ZUBE).

HK 32.2 Tue 17:15 M/HS4

High resolution MCP photon detectors for the PANDA Endcap Disc DIRC — •Julian Rieke[1], Klim Biguenko[1], Michael Düren[1], Erik Etzelmüller[1], Klaus Föhl[2], Avetik Hayrapetyan[1], Benno Kröck[1], Oliver Merle[1], and Mustafa Schmidt[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland — [2]CERN, Genf, Schweiz

The PANDA detector at the future FAIR facility in Darmstadt will require excellent particle identification (PID) to achieve its physics goals. The forward region between 5 and 22 degrees will be instrumented with a novel Disc DIRC detector which utilizes internally reflected Cherenkov light and will provide separation of pions, kaons and protons with momenta up to 4 GeV/c.

The Cherenkov photon readout will be carried out with high resolution microchannel plate photomultiplier tubes (MCP-PMTs). A custom made anode layout with a narrow strip pitch of 0.5 mm will allow the reconstructing of the point of impact of single photons with high precision. The tubes will be read out by a modified version of the TOFPET ASIC. The current status of the prototype testing of the tubes and the ASIC will be presented.

HK 32.3 Tue 17:30 M/HS4

Measurements of recent microchannel-plate photomultipliers with significantly increased lifetime — •Fred Uhlig, Wolf-

gang Eyrich, Albert Lehmann, and Alexander Britting for the PANDA-Collaboration — Universität Erlangen, physikal. Institut IV

Microchannel-plate photomultipliers (MCP-PMTs) are the favored sensors for the DIRC detectors (Detection of Internally Reflected Cherenkov Light) of the PANDA experiment. They are usable in high magnetic fields of up to 2T and reach a time resolution of better than 50 ps (σ). The anticipated average luminosity of $2 \cdot 10^{32}\ cm^{-2}s^{-1}$ in the detector requires a rate capability high enough to withstand a detected photon rate of about 200 kHz cm^{-2} at the MCP-PMT surfaces. The major drawback until recently was the limited lifetime of MCP-PMTs, which appears to be solved for the latest generation of MCP-PMT prototype devices. The aging parameter is the quantum efficiency as a function of the integrated anode charge, which will be in the region of 5 C/cm^2 for the Barrel- and the Disc-DIRC. We simultaneously measured the aging of several MCP-PMTs, which were treated with different methods to enhance the lifetime. Results of these measurements will be presented.
- supported by BMBF and GSI -

HK 32.4 Tue 17:45 M/HS4

Untersuchung der Zeitauflösung von verschiedenen Szintillator-/SiPM-Kombinationen — •Merlin Böhm, Fred Uhlig, Wolfgang Eyrich und Albert Lehmann für die PANDA-Kollaboration — Universität Erlangen-Nürnberg, Physikalisches Institut IV

Der Barrel-TOF-Detektor beim $\overline{\text{P}}$ANDA-Experiment soll die Zuordnung von Teilchenspuren zu den einzelnen Ereignissen unterstützen, sowie eine Teilchenidentifikation bei niedrigen Impulsen liefern. Dazu ist eine Zeitauflösung von <100 ps notwendig. Der Detektor ist als Hodoskop aus einigen Tausend szintillierenden Tiles (SciTils) in Kombination mit Siliziumphotomultipliern (SiPMs) geplant. Um die bestmögliche Zeitauflösung herauszufinden, wurden verschiedene Szintillator-Geometrien (z.B. 30x30x5 mm^3 bis 5x5x120 mm^3) mit SiPMs in unterschiedlichen Anordnungen untersucht. Hierzu wurden die SciTils mit einer Elektronenquelle abgescannt und die Zeitauflösung und Photonenausbeute als Funktion der Szintillatoroberfläche gemessen. Es wurden Auflösungen von ∼50 ps (σ) erreicht. Die verschiedenen Messungen und Resultate werden diskutiert.
- Gefördert durch BMBF und GSI -

HK 32.5 Tue 18:00 M/HS4

Proton detection in the neutron lifetime experiment PENeLOPE — •Christian Tietze for the PENeLOPE-Collaboration — Technische Universität München, Physik Department E18

Although neutron lifetime plays an important role in the Standard Model of particle physics, τ_n is not very precisely know and often discussed. The official PDG mean value has been lowered during the last years by more than 6σ to the new value of $880.3 \pm 1.1s$. The new precision experiment PENeLOPE, which is currently developed at Technische Universität München, will help to clear this up. Ultra-cold neutrons are lossless stored in a magneto-gravitational trap, formed by superconducting coils. The combined determination of τ_n by counting the surviving neutrons after each storage cycle on one side and in-situ detection of the decay protons on the other side together with a very good handle on systematic errors leads to an unprecedented precision of the neutron lifetime value of $0.1s$. This contribution will give an overview of the challenges concerning proton detection under the exceptional requirements of this experiment. The developed concept of using avalanche photodiodes for direct proton detection will be presented as well as results from first measurements with a prototype detector read out by particular developed electronics. This project is supported by the cluster of excellence "Origin and structure of the universe", the Deutsche Forschungsgemeinschaft and the Maier-Leibnitz Laboratorium, Garching.

HK 32.6 Tue 18:15 M/HS4

Towards the final MRPC design - Performance test with heavy ion beam — •Ingo Deppner and Norbert Herrmann — Physikalisches Institut Uni. Heidelberg, Heidelberg

The Compressed Baryonic Matter spectrometer (CBM) is a future heavy ion experiment located at the Facility for Anti-proton and Ion Research (FAIR) in Darmstadt, Germany. The 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. Aiming for an interaction rate of 10 MHz for Au+Au collisions the MRPCs have to cope with an incident particle flux between 0.1 kHz/cm^2 and 25 kHz/cm^2 depending on their location. Characterized by granularity and rate capability the actual conceptual design of the ToF-wall foresees 4 different counter types called MRPC1 - MRPC4.
In order to elaborate the final MRPC design of these counters a heavy ion test beam time was performed at GSI. In this contribution we will present performance test results of 2 different MRPC3 full size prototypes developed at Heidelberg University and Tsinghua University, Beijing.
Work was supported partially by BMBF 05P12VHFC7 and by EU/FP7-HadronPhysics3/WP19.

HK 32.7 Tue 18:30 M/HS4

SiPM properties at cryogenic temperatures — •Maik Biroth[1], Patrick Achenbach[1], Evangeline Downie[2], and Andreas Thomas[1] for the A2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany — [2]George Washington University, DC, USA

At the electron accelerator Mainzer Mikrotron (MAMI) an active target build of polarizable scintillators will be operated at approximately 25 mK. To read out the scintillation light, the photodetectors have to withstand cryogenic temperatures of 4 K and high count rates. Therefore the properties of different types of silicon photomultipliers (SiPMs) were studied at cryogenic temperatures. In liquid nitrogen at 77 K, problems with quenching in Hamamatsu SiPMs and with the protective epoxy layer covering Zecotek SiPMs were observed. Tests with one Zecotek SiPM were successful after removal of the epoxy layer in liquid helium at 4 K and no after-pulses could be observed. Fundamental parameters like break-down voltage, single-pixel gain, crosstalk probabilty and the dark-count rate were measured and compared to room temperature. The photon detection efficiency was estimated by SiPMs response to short LED pulses. All these parameters were extracted by curve-fitting of SiPM charge spectra with a new analytical function.

HK 32.8 Tue 18:45 M/HS4

Monte Carlo simulations for the optimisation of low-background Ge detector designs — •Janina Hakenmüller[1], Gerd Heusser[1], Matthias Laubenstein[2], Werner Maneschg[1], Jochen Schreiner[1], Hardy Simgen[1], Dominik Stolzenburg[1], Herbert Strecker[1], Marc Weber[1], and Jonas Westernmann[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Laboratori Nazionali del Gran Sasso, Via G. Acitelli 22, 67100 Assergi L'Aquila, Italy

Monte Carlo simulations for the low-background Ge spectrometer Giove at the underground laboratory of MPI-K, Heidelberg, are presented. In order to reduce the cosmogenic background at the present shallow depth (15 m w.e.) the shielding of the spectrometer includes an active muon veto and a passive shielding (lead and borated PE layers). The achieved background suppression is comparable to Ge spectrometers operated in much greater depth.

The geometry of the detector and the shielding were implemented using the Geant4-based toolkit MaGe. The simulations were successfully optimised by determining the correct diode position and active volume. With the help of the validated Monte Carlo simulation the contribution of the single components to the overall background can be examined. This includes a comparison between simulated results and measurements with different fillings of the sample chamber.

Having reproduced the measured detector background in the simulation provides the possibility to improve the background by reverse engineering of the passive and active shield layers in the simulation.

HK 33: Astroparticle Physics 1

Time: Tuesday 17:00–19:00 Location: P/H2

Group Report HK 33.1 Tue 17:00 P/H2

Sterile neutrino search with SOX/Borexino — •Birgit Neumair — for the SOX/Borexino Collaboration. Physik-Department E15, Technische Universität München, Germany

In the last years, several neutrino oscillation experiments reported results not compatible within the 3-neutrino model, which hint to the existence of light sterile neutrinos. To test this hypothesis, the SOX (Short distance neutrino Oscillations in BoreXino) experiment will search for oscillations from active to sterile neutrinos by placing radioactive electron (anti-)neutrino sources underneath the Borexino detector. Oscillations will be observed via a reduction of the detected interaction rate of the electron(anti-)neutrinos and an oscillatory pattern as a function of the neutrino energy and travelled distance. The talk will give an overview of the project and of the expected discovery potential for a 10MCi ^{51}Cr neutrino and a 100kCi ^{144}Ce antineutrino source.

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

Group Report HK 33.2 Tue 17:30 P/H2

Latest results from the Borexino experiment and future CNO-cycle analysis — •Jan Thurn[1] and the Borexino collaboration[2,3] — [1]Technische Universität Dresden — [2]INFN, Italy — [3]Laboratori Nazionali del Gran Sasso, Assergi, Italy

The sun is producing energy through a sequence of nuclear processes. The majority of the energy comes from the so called pp-chain where protons are merged into helium. Neutrinos named by their originating reactions are produced in several steps of this sequence. Besides the pp-chain, the CNO-cycle is considered responsible of ~1% of the total energy produced in the Sun. According to the standard astrophysics this cycle should be dominant in heavy stars. It is still unclear whether this cycle is present in our sun and how large is its contribution is, especially related to the so called 'metalliticity' problem. Differently from photons that travel about 100 000 years from the core of the sun to outside being scattered all the way, neutrinos (thanks to their weakly interacting nature) are giving a clearer signal for studying these reactions. The Borexino experiment, a low background sub-MeV neutrinos detector - by measuring the pp, pep, 7Be and 8B neutrino spectra and giving the only current limit on the CNO-neutrino flux - is one of the leading experiments in the solar neutrino physics. In this talk the latest results are presented, together with a roadmap for the next steps of solar neutrino analysis concerning the improvement of the CNO-cycle detection techniques

HK 33.3 Tue 18:00 P/H2

First Penning-trap mass measurement of the electron capture nuclide ^{163}Ho and its daughter ^{163}Dy for the ECHO project — •Fabian Schneider and the TRIGA-SPEC Collaboration for the ECHo-Collaboration — Institut für Kernchemie und Institut für Physik, Johannes Gutenberg-Universität Mainz

The ECHo (**E**lectron **C**apture of ^{163}**Ho**) project aims to determine the mass of the electron neutrino by measuring the calorimetric spectrum of ^{163}Ho. To be able to extract the neutrino mass from the spectrum near the endpoint a precise knowledge of the decay Q-value is necessary. The ideal way to measure this in a model independent way is by high-precision Penning-trap mass spectrometry.

The ECHo collaboration has ^{163}Ho samples available, which were produced by reactor neutron irradiation. Such samples are typically highly contaminated with radioactive and stable species. These were efficiently removed by chemical purification. Ionization by laser ablation allows high-precision Penning-trap mass measurements with sample sizes of 10^{16} atoms. From the measured cyclotron frequency ratio of ^{163}Ho^{16}O$^+$ to ^{163}Dy^{16}O$^+$ we determined the Q-value to be 2.5(7) keV. In addition absolute mass measurements using carbon cluster ions as reference were performed with an uncertainty two times lower than literature values.

Future measurements at SHIPTRAP (GSI, Darmstadt) and PENTATRAP (MPIK, Heidelberg) are planned with the aim to drastically improve the uncertainty of the Q-value down to a few eV and thus providing the required input for the ECHo project.

HK 33.4 Tue 18:15 P/H2

Messungen mit einer winkelselektiven Elektronenquelle am KATRIN-Hauptspektrometer — •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.) vermessen werden. Die Vermessung der Form des Tritium-β-Spektrums im Endpunktbereich ermöglicht eine modellunabhängige Bestimmung dieses wichtigen Parameters.

Die Energieanalyse der Zerfallselektronen erfolgt beim KATRIN-Experiment in einem elektrostatischen Spektrometer, das nach dem Prinzip des MAC-E-Filters arbeitet. Zur Charakterisierung des Spektrometers wird eine monoenergetische und winkelselektive Elektronenquelle benötigt, um unter anderem die Transmissionseigenschaften zu untersuchen.

An der WWU Münster wurde eine solche Photoelektronenquelle entwickelt, in der Elektronen mit geringer Linienbreite und definiertem Winkel zu den magnetischen Feldlinien aus einer mit UV-Licht beleuchteten Silberkathode emittiert und beschleunigt werden. Der Vortrag stellt den Aufbau der Photoelektronenquelle sowie Resultate der Messungen am Monitor- und am Haupspektrometer des KATRIN-Experiments vor.

Dieses Projekt wird unter dem Kennzeichen 05A11PM2 durch das BMBF gefördert.

HK 33.5 Tue 18:30 P/H2

Commissioning and first measurements with the *post regulation* for the high voltage system of the KATRIN-experiment — •Oliver Wack for the KATRIN-Collaboration — IKP,KIT,Karlsruhe,Germany

The Karlsruhe Tritium Neutrino-Experiment KATRIN will measure the endpoint energy region of the tritium β -decay spectrum to determine the mass of the electron antineutrino with a sensitivity of about $200 meV/c^2$. Therefore the principle of a MAC-E-filter spectrometer will be used. The retarding potential up to -35kV has to achieve a stability of at least 3ppm. For this two high precision voltage dividers in addition with high precision digital voltmeters will be monitoring the high voltage in parallel with another MAC-E-filter type spectrometer formerly used in the Mainz-Experiment.

This talk will give a brief introduction in the problem of electromagnetic disturbances coupling into the spectrometer resulting in AC noise in the retarding potential. It will also cover the hardware solution, the so called *post regulation* and the first measurements during the second main spectrometer commissioning phase.

HK 33.6 Tue 18:45 P/H2

Messungen der Transmissionseigenschaften des KATRIN Hauptspektrometers — •Moritz Erhard — Karlsruher Institut für Technologie (KIT), Institut für experimentelle Kernphysik (IEKP)

Ziel des Karlsruher Tritium Neutrino Experiments ist es, durch eine Endpunktsuntersuchung des β-Zerfallsspektrums von Tritium die effektive Masse des Elektronantineutrinos direkt und modellunabhängig mit einer Sensitivität von 200 meV/c^2 (90% CL) zu bestimmen. Um diese hohe Sensitivität zu erreichen wird das KATRIN Hauptspektrometer mit dem MAC-E-Filter (Magnetic Adiabatic Collimation followed by Electrostatic Filter) Prinzip betrieben.

Die Kenntnis der genauen Transmissionseigenschaften des Hauptspektrometers ist für die spätere Interpretation der Tritiumdaten und Extraktion der Neutrinomasse von großer Wichtigkeit.

In der aktuellen Messphase wurden Messungen mit einer Elektronenkanone durchgeführt die weitere Daten zur Bestimmung der Transmissionseigenschaften liefern die in diesem Vortrag präsentiert werden.

Gefördert durch das BMBF unter Kennzeichen 05A11VK3 und die Helmholtz-Gemeinschaft.

HK 34: Heavy Ion Collisions and QCD Phases 4

Time: Tuesday 17:00–19:00 Location: T/HS1

Group Report HK 34.1 Tue 17:00 T/HS1

Soft and Hard Probes in p-Pb Collisions with the ALICE Experiment — •Annika Passfeld for the ALICE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

In contrast to Pb-Pb collisions, the formation of a hot and dense medium as the quark-gluon plasma is not expected in p-Pb. Therefore, the effects of cold nuclear matter can be studied in isolation in this collision system. Furthermore p-Pb collisions bridge the multiplicity gap between pp and peripheral Pb-Pb collisions. Studying particle production in this region can improve the understanding of the underlying particle production mechanisms.

Whereas soft probes can shed light on effects like flow, hard probes are sensitive to the parton energy loss and can serve as an important constraint for the nuclear parton density functions providing information about the nuclear environment.

In this talk, p-Pb results from the ALICE group in Münster will be presented including the deuteron and neutral meson production as well as the analysis of charged jets.

HK 34.2 Tue 17:30 T/HS1

Charged pion, kaon and proton production in pp p-Pb and Pb-Pb collisions measured with ALICE — •Raul Tonatiuh Jimenez Bustamante for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Physikalisches Institut, Universität Heidelberg

The ALICE detector at the CERN LHC has excellent Particle IDentification (PID) capabilities in the central barrel ($|\eta| < 0.9$). This allows the production of pions, kaons and protons to be measured over a wide transverse momentum (p_T) range. The Inner Tracking System (ITS) and the Time Projection Chamber (TPC) measure the specific energy loss ($\mathrm{d}E/\mathrm{d}x$) of the particle, which provides track-by-track PID in the p_T range 0.1 to $\simeq$1.0 GeV/c. The time of flight detector (TOF) contributes to PID for the p_T range between 0.5 GeV/c and 3-4 GeV/c, while a Ring Imaging Cherenkov Detector (HMPID) extends the identification of protons till $p_T \simeq 6$ GeV/c. High p_T particles (up to 20 GeV/c) are identified using the relativistic rise of the specific energy loss in the TPC.

Results on identified particle spectra and production yield ratios at mid-rapidity measured by ALICE in different colliding systems (pp, p-Pb and Pb-Pb) will be presented. The similarities among them and the comparisons to models will be discussed. For Pb-Pb collisions the nuclear modification factor as a function of p_T will be shown for different collision centralities.

HK 34.3 Tue 17:45 T/HS1

π^0 reconstruction through a γ-conversion method with KF Particle Finder in the CBM experiment — •Maksym Zyzak[1,2,3], Ivan Kisel[1,2,3], and Iouri Vassiliev[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Goethe-Universitaet Frankfurt, Frankfurt am Main, Germany — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

The CBM experiment is being designed to study heavy-ion collisions at extremely high interaction rates and track densities. One of the main observables for CBM are light vector mesons decaying through dilepton channels, that are of the particular importance for the physics program of the experiment. Because of the low branching ratio the key issue for reconstruction of light vector mesons is background suppression. Being a major source of this background, π^0 and γ-conversion have to be carefully studied.

π^0 reconstruction through a γ-conversion method was implemented in the KF Particle Finder package for short-lived particle reconstruction. Based on the Kalman filter mathematics, the package allows to achieve high reconstruction quality for γ-particles and as a result — high quality for π^0 reconstructed with a width of 3 MeV/c^2. Studies were performed for pC and AuAu collisions at 10 and 25 $AGeV$ using realistic RICH, TRD and ToF PID.

Supported by FIAS, HICforFAIR and HGS-HIRe for FAIR.

HK 34.4 Tue 18:00 T/HS1

Tagging Neutral Mesons using Photons from Conversions and Calorimeters in ALICE — •Daniel Mühlheim for the ALICE-Collaboration — Institut für Kernphysik, Wilhelm-Klemm-Str. 9, 48149 Münster

The ALICE experiment is dedicated to the investigation of the so-called Quark-Gluon Plasma (QGP), which is generally believed to be created in highly energetic Pb-Pb collisions. Furthermore, pp and p-Pb collisions are studied in order to identify and understand effects which are not related to the creation of the QGP. Since photons do not directly participate in the strong interaction, they can be regarded as an ideal probe in all three collisions systems.

In general, there are two different principles to measure photons. One way is to make use of electromagnetic calorimeters. The other possibility is to look for photon conversions which happen within the detector material. In this work, photons from both detection principles are combined in order to reconstruct neutral mesons. Since two independent measurements are combined, this method provides an important cross-check for the respective results. Furthermore, the detection efficiency is maximized. By means of tagging neutral pions, the goal of this measurement is to determine the fraction of decay photons from all generated photons, generally referred to as R_γ, in all available collision systems.

In this talk, the measurement principles of the combinational method are introduced and discussed. Moreover, a first look into the analysis will be presented.

HK 34.5 Tue 18:15 T/HS1

Rekonstruktion neutraler Mesonen mit dem CBM-RICH Detektor über Konversion* — •Sascha Reinecke für die CBM-Kollaboration — Bergische Universität Wuppertal, Germany

Eines der geplanten Projekte bei FAIR ist das Schwerionenexperiment Compressed Baryonic Matter (CBM). Ziel ist die Untersuchung des QCD-Phasendiagramms sowie des Phasenübergangs hadronischer Materie zum Quark-Gluon Plasma. Die Untersuchung des invarianten Massenspektrums dileptonischer Zerfälle, insbesondere von ρ und ω, bietet hierbei eine Möglichkeit hoch-verdichtete Kernmaterie im frühen Kollisionsstadium zu untersuchen, da Leptonen das hadronische Medium ohne weitere Wechselwirkung verlassen können. Selbst mit sehr guter Teilchenidentifikation der Elektronen ist das resultierende e^+e^- invariante Massenspektrum jedoch nicht untergrundfrei zu rekonstruieren. Nach Anwendung aller Schnitte stellen Dalitz-Zerfälle von η und π^0 ($\eta/\pi^0 \to e^+e^-\gamma$) den dominierenden Untergrund dar. Eine genaue Bestimmung des Anteils an π^0 und η ist daher wichtig für den Untergrundabzug. Da die verschiedenen Verzweigungsverhältnisse sehr genau bekannt sind, kann der Untergrund über die Rekonstruktion von $\eta/\pi^0 \to \gamma\gamma$ erfolgen. Eine mögliche Nachweismethode der Photonen erfolgt über die Konversion im Detektormaterial, $\gamma \to e^+e^-$, mit nachfolgender Rekonstruktion der Konversionselektronen. Dies erfordert jedoch eine genaue Kenntnis der Konversionswahrscheinlichkeit, sowie die sichere Rekonstruktion der Konversionselektronen. Der Vortrag gibt einen Überblick über den Stand der Analyse.

*Gefördert durch BMBF-Verbundforschung 05P12PXFCE und GSI

HK 34.6 Tue 18:30 T/HS1

Reconstruction of neutral mesons via conversion method in Au+Au at 1.23AGeV with HADES — •Behnke Claudia for the HADES-Collaboration — Mav.von-Laue Str 1, 60438 Frankfurt

Lepton pairs emerging from decays of virtual photons represent promising probes of matter under extreme conditions. In the energy domain of 1 - 2 GeV per nucleon, the HADES experiment at GSI Helmholtzzentrum fuer Schwerionenforschung in Darmstadt studies di-electron and strangeness production in various reactions, i.e. collisions of pions, protons, deuterons and heavy-ions with nuclei. An 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 conversions of real photons will be demonstrated. We will present results from a two-photon analysis of Au+Au collisions at 1.23 GeV/u providing information on the production of neutral π^0 and η mesons. Supported by BMBF (06FY9100I and 05P12RFGHJ), HIC for FAIR, EMMI, GSI, HGS-Hire and H-QM

HK 34.7 Tue 18:45 T/HS1

Hadronic resonance reconstruction in πA and AA collisions at HADES — •Georgy Kornakov for the HADES-Collaboration — TU Darmstadt

Properties of nuclear matter at high temperatures and densities can be accessed by means of heavy ion collisions such as produced at SIS18 energies at GSI Helmholtzzentrum für Schwerionenforschung, in Darmstadt. The masses, widths and spectral shapes of the short lived resonances when embedded into a hot and dense medium can be modified. These modifications can be accessed by comparison of heavy-ion data to elementary and cold nuclear matter reactions. Moreover, their decay via a virtual photon contribute to the dilepton spectra and has to be properly handled in order to interpret the spectrum.

The inclusive reconstruction of strongly decaying particles with a lifetime close to that of the hot and dense medium is challenging as the decay products undergo rescattering and regeneration before freeze out. Moreover, the width and the low signal to background ratio of their invariant masses makes the reconstruction technically complicated.

In this contribution the method for inclusive resonance reconstruction in πA and AA collisions measured by HADES and preliminary results of such analysis will be presented.

This work has been supported by VH-NG-823, GSI and EMMI.

HK 35: Structure and Dynamics of Nuclei 7

Time: Tuesday 17:00–18:30 Location: T/SR14

Group Report HK 35.1 Tue 17:00 T/SR14

First results of the EXILL&FATIMA campaign at the Institut Laue Langevin* — •Jan Jolie[1], Jean-Marc Régis[1], Dennis Wilmsen[1,2], Nima Saed-Samii[1], Nigel Warr[1], Gilles de France[2], Emmanuel Clement[2], Aurelien Blanc[3], Michael Jentschel[3], Uli Köster[3], Paolo Mutti[3], Thorsten Soldner[3], Gary Simpson[4], Waldek UIrban[5], Alison Bruce[6], Stefan Lalskovski[6], Luis Fraile[7], Thorsten Kröll[8], Zsolt Podolyak[9], Patrick Regan[9], Wolfram Korten[10], Calin Ur[11], and Nicu Marginean[11] — [1]IKP, Universität zu Köln, Zülpicher Str. 77, 50937 Köln — [2]GANIL, BP 55027 — [3]ILL, 71 Av. des Martyrs, 38042 Grenoble, France — [4]University of Western Scotland, Paisley, PA1 2BE, UK — [5]Faculty of Physics, University of Warsaw, 02-093 Warsaw, Poland — [6]SCEM, University of Brighton, Brighton BN2 4GJ, UK — [7]Grupo de fisica Nuclear, Universidad Complutese, 28040 Madrid, Spain — [8]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [9]Dep. of Physics, University of Surrey, Guildford GU2 7XH, UK — [10]CEA, centre de Saclay, IRFU, 91191 Gif-sur-Yvette, France — [11]Horia Hulubei NIPNE, 77125 Bucharest, Romania

At the PF1B cold neutron beam line at the Institut Laue Langevin the EXILL&FATIMA array consisting of 8 EXOGAM clover Ge detectors and 16 LaBr3(Ce) scintillators was used for the measurement of lifetimes using the generalised centroid difference method. The studied nuclei were formed by the (n,γ) and (n,fission) reactions. We report on the set-up and present first results on ^{90}Zr and ^{196}Pt.

*Supported by BMBF under grant 05P12PKNUF.

HK 35.2 Tue 17:30 T/SR14

Lebensdauerbestimmung der 2_1^+ - Zustände von ^{58,60,62}Ni mit DSAM nach CoulEx — •Waldemar Witt[1], Christian Stahl[1], Marc Lettmann[1], Norbert Pietralla[1], Robert Stegmann[1], Dennis Mücher[2] und Dominik Seiler[2] — [1]Technische Universität Darmstadt — [2]Technische Universität München

Die B(E2; $0_{g.s.}^+ \rightarrow 2_1^+$)-Übergangsstärke von ^{58}Ni dient als Normalisierungsstandard in vielen CoulEx-Experimenten. Die akzeptierte Lebensdauer $\tau(2_1^+)$ =0.94(3) ps $\sim \frac{1}{B(E2)}$ ist ein gewichtetes Mittel experimenteller Werte, die mit verschiedenen Methoden bestimmt wurden. Insbesonders die Werte, die mit DSAM gemessen wurden, sind teilweise inkonsistent.

Zur präzisen Messung der 2_1^+-Lebensdauern mit Fokus auf systematische Fehler wurden am MLL-Tandem-Beschleuniger ^{58,60,62}Ni-Ionen auf Energien von 125-135 MeV unterhalb der Coulomb-Schwelle beschleunigt und an dünnen C-Schichten Coulomb-angeregt. Die Bestimmung der Lebensdauern erfolgte mit DSAM mit vier MINIBALL Cluster-Detektoren und einem Silicium-CD-Detektor zur Messung der Reaktions-Kinematik. Als Stopper dienten Targetschichten aus Fe, Al und Cu. Es wurden nur die 2_1^+-Zustände der Ni-Isotope angeregt, wodurch Feeding ausgeschlossen werden kann.

Es wird das Programm APCAD verwendet, um Lineshapes simultan an alle HPGe-Detektor-Spektren zu fitten und daraus die Lebensdauern zu bestimmen. Systematische Fehlerbeiträge durch die Unsicherheiten der verwendeten Stopping-Power-Modelle werden durch die verschiedenen Stopper (Fe, Al, Cu) minimiert und hier diskutiert.

HK 35.3 Tue 17:45 T/SR14

Lebensdauermessung des 2_1^+ Zustands von ^{180}Hf mittels Fast-Electronics-Scintillation-Timing (FEST) — •R. Kern[1], V. Werner[1,4], D. Bucurescu[2], R. Carroll[3], N. Cooper[4], T. Daniel[3], D. Filipescu[2], N. Florea[2], D. Ghita[2], L. Gurgi[3], R. Ilieva[3,4], N. Marginean[2], R. Marginean[2], C. Mihai[2], F. Naqvi[4], C. Nita[2], R. Lica[2], S. Pascu[2], N. Pietralla[1], P.H. Regan[3] und J. Wiederhold[1] — [1]Institut für Kernphysik, TU-Darmstadt, Deutschland — [2]IFIN-HH, Bucharest, Rumänien — [3]Physics Department, University of Surrey, UK — [4]WNSL, Yale University

In wohldeformierten Kernen der seltenen Erden wurde eine Sättigung der B(E2;$0_1^+ \rightarrow 2_1^+$) Anregungsstärke zur Schalenmitte diskutiert. Im Gegensatz dazu steht die Erwartung von effektiven Valenzraum-Modellen, dass das Maximum der B(E2)-Werte beim Maximum des Valenzraums in der Mitte einer Schale liegt. Vor kurzer Zeit sind bei Messungen an Wolframisotopen nahe der Neutronenschalenmitte erhebliche Abweichungen von 2_1^+-Lebensdauern zu Literaturwerten und eine Verschiebung des Maximums der B(E2)-Werte zu niedrigeren Neutronenzahlen beobachtet worden. Wir haben diese Messungen nun auf die Hafniumisotopenkette erweitert. Dazu wurden am 9 MV Tandembeschleuniger des IFIN-HH in Bukarest Experimente mittels der FEST Methode durchgeführt. Erste Ergebnisse für ^{180}Hf, erhalten durch Coulomb-Anregung (^{180}Hf(^{16}O,^{16}O)^{180}Hf*), sowie die FEST Messmethode werden vorgestellt. Gefördert von DFG unter SFB 634 und U.S.DOE Grant No. DE-FG02-91ER40609.

HK 35.4 Tue 18:00 T/SR14

Lifetime measurement in the region of neutron rich Zirconium isotopes — •Damian Ralet[1,2], Stephane Pietri[2], Juergen Gerl[2], and Norbert Pietralla[1] for the S428 PreSPEC and AGATA-Collaboration — [1]Technische Universität, Darmstadt, Germany — [2]Helmholtzzentrum für Schwerionenforschung GmbH (GSI), Darmstadt, Germany

A gamma-ray spectroscopy experiment for the measurement of excited states lifetimes of ^{106}Zr was performed at GSI using the PreSPEC-AGATA setup. A ^{238}U primary beam from the SIS18 was fissioned on a Beryllium target positioned at the entrance of the FRagement Separator (FRS) to produce ^{107}Nb ions identified, and selected by the FRS. The particles of this secondary beam were fragmented at relativistic energy ($\beta = v/c \sim 0.5$) on a 700 mg/cm^2 thick Beryllium target positioned at the center of the Advanced GAmma Tracking Array (AGATA). The ^{106}Zr reaction products were identified by the Lund York Cologne Calorimeter (LYCCA). The energy and position of the gamma-rays emitted by these ejectiles were measured by 19-AGATA detectors. The position sensitivity of AGATA coupled with LYCCA detectors allow a lifetime determination using the Doppler Shift Attenuation Method (DSAM). The status of the data analysis and preliminary lifetime estimations will be presented.

HK 35.5 Tue 18:15 T/SR14

Hochpräzise Selbstabsorptionsmessung an ^{6}Li* — •Christopher Romig[1], Tobias Beck[1], Jacob Beller[1], Udo Gayer[1], Laura Mertes[1], Haridas Pai[1], Norbert Pietralla[1], Philipp Ries[1], Marcus Scheck[2,3], Volker Werner[1] und Markus Zweidinger[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt — [2]School of Engineering, University of the West of Scotland, Paisley, UK — [3]SUPA, Scottish Universities Physics Alliance, Glasgow, UK

Die Methode der relativen Selbstabsorption basiert auf Photonenstreuexperimenten und erlaubt es, Lebensdauern angeregter Zustände un-

terhalb von $\sim 10^{-12}$ s zu messen. Dabei ist die Methode unabhängig von Kalibrierungs- oder Referenzwerten und ermöglicht somit, hochpräzise Messungen durchzuführen. Sie wurde angewendet, um den ersten angeregten 0^+, $T = 1$ Zustand von ^{6}Li bei einer Anregungsenergie von 3562 keV zu untersuchen. Dieser Zustand ist der leichteste hadronische Zustand, der dominant über einen elektromagnetischen, namentlich einen M1-Übergang, zerfällt. Damit eignet er sich besonders als sensitiver Test für aktuelle *ab-initio* Kernstruktur-Rechnungen. Die Methode der relativen Selbstabsorption, die Analyse solcher Messungen und damit verknüpfte Schwierigkeiten sowie Ergebnisse der Messung an ^{6}Li werden vorgestellt und diskutiert.

* Diese Arbeit wurde durch die Deutsche Forschungsgemeinschaft (DFG) im Rahmen des Sonderforschungsbereichs SFB 634 gefördert.

HK 36: Structure and Dynamics of Nuclei 8

Time: Tuesday 17:00–19:00 Location: T/HS2

Group Report HK 36.1 Tue 17:00 T/HS2

Nucleon-nucleon scattering studies at small angles at COSY-ANKE — •Zara Bagdasarian for the ANKE-Collaboration — Forschungszentrum Jülich, Jülich, Germany — Tbilisi State University, Tbilisi, Georgia

The most accepted approach to describe nucleon-nucleon (NN) interaction is the partial wave analysis (PWA). The SAID database and analysis program comprise various experimental observables at different energies over the full angular range and express them in the partial waves. The goal of the experiments held at COSY-Jülich is to provide SAID with new valuable measurements. Scattering data was taken at small angles for six beam energies between 0.8 and 2.4 GeV with polarized proton beam incident on both proton and deuteron unpolarized targets using the ANKE spectrometer. First, the results of the proton-proton (pp) scattering analyzing power and cross section are presented. While pp data closes a very important gap at small angles in the database, proton-neutron (pn) data is a crucial contribution to the almost non-explored pn database above 800 MeV. Therefore, the talk will mainly concentrate on the proton-deuteron (pd) scattering studies, which includes the overview of the older COSY experiments with polarized deuteron beam, and the abovementioned new experiment with polarized proton beam and unpolarized deuteron target. The presentation will show the most recent results of the analyzing powers of pd elastic and pn scattering.

Group Report HK 36.2 Tue 17:30 T/HS2

Decay Spectroscopy with EURICA in the Region of ^{100}Sn — Thomas Faestermann, Roman Gernhäuser, •Daniel Lubos, and Konrad Steiger for the EURICA RIBF09-Collaboration — Technische Universität München, Germany

The most recent experiment on properties of nuclei in the region of ^{100}Sn has been performed at the radioisotope beam factory (RIBF) at the RIKEN Nishina Center. For the decay spectroscopy, we used the detector arrays EURICA and WASABI 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 an increase of statistics by a factor of ∼10 for N = Z - 1 nuclei and ^{100}Sn compared to previous experiments. The presentation gives an overview on the dedicated high efficiency setup and the experimental program. A status of the on-going analysis with regard to ^{100}Sn and selected results for several nuclei and isomers in this region will be discussed.

This project is supported by the DFG Cluster of Excellence: „Origin and Structure of the Universe“.

HK 36.3 Tue 18:00 T/HS2

Probing the O(6) character of ^{196}Pt with inelastic electron scattering — •Simela Aslanidou, Sergej Bassauer, Alexander Hufnagel, Christoph Kremer, Andreas Krugmann, Peter von Neumann-Cosel, Norbert Pietralla, and Maxim Singer — Institut für Kernphysik, Technische Universität Darmstadt

The Interacting-Boson-Model [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 transition 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 performed at the superconducting electron linear accelerator S-DALINAC at Darmstadt using the high resolution LINTOTT spectrometer. The experiment and analysis results will be presented.

This work is 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 36.4 Tue 18:15 T/HS2

Study of ground and excited state decays in $N \approx Z$ Ag nuclei — •Kevin Moschner[1], Andrey Blazhev[1], Plamen Boutachkov[2], Paul Davies[3], Robert Wadsworth[3], and Nigel Warr[1] for the EURICA-RIBF83-Collaboration — [1]IKP, University of Cologne, Germany — [2]GSI Darmstadt, Germany — [3]University of York, UK

A decay spectroscopy experiment was performed within the EURICA campaign at RIKEN in 2012. It aimed at the isomer and particle spectroscopy of excited states and ground states in the mass region below the doubly magic ^{100}Sn.

Projectile fragmentation of a 345 MeV/u ^{124}Xe beam on a ^{9}Be target was used to create the nuclei of interest. The fragments were then separated and identified on an event-by-event basis in the BigRIPS spectrometer and transported to the EURICA array to perform decay spectroscopy after implantation in the active stopper SIMBA.

In ^{94}Ag a more precise value for the half-life of the ground state's superallowed Fermi transition was deduced. In addition the energy spectra of the mentioned decay could be reproduced through precise Geant4 simulations of the used active stopper SIMBA which enabled us to extract Q_β values from the measured data.

Additionally, newly determined half-life values of the $(37/2^+)$ and $(23/2^+)$ isomers in ^{95}Ag will be presented.

This work is supported by the German BMBF under contract Nos. 05P09PKCI5 and 05P12PKFNE.

HK 36.5 Tue 18:30 T/HS2

Isomerer β^+-Zerfall von protonenreichen Kernen in der Region um ^{100}Sn — •O. Müller[1], R. Gernhäuser[2], S. Ilieva[1], T. Kröll[1], R. Krücken[3], M. Lewitowicz[4] und S. Nishimura[5] für die EURICA RIBF09-Kollaboration — [1]IKP, TU Darmstadt, Germany — [2]E12, TU München, Germany — [3]TRIUMF, Canada — [4]GANIL, France — [5]RIKEN, Japan

Der radioaktive Kern ^{100}Sn ist von besonders großem Interesse für die Physik, denn er ist der schwerste gebundene “doppelt magische” N=Z Kern. Während für doppelt magische Kerne sehr große log(ft)-Werte erwartet werden, wurde für ^{100}Sn der kleinste, jemals gemessene log(ft)-Wert gefunden [1]. Am RIKEN wurde im Rahmen der EURICA-Kampagne RIBF09 der doppelt magische Kern ^{100}Sn und benachbarte Kerne der ^{100}Sn-Region untersucht. Im Rahmen dieses Experiments wurde ^{100}Sn in einer vorher noch nie zugänglichen Statistik (∼ 2000 Kerne) erzeugt. Die Nuklide wurden in den Teilchendetektor WAS3ABi implantiert und untersucht. Mit Hilfe des EURICA-Aufbaus konnte die Energie der γ-Quanten des Nuklids detektiert werden. Im Rahmen dieser Arbeit werden die Lebensdauern von isomeren Zuständen von Kernen in der Region von ^{100}Sn untersucht. Diese physikalischen Observablen helfen, theoretische Vorhersagen mit Hilfe des Schalenmodells zu verbessern und den r-Prozess näher zu untersuchen.

[1] *C. B. Hinke et al., Nature 486 (2012) 341*

Gefördert durch BMBF (05P12RDCIA und 05P12RDUNP) und HIC for FAIR.

HK 36.6 Tue 18:45 T/HS2

Nuclear X-ray emission after fusion of heavy ions — •Christian Berner[1], Dennis Mücher[1], Roman Gernhäuser[1], Thomas Faestermann[1], Walter Henning[1,2], Kosuke Morita[3], Kouji Morimoto[3], and Daija Kaji[3] — [1]Technische Universität München, Lehrstuhl E12 — [2]Argonne National Laboratory — [3]RIKEN, Research Group for Superheavy Elements

The goal is to establish in-beam K-X-ray spectroscopy as a sensitive tool to identify super heavy elements (SHEs) produced in fusion reac-

tions via their proton number. SHEs, formed after cold or hot fusion, are usually identified via the alpha-decay products, which have to be connected to well-known elements. In case of hot fusion, the daughter nuclei quickly undergo spontaneous fission, so that the identification of the produced SHEs is difficult. Using the hot fusion approach in our first test experiments, the resultant products will be analysed by the gas-filled GARIS separator at the RILAC facility at RIKEN. As the X-ray detector is required to have superior energy and timing resolution to best identify the rare events at highest masses and to supress random coincidences as sufficient as possible, we chose a thin and planar geometry, which also reduces the damage caused by fast neutrons. We show first measurements using the MINIBALL Ge array at Munich. Additionally we report on our feasibility studies and on first tests using the new detector at high count rates together with a powerful DAQ system and transistor reset preamplifiers.

Supported by DFG Cluster of excellence: "Origin and structure of the Universe"

HK 37: Hadron Structure and Spectroscopy 7

Time: Tuesday 17:00–19:00 Location: T/SR19

Group Report HK 37.1 Tue 17:00 T/SR19

New experimental results on the η'-nucleus optical potential* — •Mariana Nanova for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The η'-nucleus interaction has been studied in photo production of η'-mesons off C and Nb targets, using the CBELSA/TAPS detector system. Transparency ratio measurements provide information on the inelastic cross section and in-medium width of mesons and thereby on the imaginary part of the meson-nucleus potential [1]. The real part of the optical potential can be deduced from measurements of the excitation function and momentum distribution which are sensitive to the sign and depth of the potential. Data taken on a C and Nb target have been analysed to determine the real part of the η' - nucleus optical potential. The results are compared to previous experimental results [2] and to model calculations assuming different scenarios for in-medium η' properties. The data of both measurements are consistent with a weakly attractive potential. The relatively small in-medium width of the η' meson encourages the search for η' bound states.

[1] M. Nanova et al., *Phys. Lett. B 710* (2012) 600
[2] M. Nanova et al., *Phys. Lett. B 727* (2013) 417

*Funded by DFG(SFB/TR-16)

HK 37.2 Tue 17:30 T/SR19

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'-nucleus bound states an inclusive measurement of the ^{12}C(p,d) reaction was performed using the fragment separator FRS at GSI as a spectrometer, as proposed in [1,2]. A proton beam of 2.5 GeV, delivered by SIS 18, was used to potentially populate η'-mesic states in ^{11}C. The missing mass of the reaction was measured by analyzing the momentum of the ejectile deuterons by particle tracking with two multi-wire drift chambers in the dispersive focal plane. An excitation energy range in ^{11}C of -100 MeV to +50 MeV near the η' production threshold was covered in several $B\rho$ settings of the FRS. Particle identification was achieved by time-of-flight measurements and Cherenkov detectors. Momentum calibration was provided by backward elastic scattering in the D(p,d)p reaction. Background processes such as multi-pion production were studied in the D(p,d) reaction. The current status of the data analysis will be presented.

[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 37.3 Tue 17:45 T/SR19

Search for η'-mesic states at BGO-OD* — •Eric Gutz — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The study of the interaction between mesons and the nuclear medium is a very promising approach to understand strong QCD at a fundamental level. The determination of the real and imaginary part of the η'-nucleus potential [1,2] indicates attraction and a relatively narrow in-medium width of the η' meson, making it a suitable candidate for the observation of meson-nucleus bound states. It has been proposed [3] to search such states in the ^{12}C(γ,p) $\eta'\otimes^{11}$B reaction, using the BGO-OD setup at ELSA which combines a magnetic spectrometer at forward angles with photon detection over a large solid angle in the BGO ball. This setup allows a search for η' mesic states by missing mass spectrometry as well as by looking for decays from η' mesic states in coincidence with forward going protons. Simulations of the proposed reaction will be presented and the feasibility of the experiment will be discussed in view of a recent test experiment.

[1] M. Nanova et al., *Phys. Lett. B* **727** (2013), 417
[2] M. Nanova et al., *Phys. Lett. B* **710** (2012), 600
[3] V. Metag et al., *approved proposal ELSA/3-2012-BGO*

*Funded by DFG (SFB/TR16)

HK 37.4 Tue 18:00 T/SR19

Studies on $\mathbf{p} + \mathbf{d} \rightarrow \mathbf{d} + \eta + \mathbf{p}_{\mathrm{sp}}$ at ANKE* — •Daniel Schroeer, Christopher Fritzsch, Daniel Guderian, Malte Mielke, Michael Papenbrock, and Alfons Khoukaz — Institut für Kernphysik, WestfälischeWilhelms-Universität Münster, Germany

An unexpectedly strong interaction between η mesons and He nuclei has been observed which could lead to the formation of η-mesic nuclei. In order to further investigate the properties of this interaction for different nuclei a measurement on the reaction $\mathbf{p}+\mathbf{d} \rightarrow \mathbf{d}+\eta+\mathbf{p}_{\mathrm{sp}}$ has been conducted at the ANKE spectrometer located at the COSY accelerator of the FZ Jülich. In this case the deuteron serves as an effective neutron target with the proton being a spectator particle. The combination of two different beam momenta of $p_1 = 2.09$ GeV/c and $p_2 = 2.25$ GeV/c and the Fermi motion inside the deuteron allows the extraction of total and differential cross sections in an excess energy range from 0 MeV up to 100 MeV. The behaviour of the total cross section near threshold will allow to calculate the scattering length $a_{d\eta}$ of an s-wave final state interaction ansatz while the differential cross sections enable to proof the validity of the s-wave assumption. These information will shed new light on the interaction between η mesons and nucleons. Additionally the data at higher excess energies will provide further information on the role of nucleonic resonances on the η meson production. Recent results will be presented and discussed.

*Supported by FFE program of the Forschungszentrum Jülich

HK 37.5 Tue 18:15 T/SR19

Investigation of different normalization reactions for dp collisions at ANKE* — •Christopher Fritzsch, Daniel Guderian, Malte Mielke, Michael Papenbrock, Daniel Schröer, and Alfons Khoukaz — Institut für Kernphysik, WestfälischeWilhelms-Universität Münster, Germany

Studies on the total cross sections of the reaction $d+p \rightarrow {}^3\mathrm{He}+\eta$ are of special interest since they differ strongly from a pure phase space behaviour near threshold. This behaviour could be an indication for the presence of a quasi bound state of the η^3He-system. New high precision data from the ANKE spectrometer at the accelerator ring COSY at the Forschungszentrum Jülich allow the extraction of precise total and differential cross section values for the η production up to an excess energy of $Q = 15$ MeV. Therefore, a careful luminosity determination was realized via dp-elastic scattering for 18 beam momenta in a range between 3120.17 MeV/$c \leq p_d \leq$ 3204.16 MeV/c. Furthermore, to verify the results of the dp-elastic scattering an independent normalization channel $d + p \rightarrow d + \pi^0 + p_{spec}$ was used. The method and recent results for both channels will be presented and discussed.

*This work has been supported by the COSY-FFE program of the Forschungszentrum Jülich.

HK 37.6 Tue 18:30 T/SR19

Investigating the pd → ^{3}Heη production cross section between $Q \approx 13.6$ MeV and $Q \approx 80.9$ MeV with WASA-at-COSY* — •Nils Hüsken, Florian Bergmann, Kay Demmich, Karsten Sitterberg, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Germany

In the near threshold region, the pd → ^{3}Heη reaction has been studied in great detail. At higher excess energies, however, the amount of available data is limited. While the data from the ANKE and WASA/PROMICE experiments expose a total cross section plateau, recent results from WASA-at-COSY suggest an unexpected narrow cross section variation at $Q = 48.8$ MeV. As the WASA-at-COSY experiment is perfectly suited to study the energy dependence of the total cross section, a beam time was realized in May 2014 in order to investigate the excess energy region of interest. The measurement covered 15 different beam momenta, resulting in a Q-value range between $Q \approx 13.6$ MeV and $Q \approx 80.9$ MeV. With the new data it will be possible to extract precise total and differential cross sections of the pd → ^{3}Heη reaction for all 15 excess energies.
First results on the pd → ^{3}Heη reaction will be presented as well as an outline for the future possibilities the new data presents.

*Supported by FFE program of the Forschungszentrum Jülich and the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n 283286.

HK 37.7 Tue 18:45 T/SR19

Hard exclusive ω-meson production at the COMPASS experiment — •Johannes ter Wolbeek, Horst Fischer, Matthias Gorzellik, Philipp Jörg, Kay Königsmann, Steffen Landgraf, Christopher Regali, Katharina Schmidt, Stefan Sirtl, and Tobias Szameitat — for the COMPASS collaboration, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

In the theoretical framework of Generalized Parton Distributions (GPDs) the two-dimensional spatial information, given by form factors, and the longitudinal momentum information from the PDFs are combined to a three-dimensional picture of the nucleon. According to Ji's sum rule, the GPDs H and E are directly connected to the total angular momenta of quarks and gluons. While H can be approached using electroproduction cross section, the exclusive production of ω-mesons off a transversely polarized target allows for access of GPD E. At the COMPASS experiment at CERN measurements were performed using a longitudinally polarized 160 GeV/c muon beam and a transversely polarized NH_3 target. This talk will introduce the data analysis of exclusive ω production and recent results will be presented and compared to theoretical predictions. Supported by BMBF, DFG and EU FP7 (Grant Agreement 283286).

HK 38: Hadron Structure and Spectroscopy 8

Time: Tuesday 17:00–19:00 Location: T/SR25

Group Report HK 38.1 Tue 17:00 T/SR25

Light Meson Decays from Photon-Induced Reactions with CLAS — •Michael C. Kunkel for the CLAS-Collaboration — Forschungszentrum Jülich

Photo-production experiments with the CEBAF Large Acceptance Spectrometer (CLAS) at the Thomas Jefferson National Laboratory produce data sets with unprecedented statistics of light mesons. With these data sets, measurements of transition form factors for η, ω, and η' via conversion decays are performed using a line shape analysis on the invariant mass of the final state dileptons. Tests of fundamental symmetries and information on the light quark mass difference are performed using a Dalitz plot analysis of the meson decay. In addition, the data allows for a search for dark matter, such as the heavy photon via conversion decays of light mesons and physics beyond the Standard Model is searched for via invisible decays of η mesons. An overview of the first results and future prospects will be given.

Group Report HK 38.2 Tue 17:30 T/SR25

Studies of η' (ω) mesons with the Crystal Ball/TAPS setup at MAMI — •Patrik Adlarson for the A2-Collaboration — Institut für Kernphysik, Johannes Gutenberg Universität, Mainz, Germany

Precision studies of light meson decays are used to investigate a wide range of topics related to fundamental aspects of hadron physics. In particular, η' decays allow for tests of such diverse topics as $\pi\pi$ scattering lengths, the SU(3) singlet-octet mixing angle, quark mass differences and light-by-light contribution to the anomalous magnetic moment of the muon. Recently, a large statistics sample of η' (ω) mesons have been produced and collected with the Crystal Ball/TAPS setup at MAMI. An overview of the physics motivation, the experimental setup and preliminary results from the ongoing analyses are presented.

HK 38.3 Tue 18:00 T/SR25

Measuring the branching fraction of $\omega \to \eta\gamma$ with the Crystal Ball Experiment at MAMI — •Oliver Steffen and Wolfgang Gradl for the A2-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, D-55099 Mainz

The Crystal Ball Collaboration uses energy tagged bremstrahlung photons produced from the MAMI electron beam to study photo-induced reactions on nucleons and nuclei. The Crystal Ball/TAPS 4π calorimeter setup is optimized for the detection of neutral final states. Charged particles are identified and measured by the inner detector system.

A large data set of photoproduced η' and ω mesons has been obtained during recent data taking periods with the End Point Tagger ($E_\gamma = 1.4$ to 1.6 GeV) and the liquid hydrogen target.

We plan to use this data to measure the branching fraction of the $\omega \to \eta\gamma$ decay. Simulation studies for this decay have already started.

In this talk we will present the current status of the ongoing work and discuss the next steps of the analysis.

HK 38.4 Tue 18:15 T/SR25

η-η' Mixing in Large-N_c Chiral Perturbation Theory — •Patricia Bickert, Pere Masjuan, and Stefan Scherer — Institut für Kernphysik, JGU, Mainz

We present a calculation of the η-η' mixing in the framework of large-N_c chiral perturbation theory. The results are obtained at next-to-next-to-leading order (NNLO) in a combined expansion in $1/N_c$, quark masses, and momenta. The numerical evaluation of masses and mixing angles is successively performed at leading order, NLO, and NNLO. We investigate the influence of unknown low-energy coupling constants on these quantities.

HK 38.5 Tue 18:30 T/SR25

Analysis of the radiative decay $J/\psi \to \gamma\omega\omega$ at BESIII — •Malte Albrecht — Institut für Experimentalphysik I, Ruhr-Universität Bochum

Gluonic bound states like glueballs or hybrids are predicted to be copiously produced in the radiative decays of J/ψ. Especially the radiative decays into two vector mesons, $J/\psi \to \gamma VV$, have been intensively studied, since pseudoscalar (0^-) enhancements have been observed in the $\rho\rho$, $\phi\phi$ and $\omega\omega$ final states with low statistics in the past.

In this talk we will show preliminary results of the analysis of the radiative decay $J/\psi \to \gamma\omega\omega$, using the world's largest data sample of $\approx 1.2 \cdot 10^9 J/\psi$ events collected with the Beijing Spectrometer III (BESIII) at the Beijing Electron-Positron Collider (BEPCII). The data selection, background analysis and preliminary results of a mass-independant partial wave analysis of the selected sample will be presented.

HK 38.6 Tue 18:45 T/SR25

Towards understanding the near-threshold antiproton-proton spectra from J/ψ and ψ' decays by the final-state interaction effects — •Xianwei Kang[1], Johann Haidenbauer[2], and Ulf-G. Meissner[1,2] — [1]Institute for Advanced Simulation and Jülich Center for Hadron Physics, Institute für Kernphysik, Foschungzentrum Jülich,Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics,Universität Bonn

Utilzing the Jost-function approach, we analyze all the existing data for $p\bar{p}$ spectrum up to excess energy of 100 MeV from J/ψ, ψ' decays to γ, π, η or $\omega p\bar{p}$. For the potential used in this analysis, both the chiral potential constructed by us previously and the Jülich model A(OBE) have been considered. We have shown that the near-threshold spectrum can be described by our treatment of the final state interaction effect.

HK 39: Invited Talks 3

Time: Wednesday 11:00–13:00 Location: T/HS1

Invited Talk HK 39.1 Wed 11:00 T/HS1

Precision Tests of CPT Invariance with Single Trapped Antiprotons — •Stefan Ulmer for the BASE-Collaboration — RIKEN, Ulmer Initiative Research Unit, Wako, Saitama, Japan

The reason for the striking imbalance of matter and antimatter in our Universe has yet to be understood. This is the motivation and inspiration to conduct high precision experiments comparing the fundamental properties of matter and antimatter equivalents at lowest energies and with greatest precision. According to theory, the most sensitive tests of CPT invariance are measurements of antihydrogen ground-state hyperfine splitting as well as comparisons of proton and antiproton magnetic moments. Within the BASE collaboration we target the latter. By using a double Penning trap we performed very recently the first direct high precision measurement of the proton magnetic moment. The achieved fractional precision of 3.3 ppb improves the currently accepted literature value by a factor of 2.5. Application of the method to a single trapped antiproton will improve precision of the particles magnetic moment by more than a factor of 1000, thus providing one of the most stringent tests of CPT invariance. In my talk I will report on the status and future perspectives of our efforts.

Invited Talk HK 39.2 Wed 11:40 T/HS1

Recent results on the proton: Two photon exchange and the radius puzzle — •Jan Bernauer — Massachusetts Institute of Technology, Cambridge, USA

The proton form factors and radii are in the limelight of recent and ongoing experimental and theoretical efforts, mainly driven by two anomalies. On the one hand, precise determinations of the form factor ratio with experiments using polarization differ from Rosenbluth-type extractions. The discrepancy is attributed to two-photon exchange contributions to the scattering process. Three modern experiments, at VEPP-3, Jefferson Lab and DESY (OLYMPUS), aim to measure this effect directly. On the other hand, a measurement of the Lamb shift in muonic hydrogen atoms gives a result 10 times more precise, but 7 sigma smaller than determinations from elastic scattering and electronic hydrogen spectroscopy. So far, this discrepancy is not understood. In the talk, I will present the latest results and the state of research on both fronts.

Invited Talk HK 39.3 Wed 12:20 T/HS1

Precision Experiments with Slowed-down and Thermalized Projectile and Fission Fragments — •Wolfgang Plass — II. Physikalisches Institut, Justus-Liebig-Universität Gießen — GSI Helmholtzzentrum für Schwerionenforschung GmbH

Novel precision experiments with exotic nuclei will be enabled using the combination of the in-flight separation method with modern techniques for efficiently slowing-down, thermalizing and manipulating projectile and fission fragments produced at relativistic energies. Two key devices for this approach have been developed for the Low Energy Branch of the Super-FRS at FAIR: A cryogenic stopping cell and a multiple-reflection time-of-flight mass spectrometer. They have recently been commissioned as part of the FRS Ion Catcher experiment at GSI and first measurements have been performed. The reach to rare (few ions per hour) and very short-lived (half-lives of a few milliseconds) nuclides produced at the FRS at 1000 MeV/u has been demonstrated. The potential of the mass spectrometer as a versatile and efficient tool for the study of isomers and the production of isobarically and isomerically pure beams has been shown. Envisaged applications include the direct mass measurements of very rare nuclides and the decay spectroscopy of pure ion samples. In addition, application of these developments in analytical mass spectrometry opens up completely new possibilities for in-situ studies e.g. in climate or environmental research, medicine and safety.

HK 40: Hadron Structure and Spectroscopy 9

Time: Wednesday 14:30–16:15 Location: T/SR19

Group Report HK 40.1 Wed 14:30 T/SR19

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

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

Linear polarisation is obtained by coherent bremsstrahlung. This requires a crystal radiator; in our case a 570 μm thick diamond is used.

The production mechanism of a linearly polarised photon beam via coherent bremsstrahlung, the determination of the degree of polarisation and first results obtained with a linearly polarised photon beam will be shown in this talk.

*Supported by DFG (SFB/TR-16)

HK 40.2 Wed 15:00 T/SR19

Improved LO extraction of the gluon polarisation using COMPASS data — •Malte Wilfert — for the COMPASS collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55099 Mainz

The COMPASS experiment at the M2 beamline of the CERN SPS has taken data with a polarised muon beam (E = 160 GeV) scattering of a polarised LiD target from 2002 to 2006. The events in the DIS region are re-analysed to extract simultaneously the gluon polarisation $\Delta g/g$ and the leading process asymmetry from the same data using a Neural Network approach. The new method of extracting $\Delta g/g$ will be presented. The main feature of this method is a reduction of both the systematic and the statistical uncertainty of the gluon polarisation obtained in LO. The new result is in good agreement with the already published one in PLB 718 (2013) 922 and will be presented in three bins of gluon momentum fraction x_g.

Supported by BMBF under the contract 05P12UMCC1 and GRK Symmetry Breaking (DFG/GRK 1581)

HK 40.3 Wed 15:15 T/SR19

Presentation of K_s^0 Multiplicities from 2006 at COMPASS* — •Daniel Hahne — Physikalisches Institut Bonn

To describe the hadronization process of quarks into hadrons in deep inelastic scattering, knowledge of fragmentation functions is necessary. To extract fragmentation functions from data taken by the COMPASS experiment, final state hadrons are analyzed in addition to the incoming and scattered muon. I will give a status report of K_s^0 multiplicities from data taken in 2006 by the COMPASS experiment which can be used to parameterize K_s^0 fragmentation functions.

*supported by BMBF, project 05P12 PDCCA

HK 40.4 Wed 15:30 T/SR19

Determination of the Spin Triplet $p\Lambda$ Scattering Length from the Reaction $\vec{p}p \to pK^+\Lambda$ — •Florian Hauenstein for the COSY-TOF-Collaboration — Forschungszentrum Jülich, Deutschland

The $\vec{p}p \to pK^+\Lambda$ reaction was measured with the COSY-TOF detector using a polarized proton beam of 2.7 GeV/c. These data are used to not only study the production mechanism via Dalitz plot and polarization observables, but also to extract the spin effective $p\Lambda$ scattering length from the final state interaction in the $p\Lambda$ invariant mass spectrum. Furthermore, it is possible to determine the spin triplet $p\Lambda$ scattering length using the dependence of the Kaon analyzing power on the $p\Lambda$ invariant mass.

In this talk the extraction method as well as the results on the spin effective and spin triplet $p\Lambda$ scattering length will be shown. In addition, the dependence of the Kaon analyzing power on the $p\Lambda$ invariant mass will be given. The systematic errors of the extracted values will be discussed

HK 40.5 Wed 15:45 T/SR19

Measurement of the double polarization observable G and beam asymmetry Σ in pion photoproduction — •Karsten Spieker for the A2-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The excitation spectrum of baryons consists of many resonances which contribute selectively to distinct decay channels. To obtain information about the contributing resonances, Partial Wave Analyses (PWA) are performed to identify the resonances and characterize their properties. For an unambiguous partial wave analysis solution, the measurement of several well chosen single and double polarization observables is needed in different decay channels.

The polarization observables are measured at the A2 experiment at MAMI in Mainz, using polarized photons and polarized nucleons. The setup covers nearly 4π of the solid angle and has a high detection efficiency for neutral and charged final states. It is therefore perfectly suited for the detection of pions in the final state.

The preliminary results for the double polarization observable G and the beam asymmetry Σ in pion photoproduction are presented. They have been determined in an energy range E_γ = 200–800 MeV, using a linearly polarized photon beam in combination with a longitudinally polarized butanol target. Therefore, it is the first measurement of the double polarization observable G below 500 MeV.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16 and SFB 1044) and Schweizerischer Nationalfonds.

HK 40.6 Wed 16:00 T/SR19

Study of chiral dynamics in $\pi^-\pi^0\pi^0$ production in Primakoff reactions at COMPASS — •Markus Krämer — Technische Universität München, 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. In 2009 during a two-week long period data were recorded in order to study the Primakoff reaction by colliding a 190 GeV/c pion beam on a nickel target. A partial-wave analysis of this data allows to measure the absolute cross section of the reaction $\pi^-\gamma \to \pi^-\pi^0\pi^0$, which is predicted by chiral perturbation theory. The analysis of this reaction will be presented.

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

HK 41: Instrumentation 13

Time: Wednesday 14:30–16:30 Location: M/HS1

Group Report HK 41.1 Wed 14:30 M/HS1

Development and Verification of a Compact TDC-Based Data Acquisition System for Space Applications — •Martin Losekamm[1,2], Dominic Gaisbauer[1], Igor Konorov[1], Stephan Paul[1], and Thomas Pöschl[1] — [1]Physics Department E18, Technische Universität München — [2]Institute of Astronautics, Technische Universität München

The advances of solid-state detectors and in particular those for the detection of photons have made their application in space systems increasingly attractive in recent years. The use of, for example, silicon photomultipliers (SiPM) paired with a suitable scintillating material allows the development of compact and lightweight particle detectors. The Antiproton Flux in Space experiment (AFIS) intends to measure the flux of antiprotons trapped in Earth's magnetosphere aboard a nanosatellite using an active target tracking detector, consisting of plastic scintillating fibers read out by SiPMs. In order to implement a large number of detector channels while adhering to the given space, mass and power constraints, the development of a compact TDC-based data acquisition system was proposed. This talk will present a current prototype featuring 900 channels, real-time multi-channel temperature measurement and bias regulation. Possible alternative applications as well as the next steps in the development will also be discussed. This work is supported by the Excellence Cluster 'Origin and Structure of the Universe'.

HK 41.2 Wed 15:00 M/HS1

A new FPGA-based Time-over-Threshold System for the Time of Flight Detectors at the BGO-OD Experiment — •Oliver Freyermuth for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, D-53115 Bonn

The BGO-OD experiment at the ELSA accelerator facility at Bonn is built for the systematic investigation of meson photoproduction in the GeV region. It features the unique combination of a central, highly segmented BGO crystal calorimeter covering almost 4π in acceptance and a forward magnetic spectrometer complemented by time of flight walls.

The readout of the ToF scintillator bars was upgraded to an FPGA-based VME-board equipped with discriminator mezzanines including per-channel remotely adjustable thresholds. A firmware was developed combining a time-over-threshold (ToT) measurement by implementing a dual-edge TDC, a configurable meantimer trigger logic including a special cosmics trigger, adjustable input delays and gateable scalers, all inside a single electronics module.

An experimentally obtained relation between ToT and slope of a PMT signal can be used for a time walk correction to achieve time resolutions comparable to a classical chain of CFD and standard TDC. Additionally, the time-over-threshold information can be exploited for gain matching and allows to monitor online the gain-stability and check for electronics problems such as pulse reflections or baseline jitter.

The system is well-suited for a wide range of PMT-based fast detectors with many channels and further applications foreseen.

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

HK 41.3 Wed 15:15 M/HS1

FPGA-Based Upgrade of the Read-Out Electronics for the Low Energy Polarimeter at the Cooler Synchrotron — •Nils Hempelmann for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich

The Cooler Synchrotron (COSY) is a storage ring used for experiments with polarized proton and deuteron beams. The low energy polarimeter is used to determine the vector and tensor polarization of the beam before injection at kinetic energies up to 45 MeV for protons and 75 MeV for deuterons. The polarimeter uses scintillators to measure the energy of both outgoing particles of a scattering reaction and the time between their detection. The present read-out electronics consists of analog NIM modules and is limited in terms of time resolution and the capability for online data analysis. The read-out electronics will be replaced with a a new system based on analog pulse sampling and an FPGA chip for logic operations. The new system will be able to measure the time at which particles arrive to a precision better than 50 ps, facilitating better background reduction using coincidence measurement. In addition to measuring the beam polarization, the system will be used to precisely determine the vector and tensor analyzing powers for deuteron scattering off carbon at a kinetic energy of 75 MeV.

HK 41.4 Wed 15:30 M/HS1

FPGA-based calibration and monitoring system for the HADES Electromagnetic Calorimeter. — •Alessandra Lai for the HADES-Collaboration — University of Turin, Italy — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The High Acceptance Di-Electron Spectrometer (HADES) at GSI was designed to measure dileptons and strangeness in elementary and heavy-ion collisions. An upgrade of HADES with an Electromagnetic Calorimeter (ECAL) has started and will be ready for beam in 2017. The goal is to measure π^0 and η meson yields together with the dielectron data in pion and proton-induced reactions as well as in heavy ion collisions. Moreover, photon measurement is important for Λ^0 (1405) and Σ^0 (1385) spectroscopy.

It is essential to precisely calibrate all the lead-glass crystal modules individually in order to achieve the required ECAL performances. Continuous monitoring with a light pulser system is required. It is foreseen to use blue light from an LED source, driven by short signals from a flexible pulse generator and distributed with optical fibers to each module of the ECAL. Due to their great flexibility, Field Programmable Gate Arrays (FPGA) have been chosen to implement the mentioned monitoring system. In this contribution an FPGA-based calibration system for commissioning as well as long term stability of the ECAL modules will be presented.

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

HK 41.5 Wed 15:45 M/HS1

Read-out concepts for FPGA-based sub-systems within the CBM detector — •Jan Michel for the CBM-Collaboration — Goethe-Universität Frankfurt

The Compressed Baryonic Matter experiment (CBM) to be built at FAIR consists of several individual sub-detectors. Some are based on custom ASICs as front-ends. Others employ FPGA based modules where extensive slow control features can be implemented to ease the recording of data and to allow for fast detection of any kind of error condition. Being designed as a free-running data acquisition, the demands also include a synchronized read-out, i.e. distribution of a common clock signal to all modules. To reduce the complexity of wiring, this is to be done sharing the same optical fibers as the data transport. During the past years, TrbNet has been designed and is used in various experiments, initially for the HADES experiment at FAIR. This protocol can now serve as a platform for the CBM readout. In several steps, synchronous links with deterministic latency, as well as a free-streaming data transport can be included. At the same time, modifications to improve bandwidth and provide compatibility to the CERN GBTx links used for ASIC based sub-systems are to be developed. This contribution shows the planned steps as well as the current status of development. This work has been supported by BMBF (05P12RFFC7), GSI and HIC for FAIR.

HK 41.6 Wed 16:00 M/HS1

Upgrade of the Data Acquisition System for the A2 Experiment at MAMI — •Andreas Neiser and Wolfgang Gradl — Institut für Kernphysik, Johann-Joachim-Becher-Weg 45, Mainz

The A2 collaboration at the electron accelerator MAMI in Mainz uses energy-tagged photons to produce light mesons off the nucleon. Its current data acquisition system is the major performance bottleneck under typical trigger conditions. Furthermore, the availability of spare parts is limited, which renders the maintainability for the next decade difficult. Thus, an upgraded system is desirable for A2 to achieve the upcoming experimental goals. For this upgrade, an FPGA-based solution using the TRB3 is being considered.

The TRB3 is a multi-purpose 4+1 FPGA board, where four peripheral FPGAs communicate with one add-on board each. The central FPGA provides data readout via standard gigabit Ethernet and interconnection to other TRB3s via optical links. The TRB3 collaboration currently provides flexible TDC-in-FPGA firmwares with various discrimination front-ends as well as a 48 channel ADC add-on board with 60 MHz sampling rate and 10 bit resolution. Additionally, an extensive software framework for slow control and readout is available.

We present energy and timing measurements with the ADC add-on board at the Crystal Ball NaI(Tl) calorimeter and compare the performance to the currently used COMPASS data acquisition system. Furthermore, we give an outlook on possible feature extraction firmwares and estimate the costs for a complete upgrade of the system.

HK 41.7 Wed 16:15 M/HS1

A FPGA based DAQ for the COMPASS experiment — •Stefan Huber — Technische Universiät München

In this contribution the deployment and first results of the new FPGA-based data acquistion system (DAQ) of the COMPASS experiment is presented. Since 2002, number of channels increased from 190000 to approximately 300000, trigger rate increase from 5 kHz to 30 kHz; the average event size remained roughly 35 kB. In order to handle the increased data rates, it has been decided to develop a new DAQ system during technical shutdown of CERN accelarator in 2013-2014. The new system replaces the old computer based event building network with custom FPGA based data handling cards (DHC). The DHC cards use two different versions of firmware: multiplexer and switch. The multiplexer card can combine 15 incoming links into one outgoing, whereas the switch combines 8 data streams from multiplexers and using information from look-up table sends the full events to the readout engine servers equipped by spillbuffer PCI-Express cards that receive the data. Both types of DHC cards can buffer data which allows to distribute the load over the cycle of accelerator. As the DHC cards perform data flow control and event building, the software serves only for configuration, run control, and monitoring. For these purposes, we have developed software tools. The new DAQ system has been deployed for the pilot run starting from the September 2014. In the paper, we present preliminary performance and stability results of the new DAQ, we compare it with the original system in more detail.

HK 42: Instrumentation 14

Time: Wednesday 14:30–16:30 Location: M/HS2

HK 42.1 Wed 14:30 M/HS2

Simulationen der HEBT-Sektion für FRANZ — •O. Hinrichs, C. Arda, C. Claessens, O. Meusel, D. Noll, M. Reich, R. Reifarth, M. Schwarz, K. Sonnabend und B. Thomas — Goethe-Universität Frankfurt

Die Frankfurter Neutronenquelle am Stern-Gerlach-Zentrum (FRANZ), die sich gegenwärtig im Aufbau befindet, wird von einem Protonenstrahl mit einer Stromstärke von 20 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 Simulationen, die den Strahltransport und die Phasenraumverteilung im Hinblick auf einen variablen Strahlfleck optimieren, um bestmögliche experimentelle Bedingungen zu erreichen. Dieses Projekt wird gefördert durch die DFG (SO907/2-1).

HK 42.2 Wed 14:45 M/HS2

CST CALCULATIONS FOR THE LAYOUT OF A BUTTON BPM SYSTEM FOR THE FAIR PROTON LINAC — •Mohammed Almalki — Planckstrasse 1, 64291 Darmstadt,

M. Almalki, P. Forck, W. Kaufmann and T. Sieber, C. Krüger, P. Kowina, O. Kester GSI, Darmstadt, Germany C. Simon, CEA-Saclay/DSM/Irfu, Gif sur Yvette, France,

At the planned Proton LINAC at the FAIR facility, four-fold button Beam Position Monitor (BPM) will be installed at 14 locations along the 30 m long FAIR pLINAC. These monitors will be used to determine the beam position, the relative beam current and the mean beam energy by time of flight (TOF). Depending on the location, the BPM design has to be optimized, taking into account an energy range from 3 MeV to 70 MeV, limited space for installation at the 30 mm or 50 mm beam pipe aperture. Detailed simulations of the button parameters with the finite element code CST were executed including signal shape analysis, impedance matching characteristic and capacitance calculations. Moreover, time and frequency-domain response of the BPM output signals reflecting the BPMs interaction with the beam, nonlinearity, sensitivity and position map for different geometries and beam parameters were performed. The results of these simulations and the related measurements are presented.

HK 42.3 Wed 15:00 M/HS2

Construction of a scalable neutron source — •Eduard Friske — Universität Tübingen, Tübingen, Germany

The silicon strip detectors used in the Silicon Tracking System of the CBM project are expected to be subject to high doses of particles, including neutrons. To anticipate the effects of neutron irradiation of the detectors, a high rate neutron source is being constructed at the Rosenau accelerator facility. Using deuterium fusion and cooling via liquid nitrogen, this design will allow scaling of the neutron flux over a wide range of values. It also allows the online instrumentation of the sample during the irradiation process, as well as defined variations of the irradiation rate, e.g. to study annealing effects.

HK 42.4 Wed 15:15 M/HS2

A new cryogenic gas target for electron scattering coincidence

experiments — •Simela Aslanidou, Sergej Bassauer, Andreas Krugmann, Peter von Neumann-Cosel, Norbert Pietralla, Maxim Singer, and Gerhart Steinhilber — Institut für Kernphysik, Technische Universität Darmstadt

Exclusive electron scattering experiments off ^{3,4}He are planed at the superconductive Darmstadt electron accelerator S-DALINAC. The results promise important tests of theoretical predictions in the framework of potential models [1] and EFT [2]. The experiments will be performed at low momentum transfer where data are scarce. A new cryogenic system for coincidence experiments on gaseous targets was constructed and tested. The experimental setup and the performance of the apparatus under realistic beam conditions will be presented.
This work is supported by the DFG under contract SFB 634

[1] J. Golak et al., Phys. Rep. **415** (2005) 89
[2] E. Epelbaum, et al., Rev. Mod. Phys. **81** (2009) 1773

HK 42.5 Wed 15:30 M/HS2

Development of an thin, internal superconducting polarisation magnet for the Polarised Target — Timo Altfelde, •Marcel Bornstein, Hartmut Dutz, Stefan Goertz, Roland Miebach, Scott Reeve, Stefan Runkel, Marco Sommer, and Benjamin Streit — 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 polarisation 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.

HK 42.6 Wed 15:45 M/HS2

Entwickling eines pseudo internen Gastargets (PIT) für MAGIX — •Stephan Aulenbacher — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

Der neue energierückgewinnende Beschleuniger MESA eröffnet neue Möglichkeiten für Elektronenstreuexperimente hoher Präzision, bei niedrigen Energien (˜100 MeV). Unser Ziel ist der Aufbau eines Doppelarmspektrometers für Messungen an einem pseudo internen Gastarget. In diesem Vortrag wird die Entwicklung des Targets dargelegt. Dies beinhaltet die Wahl der Materialien und Fertigung des Targets, Design des differentiellen Pumpsystems, sowie Simulationen der Fluid-Dynamik im inneren des Targets und dem physikalischen Einfluss des Targets selbst.

HK 42.7 Wed 16:00 M/HS2

CFD-Simulations of a 4π-contiuous-mode dilution refrigerator for the CB-ELSA experiment — Timo Altfelde, Marcel Bornstein, Hartmut Dutz, Stefan Goertz, Roland Miebach, Scott Reeve, •Stefan Runkel, Marco Sommer, and Benjamin Streit — 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 CFD-simulations are done. First the different streams are simulated independently for different parts of the refrigerator to get a better estimation of the flow parameters. Then the simulation is extended to include the heat exchange between the different streams at the heat exchangers for different operational parameters of the refrigerator. Afterwards the precooling stages of the refrigerator will be tested to compare the predicted and the measured operational parameters.

HK 42.8 Wed 16:15 M/HS2

Polarisation and relaxation characteristics of 15 MeV proton irradiated polmeric materials at 1 K and at 2.5 T. — Timo Altfelde, Marcel Bornstein, Hartmut Dutz, Stefan Goertz, Roland Miebach, •Scott Reeve, Stefan Runkel, and Benjamin Streit — Physikalisches Institut, Bonn, Germany

The dynamic polarisation of nuclear spins requires the introduction of paramagnetic centres into potential target materials. A method of choice is the irradiation of such materials. A solid target material that can be handled at room temperature and in which the paramagnetic centre remains stable under theses conditions would have many advantages for nuclear and particle physics experiments. Initial indications are that the polymeric materials may fulfil these criteria. Foils of polyethylene and polypropylene of 0.18 mm thickness were irradiated with a 15 MeV proton beam at various doses and subsequently analysed under standard polarised target conditions of 2.5 T and 1 K. The influence of annealing on the radical structure and the resulting change in polarisation characteristics are presented.

HK 43: Astroparticle Physics 2

Time: Wednesday 14:30–16:30 Location: M/HS4

Group Report HK 43.1 Wed 14:30 M/HS4

Status and commissioning of the KATRIN spectrometer and detector section — •Philipp C.-O. Ranitzsch for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The goal of the **KA**rlsruhe **TRI**tium **N**eutrino experiment (KATRIN) is to investigate the neutrino mass with a sensitivity of 0.2 eV/c^2 by a high-resolution and high-statistics measurement of the end-point region of the ^{3}H β-spectrum. For this task it uses an experimental setup made of two main parts, firstly a source and transport section (STS) including a windowless gaseous tritium source (WGTS), a differential and a cryogenic pumping section (DPS and CPS). The STS provides a clean current of ^{3}H β-electrons that are analyzed and detected in the second part, namely the spectrometer and detector section (SDS). The SDS consists of two electrostatic spectrometers based on the MAC-E filter technique and a multi-pixel silicon semiconductor detector.

At the experimental site at the Karlsruhe Institute of Technology (KIT), the STS is currently under construction, while the SDS has recently undergone its second commissioning measurement phase. The main spectrometer together with the detector has been investigated regarding its transmission properties and the various sources of background. Improvements suggested from the first commissioning phase have been employed and tested.

This talk gives an overview of the current status of the KATRIN experiment, focussing on the recent second commissioning phase.

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

HK 43.2 Wed 15:00 M/HS4

Status of the tritium-source related parts of KATRIN — •Michael Sturm for the KATRIN-Collaboration — Karlsruher Institit für Technologie (KIT)

The KArlsruhe Tritium Neutrino Experiment (KATRIN) aims for the direct model-independent neutrino mass measurement with a sensitivity of $m_{\bar{\nu}_e} <$ 200 meV (90% C.L.). While the commissioning of the high resolution MAC-E Filter has already started, some of the tritium related components are still in the finishing stage at the manufacturers. We give a status report on all source and transport components of KATRIN as well as all related tritium processing and analytic intruments at the Tritium Laboratory Karlsruhe. Additionally we describe the improvements in simulations and our program to characterize the components in advance of tritium data taking. This is of special importance as the statistical and systematic uncertainties of the $m_{\bar{\nu}_e}$ measurement are closely related to the performance and stability of the windowless gaseous tritium source - as well to the functionality of the transport section, which has to reduce the tritium ow by 14 orders of magnitude in order to avoid backgrounds and to the performance

of monitoring systems which are able to detect changes in the source parameters down to a precision of 0.1%.

HK 43.3 Wed 15:15 M/HS4

Gasdynamiksimulationen für die Tritiumquelle des KATRIN Experiments — •Laura Kuckert für die KATRIN-Kollaboration — Karlsruher Institut für Technologie KIT

Ziel des Karlsruher Tritium Neutrino Experiments (KATRIN) ist die direkte Messung der Neutrinomasse über den Betazerfall molekularen Tritiums. Die Sensitivität liegt dabei bei 200 meV/c2 (90% C.L.). Da die Neutrinomasse durch Anpassen von modellierten Beta-Spektren an das gemessene Elektronenspektrum extrahiert wird, ist es für das Erreichen dieser hohen Sensitivität von immenser Wichtigkeit systematische Effekte im simulierten Spektrum zu berücksichtigen. Einen wesentlichen Einfluss hat hierbei die nicht direkt messbare Gasdynamik (Dichte- und Geschwindigkeitsverteilung) des 30K kalten molekularen Tritiums innerhalb der gasförmigen Tritiumquelle WGTS (Windowless Gaseous Tritium Source).

Dieser Vortrag geht auf die Simulation der Gasdynamik im Quellrohr und in den Pumpports der WGTS unter Einbeziehung der Temperaturverteilung ein. Dabei wird der Einfluss verschiedener Parameter wie Viskosität, Haftkoeffizient und Säulendichte mit einbezogen und die Auswirkungen auf die Neutrinomassensensitivität beschrieben.

HK 43.4 Wed 15:30 M/HS4

Work function studies of gold surfaces with a Kelvin Probe for the Rear Section of the KATRIN experiment — •Kerstin Schönung and Martin Babutzka for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The KArlsruhe TRItium Neutrino-Experiment KATRIN will perform a model-independent measurement of the electron antineutrino mass. Therefore the energy spectrum of the beta electrons of a gaseous molecular tritium source will be examined. To achieve the desired sensitivity of $0.2\,\mathrm{eV/c^2}$ (90 % CL) the plasma potential of the tritium gas must be temporally and spatially stable within $\sigma < 20\,\mathrm{meV}$. Therefore the work function of the so called Rear Wall which defines the plasma potential must be known even more precisely and the temporal changes must be investigated.

A common instrument to measure the work function of a surface with a precision of a few meV is a Kelvin Probe. Therefore such a system was built up at the Tritium Laboratory Karlsruhe. In the talk the working principle of a Kelvin Probe and the setup will be presented. Additionally the results of the commissioning of the system as well as the results of the first work function measurements at Rear Wall like samples will be discussed.

HK 43.5 Wed 15:45 M/HS4

Projektion geladener Teilchen durch Magnetfelder — •Dirk Dubbers — Physikalisches Institut der Universität Heidelberg

Viele Experimente der Kern- und Teilchenphysik nutzen homogene Magnetfelder, um Elektronen oder Ionen von ihrem Entstehungsort zu einem Detektor zu führen. Wie sieht die Intensitätsverteilung der so transportierten Teilchen auf dem Detektor aus? Man würde denken, dass dies eine einfache Übung mit wohlbekannter Lösung ist. Es wird gezeigt, dass die korrekte Lösung stark von den bislang verwendeten Verteilungsfunktionen abweichen kann. Dies wurde vor kurzem auch experimentell bestätigt. Hochpräzisionsexperimente die magnetische Führungsfelder nutzen, z.B. zum Zerfall des Neutrons oder zur Masse des Neutrinos, erfordern möglicherweise Korrekturen auf derlei Effekte.

HK 43.6 Wed 16:00 M/HS4

Die Reaktorneutrinoanomalie — •Christian Buck, Antoine Collin und Manfred Lindner — MPIK Heidelberg

In Kernreaktoren werden durch den Betazerfall von neutronenreichen Zerfallsprodukten grosse Mengen an Elektron-Antineutrinos im Energiebereich von 1-10 MeV freigesetzt. Dadurch eignen sich Kernreaktoren gut als Quelle zur Messung von Neutrinoeigenschaften. In den Vorhersagen und Berechnungen der Reaktorneutrinospektren wurden in jüngster Vergangenheit bedeutende Fortschritte erzielt. Allerdings wird in mehreren Experimenten der letzten Jahrzehnte ein Antineutrinofluss gemessen, der durchschnittlich nur etwa 94% des theoretisch vorhergesagten Flusses entspricht. Die statistische Signifikanz dieser sogenannten "Reaktorneutrinoanomalie" liegt bei 2,7 Sigma.

Mehrere Projekte weltweit haben sich zum Ziel gesetzt das Rätsel der Reaktorneutrinoanomalie zu lösen. Im Vortrag wird eines dieser Experimente näher vorgestellt. Im Stereo Projekt sollen die Neutrinos in 2000 Liter eines Gadolinium beladenen Flüssigszintillators nachgewiesen werden. Als Neutrinoquelle dient dabei ein mit 235-U angereicherter Reaktorkern mit einer Leistung von 58 MW, der sich in etwa 10 m Entfernung vom Detektor am Institut Laue Langevin (ILL) in Grenoble, Frankreich, befindet. Mit diesem Experiment soll geklärt werden, ob eine bislang unbekannte Neutrinoart, die sterilen Neutrinos, für die Reaktorneutrinoanomalie verantwortlich sind. Kompakte Antineutrinodetektoren könnten darüber hinaus in Zukunft auch zur Reaktorüberwachung und im Kampf gegen die Verbreitung von Nuklearwaffen von Nutzen sein.

HK 43.7 Wed 16:15 M/HS4

Discrimination of Alpha Particles via Pulse Shape Analysis for the COBRA Experiment — •Henning Rebber — Universität Hamburg, Institut für Experimentalphysik, 22761 Hamburg

The aim of the COBRA experiment is to detect neutrinoless double beta decay using CdZnTe semiconductor detectors. A background rate of the order of 10^{-3} counts/keV/kg/year is intended in order to be sensitive to a half-life larger than 10^{26} years. Measurements from a demonstrator set-up and Monte Carlo simulations indicate that a large background component is due to alpha particles. These generate charge clouds of only few μm in diameter in the detector, leading to characteristic pulse features. The pulse shapes of all event signals are read out by FADCs with a sampling rate of 100 MHz.

In this talk a method is described to identify alpha events based on a pulse shape analysis. Efficiency studies based on simulated pulse shapes are also discussed.

HK 44: Heavy Ion Collisions and QCD Phases 5

Time: Wednesday 14:30–16:30 Location: T/HS1

Group Report HK 44.1 Wed 14:30 T/HS1

Dynamical Locking of the Chiral and the Deconfinement Phase Transition in QCD at Finite Chemical Potentials — •Paul Springer[1], Jens Braun[2], Marc Leonhardt[2], and Stefan Rechenberger[2] — [1]Physik Department, Technische Universität München, 85747 Garching — [2]Institut für Kernphysik, Theoriezentrum, Technische Universität Darmstadt, 64289 Darmstadt

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, the relation of confining and chiral dynamics is not yet completely understood. At vanishing chemical potential, results from lattice QCD indicate that the chiral and the deconfinement phase transition lie close to each other. In this talk, we analyze the fixed-point structure of four-fermion interactions in two-flavor QCD and show that there indeed appears to be a mechanism which dynamically locks the chiral phase transition to the deconfinement phase transition, both at vanishing and at finite quark chemical potential. As a direct consequence, this observation suggests that the chiral phase transition and the deconfinement phase transition temperatures lie close to each other.

This work is supported in part by BMBF

HK 44.2 Wed 15:00 T/HS1

The Chiral Phase Transition in the Presence of Vector Mesons from the Functional Renormalization Group Approach. — •Jürgen Eser, Mara Grahl, and Dirk Rischke — Institut für Theoretische Physik, Goethe-Universität, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

The characteristics of the transition in quantum chromodynamics (QCD) from familiar hadronic matter to the quark-gluon plasma (QGP) are subject to an ongoing debate. This transition is associated with the spontaneous restoration of chiral symmetry. Experimental setups such as CBM at GSI aim to produce the QGP state

via heavy-ion collisions. Here, dropping in-medium masses of (axial-)vector mesons are promising candidates for indicating the restoration of chiral symmetry. Furthermore, (axial-)vector mesons play an important role in QCD phenomenology due to vector meson dominance. It is therefore crucial to include those degrees of freedom in a theoretical analysis. Nonperturbative methods, such as the functional renormalization group (FRG), provide new insights into the QCD transition as they do not rely on weak couplings and avoid essential drawbacks of the lattice approach.

We shed light on the two-flavor chiral phase transition in the presence of (axial-)vector mesons by applying the FRG formalism to an effective model for QCD. The order of the phase transition within this extended linear sigma model is determined. Moreover, we investigate the mass degeneracy of chiral partners occuring at the phase boundary.

HK 44.3 Wed 15:15 T/HS1

Inhomogene chiral gebrochene Phasen in ladungsneutraler stark-wechselwirkender Materie — •Daniel Nowakowski, Michael Buballa und Jochen Wambach — Institut für Kernphysik, Technische Universität Darmstadt

Im Rahmen eines Zwei-Flavor-Nambu–Jona-Lasinio Modells untersuchen wir das Phasendiagramm stark-wechselwirkender Materie. Kürzlich wurde für ein solches Modell für den Fall entarteter Quark-Flavors gezeigt, dass neben den bekannten homogenen Phasen auch inhomogene Phasen auftreten können, in denen der chirale Ordnungsparameter räumlich variiert. In diesem Vortrag diskutieren wir den Einfluss einer zusätzlichen Isospin-Asymmetrie zwischen den Quarks und die Auswirkungen der Forderung nach elektrischer Ladungsneutralität auf die inhomogenen chiral gebrochenen Phasen. Dabei konzentrieren wir uns zunächst auf eindimensionale räumliche Modulationen des Ordnungsparameters und finden für realistische Parameter, dass inhomogene Phasen auch in elektrisch neutraler Materie auftreten. Beschränkt man die Modulation der beiden Quark-Flavors auf eine gemeinsame Periode, dann sind diese inhomogenen chiral gebrochenen Phasen weniger favorisiert. Lässt man jedoch unterschiedliche Perioden zu, so finden wir, dass die inhomogenen Phasen gegenüber dem zusätzlichen Paarungsstress stabilisiert werden können. Als Anwendung präsentieren wir die Masse-Radius Beziehung eines Quark-Sterns.

HK 44.4 Wed 15:30 T/HS1

The QCD phase diagram from imaginary chemical potential — •Christopher Pinke and Owe Philipsen — Institut für Theoretische Physik, Goethe Universität Frankfurt am Main

The phase diagram of QCD is subject to ongoing investigations. First principle calculations are possible by means of Lattice QCD (LQCD) simulations. At non-zero values of the chemical potential, these are hampered by the sign-problem, which renders the currently available simulation algorithms ill-defined.

An up-to-now unresolved issue is the nature of the chiral transition in the limit of two massless flavours of quarks. This transition is either first or second order. It is important to clarify this issue in order to constrain the physical phase diagram of QCD, in particular regarding the possible existence of a critical end point in QCD at non-zero chemical potential.

At purely imaginary values of the chemical potential, QCD has very interesting symmetries. More specifically, the Roberge-Weiss or extended center symmetry limits the physically relevant region to be within specific values. In addition, the Roberge-Weiss transition, happening at these specific values, then allows for constraints on the physical phase diagram.

We explore this region by means of two flavour LQCD simulations and present results regarding the two flavour chiral limit.

Supported by the Hessian LOEWE initiative through the Helmholtz International Center for FAIR (HIC for FAIR).

HK 44.5 Wed 15:45 T/HS1

Studying properties of the QCD phase diagram with Dyson-Schwinger equations — Christian S. Fischer, Gernot Eichmann, Christian H. Lang, and •Christian A. Welzbacher — Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 16, D-35392 Giessen, Germany

The Dyson-Schwinger equations (DSEs) as one kind of functional methods provides us with a toolbox to investigate the structure of the QCD phase diagram. By solving the carefully truncated coupled set of equations, the quark and gluon propagators at finite temperature and light-quark chemical potential are obtained. Those quantities give insights about the chiral and deconfinement phase transitions and have interesting analytic properties. We present results for N_f=2+1 flavors and discuss the location of a potential critical endpoint as well as the possible influence of baryonic degrees of freedom on its position.

HK 44.6 Wed 16:00 T/HS1

Thermalization of hadrons through Hagedorn states — •Maxim Beitel, Kai Gallmeister, and Carsten Greiner — Institut für Theoretische Physik Johann Wolfgang Goethe-Universität Max-von-Laue-Str. 1 60438 Frankfurt am Main, Germany

One of the most intriguing questions in high energy collisions is how hadrons produced in a non-equilibrium system achieve thermal equilibrations on such short time scales. To simulate the dynamic multiplicity evolution of hadron multiplicities we use the hadronic transport model "UrQMD" as microscopic model for high-energetic heavy ion collisions. Currently the equilibration times in this model are too long because detailed balance is not realized for all collisions which may occur. In our approach to get rid of this drawback we deploy Hagedorn-States proposed by the "Statistical Bootstrap Model". Creation of these states in binary collisions and their decay into two particles only will lower the thermalization times in UrQMD. Supported by HGS-HIRe.

HK 44.7 Wed 16:15 T/HS1

Lattice QCD based equation of state at finite baryon density — •Pasi Huovinen[1,2], Peter Petreczky[3], and Christian Schmidt[4] — [1]Institut für Theoretische Physik, Goethe-Universität, Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]Brookhaven National Laboratory, USA — [4]Fakultät für Physik, Universität Bielefeld, Bielefeld, Germany

The effects of non-zero baryon density are expected to become important in hydrodynamic modeling of heavy-ion collisions below the highest energy at RHIC. Recent calculations in effective models and in QCD using Dyson Schwinger equation suggest that the transition in QCD remains a crossover up to baryon chemical potentials of about 800MeV. If so, the equation of state relevant for hydrodynamic models can be calculated on the lattice using Taylor expansion. However, except for the coefficients of the lowest order, there are large cutoff effects in present lattice calculations for non-zero chemical potentials.

To extend our previous parametrization of the equation of state to finite baryon density, we employ the continuum extrapolated lattice QCD data on Taylor expansion coefficients in order two, and complement them with coefficients in order four and six evaluated using p4 action. To avoid large cutoff efects these coefficients are smoothly matched to those of hadron resonance gas at low temperature. We also show how the hydrodynamical evolution is affected by this equation of state in the energy range relevant for SPS and the RHIC energy scan.

This work is funded by BMBF under contract no. 06FY9092.

HK 45: Structure and Dynamics of Nuclei 9

Time: Wednesday 14:30–16:30 Location: T/HS2

Group Report HK 45.1 Wed 14:30 T/HS2

Low electric dipole response in ^{120}Sn — •Anna Maria Krumbholz[1], Peter von Neumann-Cosel[1], Atsushi Tamii[2], Vladimir Yu. Ponomarev[1], and Michael Mathy[1] for the EPPS0-Collaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Physics, University Osaka

A consistent and powerful method to measure electric and magnetic dipole modes over a broad excitation energy range including energies below and above the neutron separation energy is polarized proton scattering at small scattering angles including 0° [1]. Measurements of the ^{120}Sn($\vec{p},\vec{p}'$) reaction have been performed at RCNP with a beam energy of 295 MeV and an energy resolution of about 25 keV. For the separation of electric and magnetic contributions two different inde-

pendent methods are applied: a multipole decomposition of the angular distributions and the analysis of the polarization transfer. In the energy region between 5.5 and 6.5 MeV the extracted E1 strength is comparable to results of the (γ,γ') reaction [2]. Between 7 MeV and 9 MeV significant previously unknown E1 strength is found. The low energy E1 strength distribution shows a resonance-like structure peaking at 8.2 MeV. A comparison with B(E1) strength distributions from various microscopic models is shown. The electric dipole polarizability was determined from the data: It represents an important test of the poorly contrained isovector strength of modern mean field models.

[1] A. Tamii et al., Phys. Rev. Lett. 107, 062502 (2011).
[2] B. Özel-Tashenov et al., Phys. Rev. C 90 024304.

*Supported by DFG under contracts SFB 634 and NE 679/3-1.

Group Report HK 45.2 Wed 15:00 T/HS2

Axial asymmetry of excited heavy nuclei as essential feature for the prediction of compound nuclear cross sections and decay rates — •Eckart Grosse[1], Arnd R. Junghans[2], and Ralph Massarczyk[2,3] — [1]IKTP, Technische Universität Dresden — [2]ISP, Helmholtz-Zentrum Dresden-Rossendorf — [3]LANL, New Mexico, USA

Nuclear level densities ρ(Ex,J) are a very important input for the prediction of compound nuclear cross sections and decay rates. Different experimental data enter and theory based parameterizations are needed. Fermi energy and pairing gap fix the level density parameter â and the pair condensation energy, but in finite nuclei the energy backshift changes with surface and shell effects controlled by comparing mass formulae to data. A (surprisingly small) surface term added to â is used as the only free global fit parameter and, using a CTM at low Ex, we describe well neutron capture resonance spacings as observed for 146 even-even target nuclei with 51<A<253. This modelling of collectively enhanced level density avoids any ad hoc assumption about an axial symmetry of excited nuclei.

A combination of the photon strength from the global description of IVGDR shapes and their tails by the sum of three Lorentzians (TLO), summed up to obey the TRK sum rule, to the new parameterization for ρ(Ex,J) compares well to cross section data for radiative neutron capture - including Maxwellian averages. Photon scattering and other experiments show that additional minor dipole strength exists; it weakly increases capture cross sections.

HK 45.3 Wed 15:30 T/HS2

dipole response of ^{156}Gd below 7.1 MeV — •Esra Acıksoz[1,2], Tobias Beck[3], Jacob Beller[3], Udo Gayer[3], Laura Mertes[3], Haridas Pai[3], Norbert Pietralla[3], Philipp Ries[3], christopher Roming[3], Volker Werner[3], and Markus Zweidinger[3] — [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

The $J^\pi = 1^+$ scissor mode was first observed in ^{156}Gd in high-resolution electron scattering experiments in 1984 and shortly after confirmed in Nuclear Resonance Fluorescence (NRF) experiments. An experiment was performed at the superconducting Darmstadt linear electron accelerator (S-DALINAC) using the NRF technique to study dipole-excitations of ^{156}Gd up to ~ 7 MeV. A monoenergetic electron beam of 7.1 Mev was used for the production of bremsstrahlung which allows for the investigation of dipole excitations of ^{156}Gd in the sensitive energy range from $\sim 3-7$ MeV. First results of the^{156}Gd (γ,γ') experiment will be presented and discussed.

∗Supported by the *TÜBİTAK – BİDEB* 2214/A Program and DFG under contract No. SFB 634

HK 45.4 Wed 15:45 T/HS2

Origin of low-lying enhanced $E1$ strength in rare-earth nuclei — •Mark Spieker[1], Sorin Pascu[1,2], and Andreas Zilges[1] — [1]Institute for Nuclear Physics, University of Cologne, Germany — [2]Horia Hulubei National Institute of Physics and Nuclear Engineering, Bucharest, Romania

Candidates for excited α-cluster states have been identified in many light nuclei being organized in rather simple quasimolecular configurations [1]. For heavier nuclei the existence of these states remains an open question, though different experimental observables have been discussed as possible signatures. The electric dipole response of atomic nuclei is intimately connected to the breaking of isospin symmetry in simplified macroscopic nuclear models. Here, an α cluster could oscillate against the remaining core, which would generate a dynamic electric dipole moment in the nucleus [2]. To study this possibility, we have adopted the *spdf* interacting boson model for the description of the $E1$ response below 4 MeV in the neodymium isotopes. In this contribution, we will show that the model successfully reproduces the main features of the $E1$ response and, thus, might establish α clusters as an important ingredient to describe the $E1$ strength distribution in heavier nuclei. Supported by the DFG (ZI-510/4-2).

[1] W. von Oertzen *et al.*, Phys. Rep. **432** (2006) 43
[2] F. Iachello, Phys. Lett. B **160** (1985) 1

HK 45.5 Wed 16:00 T/HS2

Deformation of ground and beta-bands: search for the $2^+_\beta \rightarrow 0^+_\beta$ decay in ^{158}Gd — •J. Stamm[1], V. Werner[1], M. Thürauf[1], N. Pietralla[1], C. Bernads[2], A. Blanc[3], R.B. Cakirli[7], R.F. Casten[2], N. Cooper[2], G. de France[8], M. Jentschel[3], J. Jolie[6], U. Köster[3], P. Mutti[3], R.B. Régis[6], M Scheck[5], G. Simpson[5], W. Urban[4], and D. Wilmsen[6] — [1]TU Darmstadt — [2]Yale University — [3]Institut Laue-Langevin — [4]University of Warsaw — [5]University of West Scotland — [6]Universität zu Köln — [7]University of Istanbul — [8]Grand Accélérateur National d'Ions Lourds

A crossing of the deformations of the ground state and the band head of the K=0 (β) band had been observed in the Gadolinium isotopic chain at N=90, where a phase transition from spherical to deformed shapes occurs. As a consequence past N=90 the first excited 0^+ state has a smaller β-deformation than the ground state. However, it has been predicted that the deformations of both states should become similar in the deformed limit. To test this prediction in ^{158}Gd, we performed an experiment within the EXILL (n, γ) campaign at the Institut Laue-Langevin in Grenoble. Excited states in ^{158}Gd were populated after neutron capture, and we searched for the 64 keV $2^+_3 \rightarrow 0^+_2$ γ-decay within the K=0 band. A weak signal of the transition of interest has been identified in the $\gamma\gamma$ coincidence matrix, which allows to constrain the shape of the 0^+_2 state.

Supported by DFG Grant SFB 634 und U.S.DOE Grant No. DE-FG02-91ER40609

HK 45.6 Wed 16:15 T/HS2

Identification of the $\pi p_{3/2} \rightarrow \pi p_{1/2}$ spin-flip transition in ^{85}Br at PreSPEC-AGATA — •Christian Stahl[1], Michael Reese[1], Georgi Rainovski[2], and Norbert Pietralla[1] for the PreSPEC-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Faculty of Physics, St. Kliment Ohridski University of Sofia, Bulgaria

We present an experiment performed at GSI's PreSPEC-AGATA setup aiming at the identification of the $\pi p_{3/2} \rightarrow \pi p_{1/2}$ spin-flip transition in radioactive ^{85}Br. A novel experimental technique was employed for the determination of the absolute B(M1) transition strength between the $\pi p_{3/2}$-dominated ground-state and its spin-orbit partner candidate at 1191 keV excitation energy. The technique is based on the comparison of E2 and M1 Coulomb-excitation cross sections at different beam energies by exploiting AGATA's superb position resolution and the fast beams from GSI's heavy ion synchrotron. This work was supported by the BMBF under grant No. 06P12RDFN8, the german-bulgarian exchange program under grants No. PPP 50751591 and DNTS/01/2/2011 and by HIC for FAIR.

HK 46: Structure and Dynamics of Nuclei 10

Time: Wednesday 14:30–16:15 Location: T/SR14

HK 46.1 Wed 14:30 T/SR14

Isotope Shifts and Charge Radii in Zn around N=50 — •Laura Grob for the COLLAPS IS519-Collaboration — CERN, Geneva, Switzerland — Institut für Kernphysik, TU Darmstadt

For neutron-rich isotopes far from stability shell closures have been observed at neutron numbers than differ from the well-established magic ones. The weakening or disappearance of the magic number N=50 has been predicted for isotopes around the Z=28 shell closure and might

be caused by tensor interactions. Laser spectroscopic studies of Cu (Z=29) and Ga (Z=31) around the N=50 shell closure have already provided information on level migration due to tensor effects. In both isotopic chains an inversion of the proton level occurs, detected by spin changes. To study the Z-dependence of this level migration and its link to the tensor interaction, collinear laser spectroscopy measurements on neutron-rich Zn were performed at COLLAPS/ISOLDE. The optical spectra comprise important information on the ground state properties of the measured isotopes such as spins, charge radii, magnetic and quadrupole moments. For Zn there are four stable isotopes for which charge radii are known from electron scattering experiments. This will allow us to calibrate the charge radius information in this region. This talk will briefly explain the experimental technique and setup, and will present the first results of isotope shifts and charge radii for the even Zn isotopes up to N=50.

HK 46.2 Wed 14:45 T/SR14

Coulombanregung von ^{48}K — •Burkhard Siebeck für die IS482 - 2012-Kollaboration — IKP, Universität zu Köln

Isotope in der direkten Nachbarschaft von doppelt-magischen Kernen sind besonders geeignet zur Untersuchung von Einteilchenzuständen und effektiven Zweikörperwechselwirklungen. Im Falle von ^{48}K koppelt ein Neutron in der $p_{3/2}$-Schale mit einem Protonloch in der $s_{1/2}$- oder $d_{3/2}$-Schale. Der niederenergetische Teil des Termschemas von ^{48}K, sowie Lebensdauern wurden mit einer tief inelastischen Transferreaktion bestimmt [1]. Komplementär wurden nun reduzierte Übergangswahrscheinlichkeiten gemessen. Hierzu wurde ein Coulombanregungsexperiment mit einem radioaktiven ^{48}K-Strahl vom REX-ISOLDE Beschleuniger bei einer Energie von 2,82 MeV/u und dem MINIBALL-Spektrometer durchgeführt. Die Abregung der ersten beiden angeregten Zustände von ^{48}K bei 143 keV und 279 keV sowie des ersten angeregten Zustandes des ^{104}Pd Targets wurden beobachtet. Mithilfe von GOSIA2 werden hieraus die Übergangsmartixelemente bestimmt und mit theoretischen Werten aus Schalenmodellrechnungen verglichen.

Unterstützt durch BMBF (05P09PKCI5 und 05P12PKFNE)

[1] W. Krolas et al.; Phys. Rev. C 84, 064301 (2011)

HK 46.3 Wed 15:00 T/SR14

Low-lying structure of ^{30}Na and the *sd-pf* shell gap — •Marina Petri — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Light neutron-rich nuclei around N=20 show properties that are not in line with their expected magicity but rather imply a deformed shape. These nuclei lie in the so-called "Island of Inversion" where the deformation is due to neutron cross-shell excitations, namely $\nu(\mathrm{sd})^{-2}(\mathrm{fp})^2$ configurations, dominating their ground and low-lying states. Recently, there has been much interest in studying the transition towards this region to determine the evolution of the N=20 shell gap and to provide a stringent test for nuclear models.

In this work the odd-odd nucleus ^{30}Na is studied via 1p, 1p1n and 1n knockout reactions at the NSCL using ^{31}Mg, ^{32}Mg and ^{31}Na radioactive beams, respectively. Combining high-resolution γ-ray spectroscopy with the selectivity of the various reaction mechanisms we are able to distinguish multiple configurations. Negative parity states in ^{30}Na are identified for the first time, providing an important measure of the excitation of the 1p1h configuration. Gamma rays de-exciting both K=1 and K=2 2p2h structures have been observed, while the rotational band built on the ground state has been established. These new results provide a stringent test for the state-of-the-art effective interactions used in this region and constrain the *sd-pf* shell gap.

HK 46.4 Wed 15:15 T/SR14

Single-particle structure of exotic beryllium isotopes studied in quasi-free (p,pn)-reactions — •Julian Kahlbow[1], Thomas Aumann[1], Christoph Caesar[2], and Heiko Scheit[1] for the R3B-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany

The neutron-rich beryllium isotopes have been studied in inverse kinematics at the R^{3}B-LAND setup at GSI. The high neutron-proton asymmetry leads to the breakdown of the $N = 8$ shell-closure in ^{12}Be. The ^{12}Be ground-state configuration is composed of s-,p- and d-wave for the valence-neutron pair.

Proton-induced quasi-free neutron-knockout reactions at relativistic energies are used to investigate these single-particle properties in a kinematically complete measurement. The ^{11}Be-halo fragment is either populated in the ground-state, in a low-lying excited or an unbound state that is identified. Finally, partial cross sections are extracted.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and the BMBF project 05P12RDFN8.

HK 46.5 Wed 15:30 T/SR14

Isomer measurements with the MR-TOF-MS at the FRS Ion Catcher — •Christine Hornung for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany

At the future Low-Energy Branch (LEB) of the Super-FRS at FAIR, the precision experiments MATS and LaSpec will be performed. The FRS Ion Catcher at GSI is the test facility for the future LEB, consisting of the following three key components. With the FRS projectile and fission fragments are produced at relativistic energies, separated in-flight and range-focused. Further they are slowed-down and thermalized in a cryogenic stopping cell (CSC) to kinetic energies of a few eV. A multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) is used to clean the beam from isobaric contaminants. Due to its ultra-high mass resolving power excited and ground state can be spatially separated and pure isomeric beams can be provided.

In the experiment in October 2014, mass measurements of the isomeric and ground states of projectile and fission fragments were performed with the MR-TOF-MS. The capability of the MR-TOF-MS of a simultaneous mass measurement of the ground and isomeric state is used to confirm excitation energies and yield ratios of isomers and it will open new possibilities for mass and isomer resolved decay spectroscopy. This will lead to a better understanding of the production mechanisms and yield rates of in-flight facilities.

HK 46.6 Wed 15:45 T/SR14

Radiale Dichteverteilung der Kernmaterie in ^{56}Ni — •Mirko von Schmid für die EXL E105-Kollaboration — Institut für Kernphysik, TU Darmstadt

Im Rahmen des laufenden EXL-Experimentierprogramms („**EX**otic nuclei studied in **L**ight-ion induced reactions") wurde am ESR („**E**xperimental **S**torage **R**ing", GSI) mit der Reaktion ^{56}Ni$(p,p)^{56}$Ni zum ersten Mal erfolgreich eine Kernreaktion mit gespeicherten, exotischen Schwerionen untersucht.

Das Kernziel des Experiments war dabei die Bestimmung der radialen Dichteverteilung des doppelt magischen $N = Z$ Kerns ^{56}Ni mittels elastischer Protonenstreuung. Um die Dichteverteilung der Kernmaterie zu bestimmen, wird eine phänomenologische Parametrisierung der Dichteverteilung durch Variation ihrer freien Parameter so angepasst, dass der daraus mittels Glauber-Modellrechnungen errechnete Wirkungsquerschnitt den experimentell gemessenen Wirkungsquerschnitt nachbildet. Für die Parametrisierung der Dichteverteilung wurde hierbei ein modellunabhängiger Sum-Of-Gaussians (SOG) Ansatz gewählt. Der Vortrag wird die Ergebnisse dieser Analyse diskutieren.

Gefördert durch BMBF (06DA9040I und 05P12RDFN8), HIC for FAIR, den TU Darmstadt-GSI Kooperationsvertrag und den GSI-RUG/KVI Kooperationsvertrag.

HK 46.7 Wed 16:00 T/SR14

Investigation of isoscalar giant resonances in a stored beam experiment with EXL — •J.C. Zamora for the EXL E105-Collaboration — Institut für Kernphysik, TU Darmstadt

The objective of the EXL project is the investigation of nuclear rections of stored exotic nuclei with internal targets at FAIR. In this project a universal detector system will provide high resolution and large solid angle coverage for kinematically complete measurements.
In the first campaign of EXL at the present Experimental Storage Ring (ESR) at GSI, the collaboration performed commissioning and a first physics programme by using dedicated UHV compatible DSSDs for in-ring particle detection. With this setup, an experiment was done with a stored ion beam of ^{58}Ni and an internal helium gas-jet target aiming for the investigation of isoscalar giant resonances in inverse kinematics. Preliminary results show evidence for the excitation of the ISoscalar Giant Monopole Resonance (ISGMR) and the ISoscalar Giant Dipole Resonance (ISGDR) in the ^{58}Ni nucleus. In this talk, results and the current status of the data analysis will be discussed. This work is supported by BMBF (06DA9040I and 05P12RDFN8), HIC for FAIR, TU Darmstadt-GSI cooperation contract and GSI-KVI/RUG cooperation contract.

HK 47: Hadron Structure and Spectroscopy 10

Time: Wednesday 14:30–16:30 Location: T/SR25

HK 47.1 Wed 14:30 T/SR25

Extraction of Quark Fragmentation Functions in Leading Order at COMPASS — •Nicolas du Fresne von Hohenesche — For the COMPASS collaboration— Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55099 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 using a χ^2 fit. The COMPASS collaboration has recently measured charged hadron multiplicities for identified pions and kaons using a 160 GeV/c muon beam impinging on an iso-scalar 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 newest results from COMPASS on pion multiplicities and LO fragmentation functions will be presented.

Supported by BMBF

HK 47.2 Wed 14:45 T/SR25

Narrow Delta-resonance contribution to lepton-proton scattering — •Volodymyr Shubnyi[1,2] and Marc Vanderhaeghen[1] — [1]JGU Mainz, Germany — [2]KNU Kiev, Ukraine

The measured value of the proton charge radius from the Lamb shift of energy levels in muonic hydrogen is in strong contradiction, by 7-8 standard deviations, with the value obtained from electronic hydrogen spectroscopy and the value extracted from the unpolarized electron-proton scattering data. The dominant unaccounted higher order contribution in scattering experiments corresponds to two photon exchange (TPE) diagram. The delta-resonance contribution to TPE correction was studied in narrow width approximation.

HK 47.3 Wed 15:00 T/SR25

Nucleon axial form factors from two-flavour Lattice QCD — •jiayu hua[1], parikshit m. junnarkar[2], stefano capitani[2], dalibor djukanovic[2], georg m. von hippel[1], benjamin jäger[3], harvey b. meyer[1,2], thomas d. rae[2], and hartmut wittig[1,2] — [1]PRISMA Cluster of Excellence and Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]Helmholtz-Institut Mainz, Mainz, Germany — [3]Department of Physics, College of Science, Swansea University, Swansea, UK

We present preliminary lattice QCD results on the axial form factor $G_{\mathrm{A}}(Q_2)$ and the induced pseudoscalar form factor $G_{\mathrm{P}}(Q_2)$ of the nucleon. A systematic analysis of the excited-state contributions in correlation functions is performed on two-flavour ensembles with O(a) improved Wilson fermions. We observe that the form factors suffer from non-trivial excited-state contributions at the source-sink separations available to us. We use both the matrix elements of the axial current and the pseudoscalar density to extract the form factors.

HK 47.4 Wed 15:15 T/SR25

Geant 4 Monte Carlo simulation for the COMPASS-II experiment at CERN — •Christopher Regali, Fischer Horst, Matthias Gorzellik, Philipp Jörg, Kay Königsmann, Steffen Landgraf, Katharina Schmidt, Stefan Sirtl, Tobias Szameitat, and Johannes ter Wolbeek — for the COMPASS collaboration, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg

The COMPASS-II experiment at CERN/SPS is a multi purpose experiment for nucleon structure studies and hadron spectroscopy. It offers the unique possibility to measure exclusive processes like Hard Exclusive Meson Production and Deeply Virtual Compton Scattering with different beams over a wide kinematic range. Such processes will provide access to Generalized Parton Distributions (GPDs), which, as a theoretical framework, are particularly interesting, because they can give a dynamical insight into the nucleon. For future measurements a very precise understanding of the spectrometer acceptance is needed, as the measurement aims towards asymmetries in total cross sections. In order to accomplish this, a new Geant4 based simulation software was developed. This talk will give an overview of the project. Supported by BMBF, DFG and EU FP7 (Grant Agreement 283286).

HK 47.5 Wed 15:30 T/SR25

Messung des differentiellen und totalen Wirkungsquerschnitts der η' Photoproduktion an MAMI — •Patrik Ott für die A2-Kollaboration — Institut für Kernphysik, Universität Mainz, Mainz, Germany

Am Crystal-Ball (CB) Experiment am Elektronenstrahl-Beschleuniger MAMI in Mainz werden Nukleonen und weitere Hadronen mittels eines reellen Photonenstrahls untersucht. Mit der Beschleunigerstufe MAMI-C, steht ein intensiver polarisierter Strahl mit einer Energie von bis zu 1,604 GeV zur Verfügung. Durch Bremsstrahlung wird mit Hilfe eines neu entwickelten Magnet-Spektrometers ein hochenergetischer energiemarkierter Photonenstrahl erzeugt. Erste Experimente wurden 2012 durchgeführt. Ein hermetisches Detektorsystem, bestehend aus dem CB/TAPS-Kalorimeter und weiteren Detektoren, welche eine Teilchenidentifikation und Spurrekonstruktion erlauben, weist Vielkörper-Endzustände exklusiv nach.

In meinem Vortrag werde ich Messungen des totalen und differentiellen Wirkungsquerschnitts der Photoproduktion $\gamma p \to \eta' p$ präsentieren. Diese beruhen auf der Analyse des neutralen Zerfallskanals $\eta' \to \eta\pi^0\pi^0 \to 6\gamma$.

HK 47.6 Wed 15:45 T/SR25

In-medium properties of the ω-meson* — •Stefan Friedrich for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

The attenuation of ω-mesons in cold nuclear matter has been studied in photonuclear reactions on proton, ^{12}C and ^{93}Nb nuclei, using the tagged photon beam at the ELSA accelerator in Bonn. The combined setup of the Crystal Barrel and MiniTAPS detector systems, which form a 4π electromagnetic calorimeter, was used for detecting the ω-mesons via the $\omega \to \pi^\circ + \gamma$ decay mode.
Results on the in-medium width of the ω-meson, derived from the transparency ratio measurements, will be presented and compared to experimental data [1] and recent theoretical predictions [2,3]. The inelastic ωN cross section is deduced as a function of momentum as well. In particular, the momentum-dependence for slow ω-mesons will be discussed.
[1] Kotulla et al., *Phys. Rev. Lett.* **100** (2008), 192302
[2] Cabrera and Rapp, *Phys. Lett. B* **729** (2014), 67
[3] Ramos et al., *Eur. Phys. Jour. A* **49** (2013), 148
*Funded by DFG (SFB/TR16)

HK 47.7 Wed 16:00 T/SR25

Determination of the strange vector form factors and the anapole moment of the nucleon from measurements of the A4 Collaboration — •David Balaguer Ríos, Kurt Aulenbacher, Sebastian Baunack, Dominik Becker, Luigi Capozza, Jürgen Diefenbach, Boris Gläser, Dietrich von Harrach, Yoshio Imai, Eva-Maria Kabuss, Rainer Kothe, Jeonghan Lee, Frank Maas, Harald Merkel, María Carmen Mora Espí, Ernst Schilling, and Christoph Weinrich for the A4-Collaboration — Institut für Kernphysik, Mainz, Germany

At the MAMI accelerator facility the A4 collaboration has measured the parity violating asymmetry in the quasielastic scattering of longitudinally polarized electrons on the deuteron at backward angles at $Q^2 = 0.23$ (GeV)^2. The aim is to extract simultaneously the strange vector form factors G_E^s, G_M^s and the dominant isovector axial vector form factor of the nucleon $G_A^{e,(T=1)}$. Moreover this set of measurements permits the constrain of electroweak radiative corrections contributing to the effective axial vector current of the nucleon as seen by the photon (the nucleon anapole moment). In this talk the latest measurement of the asymmetry is presented and discussed in terms of strangeness and axial form factors of the nucleon.

HK 47.8 Wed 16:15 T/SR25

Extending the alpha/beta rule for accurate calculation of meson masses to baryons — •Karl Otto Greulich — Fritz Lipmann Instute, Beutenbergstr.11,D07745 Jena

The alpha/beta rule: m (particle) = alpha power to -n x beta power to m x 27,2 eV/c2 has recently been reported to predict, for n=3 and m=0, a mass of 70,02 MeV/c2 (K.O.Greulich, DPG Spring meeting 2014, Frankfurt, HK 18.5). Thereby alpha is the fine structure con-

stant (= 1/137,036), beta is the proton vs. electron mass ratio (= 1836,12); m and n are integers. The predicted mass is a sort of building block for most mesons and allows accurate calculation of their masses. Here it is reported that the masses of a number of baryons also fit into this scheme.

HK 48: Poster

Time: Wednesday 17:00–19:00 Location: C/Foyer

HK 48.1 Wed 17:00 C/Foyer

Studies on the reaction pd → ^{3}Heπ^0 at WASA-at-COSY* — •Karsten Sitterberg, Nils Hüsken, Florian Bergmann, Kay Demmich, and Alfons Khoukaz — Institut für Kernphysik, WestfälischeWilhelms-Universität Münster, Germany

The limited database for the total cross sections of the pd → ^{3}Heη reaction presents unexpected fluctuations in the excess energy range of 20-60 MeV. In order to examine these variantions and to look for an underlying structure in the cross sections, a beam time at the WASA-at-COSY installation was performed in May 2014. The 15 different momenta for the proton beam used ranged from $p_p = 1.60\,\mathrm{GeV/c}$ to $p_p = 1.74\,\mathrm{GeV/c}$, i.e. $Q = 13.6\,\mathrm{MeV}-80.9\,\mathrm{MeV}$ for the ^{3}Heη-reaction. In order to obtain total and differential cross sections, the luminosities for the different beam momenta have to be determined. This can be done via the reconstruction of the normalisation reaction pd → ^{3}Heπ^0 and its angular distributions.
First analysis results of the data obtained at the WASA-at-COSY beam time will be presented and discussed.

*Supported by FFE program of the Forschungszentrum Jülich and the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n 283286.

HK 48.2 Wed 17:00 C/Foyer

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

One important step in understanding the baryon spectrum is a precise knowledge of the excited states and their decays. In order to extract the contributing resonances from experimental data a partial wave analysis needs to be performed. To resolve ambiguities, the measurement of polarization observables is indispensable. In the regime of high mass baryon resonances multi-meson final states are of particular importance. Here sequential decays of resonances are observed.

The Crystal Barrel/TAPS experiment is ideally suited to measure the photoproduction of neutral mesons decaying into photons due to its good energy resolution, high detection efficiency for photons, and the nearly complete solid angle coverage. In combination with a longitudinally or transversely polarized target and an energy tagged, linearly or circularly polarized photon beam the experiment allows the measurement of a large set of polarization observables.

Preliminary results on the reaction $\vec{\gamma}\vec{p} \to p\pi^0\pi^0$ obtained with a transversely as well as with a longitudinally polarized target will be presented.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 48.3 Wed 17:00 C/Foyer

Messung des Beitrags der Strange-Quarks zu den Vektor-Formfaktoren des Protons bei Q^2=0.1(GeV/c)^2 — •Boris Gläser[1], David Balaguer Rios[1], Sebastian Baunack[1], Dominik Becker[1], Jürgen Diefenbach[1], Dietrich von Harrach[1], Yoshio Imai[1], Jeong Han Lee[1,4], Frank Maas[1,2,3], Maria Carmen Mora Espi[1], Roberto Perez Benito[1], Ernst Schilling[1] und Iris Zimmermann[1] für die A4-Kollaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz — [4]Institute for Basic Science, Daejeon, Korea

Die A4-Kollaboration am Elektronenbeschleuniger MAMI der Johannes Gutenberg-Universität Mainz befasst sich mit der Untersuchung der Strange-Quark-Beiträge zu den Vektor-Formfaktoren des Nukleons. Hierzu wurde die paritätsverletzende Asymmetrie in der elastischen Streuung longitudinal polarisierter Elektronen an unpolarisierten Protonen vermessen. Der Nachweis der gestreuten Elektronen erfolgte mit einem segmentierten PbF_2-Kalorimeter, das sowohl für Messungen unter Vorwärts- als auch unter Rückwärtsstreuwinkeln eingesetzt wurde. Messungen bei konstantem Impulsübertrag aber unterschiedlichem Streuwinkel ermöglichen die unabhängige Bestimmung des seltsamen elektrischen und seltsamen magnetischen Formfaktors. Die letzte Messung der A4-Kollaboration wurde 2012 abgeschlossen. Der Beitrag stellt den aktuellen Datenpunkt für Messungen bei einem Impulsübertrag von $0.1(\mathrm{GeV/c})^2$ unter Rückwärtsstreuwinkeln vor.

HK 48.4 Wed 17:00 C/Foyer

Technical Development of the Backward End-Cap (BWEC) for the PANDA Electromagnetic Calorimeter (EMC) — •Roserio Valente[1,2], Heybat Ahmadi[1,2], Samer Ahmed[1], Luigi Capozza[1,3], Alaa Dbeyssi[1,3], Malte Deiseroth[1,2], Bertold Fröhlich[1,3], Dmitry Kahneft[1,2], Dexu Lin[1,3], Frank Maas[1,3], María Carmen Mora Espí[1,3], Cristina Morales Morales[1,3], Oliver Noll[1,2], David Rodríguez Piñeiro[1,3], Manuel Zambrana[1,2], and Iris Zimmermann[1,3] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz — [2]Johannes Gutenberg-Universität Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The Backward End-Cap (BWEC) of the PANDA Electromagnetic Calorimeter (EMC) will be placed upstream of the interaction point. In this region several other sub-detectors, that operate at different working conditions, are assembled and inserted into PANDA solenoid cavity. This constitutes a challenge for the structural and functional development of the BWEC, since the solid angle coverage with lead tungsten crystals needs to be maximized to meet the physics case requirements. Thanks to a profitable collaboration with the neighbor sub-detector groups, the BWEC 3D design has been constantly updated to take into account the constraints of the experiment. The design of parts, such as the BWEC support, insertion trolley, cooling network and service routing were optimized. In parallel, studies are being done to validate the pressure drop and heat distribution inside the cold volume as well to validate the mechanical stability of the supporting parts.

HK 48.5 Wed 17:00 C/Foyer

Proton Time-like Electromagnetic Form Factor Measurements with the ISR Method at BESIII-experiment — •Dexu Lin[1,2], Samer Ali Nasher Ahmed[1,2], Alaa Dbeyssi[1], Paul Larin[1], Frank Maas[1,2,3], Cristina Morales[1], and Christoph Rosner[1,2] — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germay — [3]PRISMA Cluster of Excellence, Johannes Gutenberg Universität Mainz, 55099 Mainz, Germay

The structure of the proton can be understood through the study of its electromagnetic (EM) form factors. Electron scattering experiments have allowed to explore, with a high accuracy, the proton EM form factors in the space-like region. 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) is collecting large data samples at J/Ψ, Ψ″ and XYZ energy range. These data can be used to measure proton EM form factors using Initial-State-Radiation (ISR) events with the process $e^+e^- \to p\bar{p}\gamma_{ISR}$. In this poster, the status of proton EM form factors analysis in time-like regeion with the data from around 4 GeV center of mass energy will be summarized together with a discussion of the background substraction procedure.

HK 48.6 Wed 17:00 C/Foyer

High precision determination of the weak mixing angle at the future P2-experiment at the MESA-accelerator in Mainz — •Dominik Becker[1], Kathrin Gerz[1], Sebastian Baunack[1], Krishna S. Kumar[2], and Frank E. Maas[1,3,4] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany — [2]University of Massachusetts Amherst, Massachusetts, USA — [3]GSI

Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz, Germany

The goal of Project P2 is to determine the electroweak mixing angle $\sin^2(\theta_W)$ to a precision of better than 0.15 % at low momentum transfer ($Q^2 = 0.003$ GeV^2). The experiment will be carried out at the upcoming MESA accelerator facility in Mainz. MESA is a superconducting energy recovering linear accelerator for electrons up to 155 MeV.

The experimental method comprises a measurement of the proton's weak charge Q_W^p to a relative uncertainty of 1.9 % via measurement of the parity violating asymmetry in elastic electron-proton scattering. In our poster, we are going to present the experimental method and discuss the achievable precision in the determination of the weak mixing angle. We also show results of Geant4 simulations which were carried out to study the experimental setup. A solenoid magnet with 2 pi azimuthal acceptance will be employed together with a 60 cm hydrogen target. The high luminosity is necessary to get the required statistical precision at the 8 $\times 10^{-9}$-level.

HK 48.7 Wed 17:00 C/Foyer

Development of a Prototype for the Backward End-Cap for the PANDA Electromagnetic Calorimeter at FAIR — Heybat Ahmadi[1], Samer Ahmed[2], Luigi Capozza[3], Alaa Dbeyssi[3], Malte Deiseroth[1], Bertold Fröhlich[3], Dmitry Khaneft[1], Dexu Lin[3], Frank Maas[3], María Carmen Mora Espí[3], Cristina Morales Morales[3], •Oliver Noll[1], David Rodríguez Piñeiro[3], Roserio Valente[1], Manuel Zambrana[1], and Iris Zimmermann[3] — [1]UNI-MAINZ/HIM — [2]HIM — [3]HIM/GSI

We have developed a prototype (PROTO16) for the backward end-cap (BWEC) of the PANDA electromagnetic calorimeter. The aim has been to test as much as possible the final details concerning crystal read out and insulation system of the BWEC. This ranges from equipping the scintillator material lead tungstate (PWO) with large area avalanche photodiodes (APDs) and ASIC-Preamplifiers (APFEL) of the last generation to the insulating material of Vacuum-Insulation-Panels (VIP) and Aerogel up to a fully executable slow control- and data acquisition system. Moreover innovative methods for subsystems like the high precision calibration system for thermal sensors have been realized reaching a new level of accuracy. Due to the high light yield variation of PWO with temperature this is an important ingredient to reach the required good energy resolution. As a result, it is possible to monitor relative and absolute temperature differences in the prototype with a precision of 0.1 °C. The prototype has been tested at the tagged photon beam of the MAMI electron accelerator in Mainz in July 2014. Design concept, realization and test results will be presented.

HK 48.8 Wed 17:00 C/Foyer

Towards Measuring the Electromagnetic Structure of η' Mesons with the CLAS g12 Experiment — •Michaela Schever for the CLAS-Collaboration — RWTH Aachen — Forschungszentrum Jülich

The CLAS g12 experiment was performed with a tagged Bremsstrahlung photon beam using the 6 GeV electron beam from the CEBAF accelerator at Jefferson Lab, USA. We report on the Monte Carlo simulations being performed in order to support the CLAS approved analysis for light meson decays from existing data sets of the g12 experiment.

The specific goal of the effort described here is to look for events from the Dalitz decay $\eta' \to \gamma e^+ e^-$ and the possibility to deduce the electromagnetic transition form factor of the η' meson. This would be achieved by comparing the measured dilepton invariant mass distribution with the QED calculation. It is expected that the resulting form factor dominantly displays the line shape of an intermediate vector meson, according to models based on vector meson dominance. So far, experimental results have suffered from a lack of statistics. Along with the actual data analysis, it is essential to model possible background contributions form competing decay channels as well as the contamination from external conversion processes.

HK 48.9 Wed 17:00 C/Foyer

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

The decay $\eta \to \pi^0 e^+ e^-$ is a perfect probe for testing the conservation of the C-parity within the standard model and for the search of dark U-bosons. This reaction has not been observed so far and only an upper limit of the branching ratio of 4×10^{-5} is quoted by the PDG. With the WASA-at-COSY facility a huge data set of $\approx 5 \times 10^8$ η mesons has been produced in proton-proton scattering dedicated for studies on rare and forbidden decays of the η meson. This high statistics measurement allows for the determination of the relative branching ratio below the recent upper limit and is sensitive to small C-violating and dark matter contributions. The current status of the analysis will be presented and discussed.

*Supported by FFE program of the Forschungszentrum Jülich.

HK 48.10 Wed 17:00 C/Foyer

Feasibility Study of a Transversely Polarized Target in PANDA — Heybat Ahmadi[1,2], Samer Ahmed[1], Luigi Capozza[1,3], Alaa Dbeyssi[1,3], Malte Deiseroth[1,2], •Bertold Fröhlich[1,3], Dmitry Khaneft[1,2], Dexu Lin[1,3], Frank Maas[1,3], María Carmen Mora Espí[1,3], Cristina Morales Morales[1,3], Oliver Noll[1,2], David Rodríguez Piñeiro[1,3], Roserio Valente[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[1,3] — [1]Helmholtz-Institut Mainz — [2]Johannes Gutenberg-Universität Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH

The PANDA (Antiproton Annihilation at Darmstadt) spectrometer, located at the Facility for Antiproton and Ion Research (FAIR), is an excellent tool for exploring the nucleon structure. An unpolarized target allows the determination of the electromagnetic time-like form factor of the proton. An additional experiment in which the target is transversely polarized is necessary for the first-time extraction of their imaginary part.

A transverse polarization requires the shielding of the 2 T longitudinal field from the PANDA-Solenoid at the target volume and an additional transverse holding field.

We present results from our first experiment at the Institut für Kernphysik in Mainz on intense magnetic flux shielding using a BSCCO (bismuth strontium calcium copper oxide) thin-wall hollow cylinder at 4.2 K and a 1.4 T external magnetic field and compare this to numerical calculations.

HK 48.11 Wed 17:00 C/Foyer

The Search for a $\pi\Lambda N - \pi\Sigma N$ Resonance in pp@3.5 GeV* — •Jia-Chii Berger-Chen for the HADES-Collaboration — Physik Department E12 and Excellence Cluster "Universe", Technische Universität München, 85748 Garching, Germany

Inspired by recent relativistic three-body Fadeev calculations by Garcilazo and Gal [1] predicting a possible existence of a $\pi\Lambda N - \pi\Sigma N$ resonance, an experimental analysis was started to search for this state in p+p reactions at $E_{kin} = 3.5$ GeV recorded with the HADES experiment (GSI, Darmstadt, Germany). This hypothetical resonance can be denoted as a $\mathcal{Y}$ dibaryon with the quantum numbers $(Y, I, J^P) = (1, \frac{3}{2}, 2^+)$ and seen as a quasibound state of $\Sigma(1385)N - \Delta(1232)Y$ (N = nucleon, Y = hyperon) with a binding energy of about 50 MeV. The analysis exploits the unique decay of the double charged $\mathcal{Y}$ into a Σ^+ and a proton in the reaction $p + p \to \mathcal{Y}^{++} + K^0$ and the knowledge gained in the exclusive analysis of K^0 channels associated with resonances [2]. The contribution includes a description of the analysis as well as preliminary results.

[1]H. Garcilazo and A. Gal, Nucl. Phys. A 897:167-178 (2013).

[2]G. Agakishiev et al. (HADES), Phys. Rev. C 90:015202 (2014).

*supported by BMBF (05P12WOGHH), Excellence Cluster "Universe" and the TUM Graduate School

HK 48.12 Wed 17:00 C/Foyer

Measurement of the Pion Polarizability with COMPASS — •Stefan Huber for the COMPASS collaboration — Technische Universiät München

Chiral Perturbation Theory predicts a precise value for the charged-pion polarisability. Experiments performed within the last decades are in tension with this value and also do not agree with each other. At the COMPASS experiment at CERN the pion polarisability is accessible through the Primakoff effect, where the quasi-real photons surrounding the nickel nuclei are used to measure pion-photon scattering. Studying the energy distribution of the outgoing photons, the polarisability value can be extracted. During the 2009 data taking COMPASS performed a first measurement based on about 60 000 exclusive events. In addition to the measurement with a pion beam a control measurement

with a muon beam has been performed in order to control the systematics. The details of the measurement as well as the results will be discussed. Currently we are analysing a data set taken in 2012 which will allow us to study the value with better statistical and systematical precision.

HK 48.13 Wed 17:00 C/Foyer

Status of a High Gradient CH - Cavity — •Ali Almomani and Ulrich Ratzinger — IAP - Frankfurt Universität

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. Additionally, operating of normal conducting cavities at cryogenic temperatures will be discussed for the case of very short RF pulses. The first measurement results for this cavity will be presented.

HK 48.14 Wed 17:00 C/Foyer

Entwicklung eines neuartigen Injektionssystems für einen toroidalen Hochstromspeicherring — •Heiko Niebuhr, Adem Ates, Martin Droba, Oliver Meusel, Ulrich Ratzinger und Joschka Wagner — Institut für Angewandte Physik, Goethe-Universität, Max-von-Laue Str. 1, 60438 Frankfurt

Zur Realisierung des angedachten supraleitenden magnetostatischen Speicherrings (F8SR) zur Speicherung hoher Ionenströme wird zurzeit an der Universität Frankfurt ein herunterskaliertes Strahlexperiment mit zwei normalleitenden Toroidsegmenten durchgeführt. Nachdem die Strahldynamik beim Strahltransport eines Ionenstrahls durch einen solchen toroidalen Kanal erforscht wurde, wird im nächsten Schritt die seitliche Injektion mittels einer Injektionsspule bei gleichzeitiger Beobachtung des Ringstrahls erforscht. Zur Umsetzung des angedachten Experiments werden neben theoretischen und experimentellen Befunden auch Simulationen des Experiments mit dem am IAP in Entwicklung befindliche 3D Simulationsprogramm "bender" genutzt. Bei dem Experiment handelt es sich im Vergleich zum angedachten magnetostatischen Speicherring um ein herunterskaliertes Experiment bei Raumtemperatur mit zwei Toroidsegmente mit einem Magnetfeld von 0,6 T. Die niederenergetischen Ionenstrahlen werden durch zwei Volumenionenquellen bereitgestellt. Mit Hilfe zweier Filterkanäle werden die Strahlen gefiltert um zwei Protonenstrahlen 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.

HK 48.15 Wed 17:00 C/Foyer

Development of a 325 MHz Ladder-RFQ of the 4-Rod-Type — •Maximilian Schütt[1], Ulrich Ratzinger[1], and Robert Brodhage[2] — [1]Institut für Angewandte Physik, Goethe-Universität, Frankfurt a. M. — [2]GSI, Darmstadt

For the research program with cooled antiprotons at FAIR a dedicated 70 MeV, 70 mA proton injector is required. In the low energy section, between the Ion Source and the main linac an RFQ will be used. The 325 MHz RFQ will accelerate protons from 95 keV to 3.0 MeV. This particular high frequency for an RFQ creates difficulties, which are challenging in developing this cavity. In order to define a satisfactory geometrical configuration for this resonator, both from the RF and the mechanical point of view, different designs have been examined and compared. Very promising results have been reached with a ladder type RFQ, which has been investigated since 2013. We present recent 3D simulations of the general layout and of a complete cavity demonstrating the power of a ladder type RFQ as well as measurements of a 0,8 m prototype RFQ, which was manufactured in late 2014 and designed for RF power and vacuum tests. We will outline a possible RF layout for the RFQ within the new FAIR proton injector and highlight the mechanical advantages.

HK 48.16 Wed 17:00 C/Foyer

Beam Dynamics for the sc cw Heavy Ion Linac at GSI — •Malte Schwarz[1], Michael Amberg[1,2], Kurt Aulenbacher[2], Winfried Barth[3], Markus Basten[1], Florian Dziuba[1], Viktor Gettmann[3], Sascha Mickat[3], Holger Podlech[1], and Stepan Yaramyshev[3] — [1]Institut für Angewandte Physik, Goethe-Universität Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [3]Helmholtz Institut Mainz (HIM)

For future experiments with heavy ions at the coulomb barrier within the SHE research project a multi-stage R&D program of GSI, HIM and IAP is currently under progress. It aims at developing a superconducting (sc) continuous wave (cw) LINAC with multiple CH-cavities as key components. The beam dynamics concept is based on EQUUS (Equidistant Multigap Structure) constant-beta cavities. The advantages of its periodicity are a high simulation accuracy, easy manufacturing and tuning with minimized costs as well as a straightforward energy variation. An important milestone will be the full performance test of the first LINAC section (demonstrator) with beam. The corresponding beam dynamics simulations will be presented.

HK 48.17 Wed 17:00 C/Foyer

Entwurf einer Targetkammer zum Einsatz in (p,γ)-Experimenten an FRANZ* — •Ceyhun Arda, Kerstin Sonnabend, René Reifarth, Benedikt Thomas, Markus Reich, Anne Endres, Jan Glorius und Stefan Schmidt — Goethe Universität Frankfurt

An der Frankfurter Neutronenquelle am Stern-Gerlach-Zentrum (FRANZ) werden Experimente mit hochintensiven Protonenstrahlen geplant. Für die geplanten kalorimetrischen Messungen der Wirkungsquerschnitte ^{90}Zr(p,γ) und ^{91}Nb(p,γ) ist die Entwicklung einer Targetkammer unabdingbar. Durch 3D-Modellierungen einer Targetkammer und des 4π BaF_2-Kalorimeters konnte das geringe Platzangebot innerhalb des Detektors optimal in den Entwicklungsprozess eingebunden werden. Bei dem Entwurf der Targetkammer wurden Bauteile wie Gegenspannungsblende, Lochblende und Kühlfalle berücksichtigt und in die Targetkammer integriert. Zudem wurden Temperatursimulationen bezüglich der Kühlfalle durchgeführt. Der bisherige Entwurf und weitere Pläne werden vorgestellt.

*gefördert durch die DFG(SO907/2-1), Nautilus und HIC for FAIR.

HK 48.18 Wed 17:00 C/Foyer

Konstruktion und Erprobung einer Probenhalterung mit integrierter Wasserkühlung und Temperaturüberwachung für hochleistungsbeständige Proben an FRANZ* — •Markus Reich, Kerstin Sonnabend, René Reifarth, Ceyhun Arda, Anne Endres, Philipp Erbacher, Benedikt Thomas und Stefan Schmidt — Goethe Universität Frankfurt

Experimente mit hochintensiven Protonenstrahlen an der Neutronenquelle FRANZ stellen besondere Anforderungen an bestrahlte Proben. Da in der ersten Aufbauphase ein Protonenstrahl mit 2 MeV Energie und etwa 2 mA Intensität zur Verfügung steht wird eine Leistungsdeposition von 4 kW in den Proben erwartet. Um zu hohen Temperaturen und damit einer Beschädigung der Proben entgegen zu wirken, muss diese Leistung effektiv von der Probe abgeführt werden. Eine bereits in Temperatursimulationen untersuchte, effiziente Wasserkühlung wird realisiert und getestet. Zur Überwachung der Temperaturentwicklung auf der Probenoberfläche wird zusätzlich eine in die Probenkammer integrierte Temperaturüberwachung mittels IR-Sensoren entwickelt und unter Strahlbedingungen getestet. Der aktuelle Stand der Entwicklungsarbeiten wird vorgestellt und folgende Schritte diskutiert.

* gefördert durch DFG(SO907/2-1) und HIC for FAIR.

HK 48.19 Wed 17:00 C/Foyer

Construction and Test of a New Time-of-Flight Wall Prototype for R^{3}B — Max Gilbert[1], •Michael Heil[2], René Reifarth[1], Jan Glorius[1], and Tanja Heftrich[1] for the R3B-Collaboration — [1]Goethe Universität Frankfurt, Frankfurt, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany

In order to fully exploit the potential of FAIR beams at the R^{3}B setup a new time-of-flight wall with superior time and energy resolution is essential. With the time-of-flight and energy loss measurements of the ToF wall the mass and the nuclear charge of the reaction products can be uniquely determined. The excellent performance has to be maintained even for heavy ion beams up to the Pb region and at high counting rates up to 1 MHz. The planned detector will consist of 176 plastic scintillator paddles in 4 layers. A smaller prototype with 24 paddles was tested at GSI with ^{58}Ni and ^{48}Ca beams. The design of the detector as well as the results of the performance tests will be

presented.

HK 48.20 Wed 17:00 C/Foyer

Bestimmung des ^{10}Be(n,γ) Wirkungsquerschnitts mit LaBr$_3$ Detektoren — •Meiko Volknandt[1], Enno Hrivula[1], Klaus Eberhardt[2], Anne Endres[1], Matthias Fix[1], Tanja Heftrich[1], Stefan Heinitz[3], 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

Für das Verständnis der Nukleosynthese des Urknalls und zur Verifikation der Abschätzung der Umkehrreaktion, dem Coulombaufbruch von ^{11}Be ist die Analyse der ^{10}Be(n,γ) Reaktion unerlässlich. Über eine Aktivierung im Neutronenspektrum am TRIGA-Forschungsreaktor in Mainz wurde der ^{10}Be(n,γ) Wirkungsquerschnitt für thermische und epithermische Neutronen bestimmt. Die Trennung der beiden Anteile im Spektrum wurde mit der Cadmiumdifferenzmethode durchgeführt. Die Aktivität des frisch erzeugten, kurzlebigen ($t_{1/2}$ = 13.81 s) ^{11}Be wurde mit Hilfe von LaBr$_3$ Szintillationsdetektoren gemessen. Anhand der sehr hochenergetischen Gammalinie bei 6.791 MeV konnte ^{11}Be untergrundfrei direkt beobachtet und quantitativ ausgewertet werden. Es handelt sich dabei um die erstmalige Bestimmung des ^{10}Be(n,γ) Querschnittes.

HK 48.21 Wed 17:00 C/Foyer

Bound-state β-decay of bare ^{205}Tl^{81+} — •Bingshui Gao for the FRS-ESR-Collaboration — GSI, Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, D-64291 Darmstadt, Germany

Beta decay into bound electron states of the daughter atom (β_b^-), accompanied by the emission of a monochromatic antineutrino, has been predicted by Daudel et al. However, a noteworthy probability of β_b^--decay exists only for highly-charged ions and the experimental storage ring ESR at GSI is a unique tool for investigating β_b^--decays. A forthcoming experiment is the determination of the half-life of β_b^--decay of bare ^{205}Tl^{81+}, which is related to both the solar pp-neutrino flux and the s-process nucleosynthesis. On the one hand, the LOREX project addresses the relative amount of ^{205}Tl and ^{205}Pb atoms in deep-lying thallium-rich minerals. There ^{205}Pb atoms are generated by the capture of solar pp-neutrinos, with an unprecedented small threshold of only 52 keV. The ratio of ^{205}Pb/^{205}Tl renders the product of the mean pp-solar neutrino flux $<\phi_{\nu_e}>$ and the neutrino capture cross section σ_{ν_e}. The latter can only be obtained by measuring the half-life of β_b^--decay of bare ^{205}Tl^{81+} because ν_e-capture andβ_b^--decay share the same nuclear matrix element. On the other hand, ^{205}Pb is the only purely s-process short-lived radioactivity which gives insight in nucleosynthesis just prior to Sun's birth. It has been demonstrated that in the stellar environment the production rate of ^{205}Pb in the s-process sensitively depends on both free electron capture of ^{205}Pb and β_b^--decay of bare and H-like ^{205}Tl. It is thus desirable to measure the half-life of the β_b^--decay of ^{205}Tl^{81+}.

HK 48.22 Wed 17:00 C/Foyer

Elliptic flow of inclusive electrons in Pb-Pb collisions — •Sebastian Scheid, Raphaelle Bailhache, Theodor Rascanu, 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 produced in high-energy heavy-ion collisions. Since heavy quarks, i.e. charm and beauty, are produced on a shorter time scale with respect to the hot fireball, they are suited to probe the interaction dynamics inside the medium.

Heavy-flavour hadrons can be measured via their semi-electronic decays at mid-rapidity with ALICE. The heavy-flavour elliptic flow, the second harmonic in the Fourier expansion of the particle azimuthal distribution, is an observable sensitive to the degree of thermalization of charm and beauty quarks in the medium at low p_{T}, as well as to the path length dependence of the energy loss of heavy quarks at high p_{T}.

In this poster, I will show how the elliptic flow of inclusive electrons is measured with the event-plane method in 20-40% central Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. Electrons are identified with the Time-Projection-Chamber and the Time-Of-Flight in the central barrel in the p_{T} range 1.5-6 GeV/c. The estimation of the remaining hadron contamination will be presented as well as a possible way to subtract this contribution to the elliptic flow.

Supported by BMBF and the Helmholtz Association.

HK 48.23 Wed 17:00 C/Foyer

Investigation of resonance lifetimes and mean free paths in a transport approach — •Marcel Lauf[1,2], Thomas Kehrenberg[1,2], Dmytro Oliinychenko[1,3], Janus Weil[1], Matthias Kretz[1], and Hannah Petersen[1,2] — [1]Frankfurt Institute for Advanced Studies, Frankfurt, Germany — [2]Goethe University, Frankfurt, Germany — [3]Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

Hadronic transport approaches are used to describe the dynamical evolution of heavy-ion reactions at low beam energies (up to FAIR/RHIC/SPS energies). In this work, we investigate specific properties of a time step based simulation of heavy-ion collisions in a microscopic transport model (SMASH). First, the actual lifetimes of resonances in the simulation are compared to theoretical expectations. Furthermore, the dependence of scattering rates on the choice of the time step size is analyzed. The time steps need to be smaller than the mean free path of the particles, which is calculated via the local density and individual scattering cross section. Based on these findings an algorithm to determine the optimal time step size is developed.

HK 48.24 Wed 17:00 C/Foyer

Charged particle production under EMCal trigger condition with ALICE — •Patrick Huhn — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to study the properties of the Quark-Gluon-Plasma (QGP). The measured transverse momentum (p_{T}) distribution in heavy ion collisions can be compared to that measured in pp collisions in terms of the nuclear modification factor (R_{AA}). The minimum bias pp reference at $\sqrt{s}$ = 2.76 TeV and therefore R_{AA} in Pb-Pb collisions are currently limited in their p_{T} range to p_{T} = 50 GeV/c. To extend the p_{T} distribution to higher p_{T} ($p_{\mathrm{T}} > 50$ GeV/c), triggers can be used.
We present an analysis of the cross section of inclusive charged particles in pp collisions as a function of p_{T} with a selection on deposited energy in the electromagnetic calorimeter (EMCal). Results based on a Toy Monte Carlo simulation including realistic EMCal geometry and acceptance to evaluate trigger biases are presented.
Supported by BMBF and the Helmholtz Association.

HK 48.25 Wed 17:00 C/Foyer

Measurement of Neutral Pions with the ALICE PHOS in pp-collisions at $\sqrt{s}$ = 8 TeV — •Svenja Pflitsch — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE-experiment at the LHC is dedicated to study the properties of the Quark-Gluon-Plasma by means of heavy-ion-collisions. Hadronic spectra in pp-collisions at the same energy establish a vital baseline for the understanding of hadron-production. In this context the measurement of neutral pions via the two-photon decay channel provides a complementary analysis to the measurement of charged pions.

The PHOS is one of the two electromagnetic calorimeters of ALICE, consisting of $PbWO_4$ crystals. The reconstruction method of the decay-photons and the large signal-to-background ratio in pp collisions lead to a high statistics measurement across a large p_T range.

We present the status of the analysis of neutral pions based on LHC Run 1 data at $\sqrt{s}$ = 8 TeV. Details of the analysis such as peak extraction and the resulting spectra are discussed. This includes acceptance and reconstruction efficiencies derived from Monte-Carlo simulations as well as a comparison with an independent parallel analysis.

Supported by BMBF and the Helmholtz Association.

HK 48.26 Wed 17:00 C/Foyer

Measurement of the eta meson with the ALICE PHOS. — •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 the eta meson production complements other measurements of identified particles in the experiment. Collisions of protons with nuclei function as a control experiment to study initial state effects in heavy

ion collisions.

The PHOS, one of the electromagnetic calorimeters of the experiment, measures the energy and position of photons with high resolution and therefore allows for the reconstruction of the eta meson by its two-photon decay channel.

The status of the analysis of the eta meson in p-Pb collisions at $\sqrt{s} = 5.02$ TeV with the ALICE PHOS including peak extraction and acceptance and reconstruction efficiency corrections will be presented.

Supported by BMBF and the Helmholtz Association.

HK 48.27 Wed 17:00 C/Foyer

Study of intermediate mass e+e- pairs from correlated semileptonic decays of heavy-flavour hadrons — •Marvin Kohls, Raphaelle Bailhache, and Harald Appelshäuser for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt am Main

The main purpose of ALICE at the LHC is to investigate the properties of the deconfined state of strongly interacting matter produced in high-energy heavy-ion collisions. Since leptons do not interact strongly with the medium, dielectrons carry information from all collision stages with negligible final state interactions. In particular in the intermediate invariant mass region the measurements of thermal dielectron emission would allow to estimate the temperature of the medium created. The main background is coming from electron-positron pair from correlated semi-leptonic charm and anti-charm quark decays.

In this poster, we will present feasibility studies to suppress and/or measure the ccbar correlation contribution in the dielectron spectrum in Pb-Pb collisions. We make use of the large life time of the D mesons and therefore the large distance of closest approach (DCA) to the primary vertex of the charm decay electrons. We will show first results based on Monte Carlo studies with a complete simulation of the ALICE detector.

HK 48.28 Wed 17:00 C/Foyer

Estimating Hadron Contamination of Electron Samples in Pb–Pb Collisions at Low Momenta Using ALICE — •Martin Brass for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg, Germany

A Large Ion Collider Experiment at the LHC is exploring a new state of matter at high energy densities in Pb–Pb collisions. Electrons from heavy-flavor decays are interesting probes of the properties of this state, since charm and beauty quarks - produced in initial hard scatterings - experience the whole evolution of the state. Due to high multiplicities in Pb–Pb collisions and to the limited separation power of the ALICE Time-Of-Flight (TOF) detector between electrons and pions at momenta above 1 GeV/c, there is a large hadronic background in the observed electron samples. Furthermore a significant amount of protons, kaons and deuterons are misidentified by TOF and contaminate the electron sample, too. Many Heavy-Flavor-Electron analyses rely on a precise estimation of the contamination. The presented analysis uses measured energy loss distributions of the ALICE Time Projection Chamber as templates for a least squares fit routine to estimate the amount of hadronic background in the electron sample at momenta above 0.4 GeV/c. To describe the energy loss distributions of the misidentified particles, the measured distributions of particles which are identified by TOF are used. The energy loss distribution for pions is obtained using the ALICE Transition Radiation Detector which provides good separation between pions and electrons.

HK 48.29 Wed 17:00 C/Foyer

Vergleich von Photoabsorptionsquerschnitten relativistischer Protonenstreuung mit elektromagntischen Proben* — •Sergej Bassauer[1], Jonny Birkhan[1], Carlos Bertulani[2] und Peter von Neumann-Cosel[1] für die EPPS0-Kollaboration — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]Department of Physics and Astronomy, Texas A&M University-Commerce, Commerce, USA

Durch den Vergleich aus der Coulombanregung extrahierter Photoabsorptionsquerschnitte in relativistischer Protonenstreuung mit elektromagnetischen Proben können Rückschlüsse auf den aus nuklearen Prozessen resultierten Untergrund gezogen werden [1,2]. Hierfür stehen Protonenstreudaten für die Kerne ^{28}Si, ^{40}Ca, ^{48}Ca, ^{96}Mo, ^{120}Sn, ^{144}Sm, ^{154}Sm und ^{208}Pb sowie die entsprechenden Photoabsorptionsquerschnitte zur Verfügung. Die Photoabsorptionsquerschnitte werden mit Hilfe der semiklassischen virtuellen Photonenmethode und mit Hilfe der eikonalen Näherung extrahiert [3,4]. Hierbei werden die Ergebnisse der beiden Methoden verglichen und die Vor- bzw. Nachteile diskutiert.

*Gefördert durch die DFG im Rahmen des SFB 634 und NE 679/3-1.

[1] A. Tamii et al., Phys. Rev. Lett. **107** (2011) 062502.
[2] I. Poltoratska et al., Phys. Rev. C **85** (2012) 041304.
[3] C. Bertulani und G. Baur, Phys. Rep. **163** (1987) 299.
[4] C. Bertulani und A. Nathan, Nucl. Phys. A **554** (1993) 158.

HK 48.30 Wed 17:00 C/Foyer

Study of quadrupole collectivity in odd mass Po and Bi isotopes * — •H. Pai[1], M. L. Cortés[1,2], M. Reese[1], J. Gerl[2], M. Górska[2], N. Pietralla[1], Zs. Podolyák[3], and D. Rudolph[4] for the S429 PreSPEC-AGATA-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany — [3]Department of Physics, University of Surrey, Guildford, GU2 7XH, United Kingdom — [4]Department of Physics, Lund University, SE-22100 Lund, Sweden

Relativistic Coulomb excitations of odd-mass Po and Bi isotopes [1] were performed during the PreSPEC-AGATA campaign [2] at GSI to study the quadrupole collectivity in the direct vicinity of the heaviest stable doubly-magic nucleus ^{208}Pb. The PreSPEC-AGATA campaign is the predecessor of the HISPEC (High-resolution In-flight Spectroscopy) experiment in the FAIR context. It was running 2012 and 2014 at GSI. Up to 23 AGATA crystals were used in this campaign, located behind the FRagment Separator. We will present the status of the ongoing data analysis and discuss the challenges of data analysis for this type of experiments.

[1] D. Rudolph, Zs. Podolyák *et al.,* GSI-Proposal **S429** (2011).
[2] N. Pietralla *et al.,* EPJ Web of Conferences **66**, 02083 (2014).

*Supported by the Helmholtz International Center for FAIR, European Nuclear Science and Applications Research (ENSAR) and by the German Federal Ministry of Education and Research (BMBF).

HK 48.31 Wed 17:00 C/Foyer

Wavelet analysis ^{120}Sn(p,p') reaction data — •Andreas Ebert[1], Anna Maria Krumbholz[1], Peter von Neumann-Cosel[1], and Atsushi Tamii[2] for the EPPS0-Collaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Physics, Osaka University, Japan

In the recent years wavelet analysis has been established as a tool in nuclear structure physics. For an analysis of the fine structure in the energy region of the Giant Dipole Resonance the wavelet analysis allows the extraction of scales [1] and level densities [2] from scattering data. In a high-resolution experiment the ^{120}Sn(p,p') reaction was investigated with a 295 MeV beam scattered under zero degrees at the Research Center for Nuclear Physics (RCNP) in Osaka/Japan [3,4]. The extracted scales and level densities will be compared with various theoretical predictions.

[1] A. Shevchenko et al., Phys. Rev. C 77, 024302 (2008)
[2] P G. Hansen, Annu. Rev. Nucl. Part. Sci. 29, 69 (1979)
[3] A. Tamii et al., Phys. Rev. Lett. 107, 062502 (2011)
[4] A. M. Krumbholz, Doctoral thesis D 17, TU Darmstadt, (2014)

*supported by the DFG through the projects SFB 634 and NE 679/3-1.

HK 48.32 Wed 17:00 C/Foyer

Compton-Polarimetrie von Gammaquanten aus der Reaktion ^{143}Nd$(n,\gamma)^{144}$Nd mit EXOGAM@ILL. — •Mehmet Tezgel und Michael Thürauf für die EXILL-Kollaboration — Institut für Kernphysik, TU Darmstadt

In ^{144}Nd wird ein isovektorieller Oktupolzustand bei 2779 keV vermutet, welcher durch einen starken $M1$-Übergang in sein symmetrisches Pendant zerfällt. Diese Klasse von Zuständen wurde im Rahmen des Interacting-Boson-Modells (IBM-2) vorhergesagt. Als Teil der EXILL-Kampagne im Jahr 2012/13 wurde daher ein Neutroneneinfangexperiment an ^{143}Nd durchgeführt. Der Kern ^{144}Nd wird über die Reaktion ^{143}Nd$(n,\gamma)^{144}$Nd erzeugt und befindet sich in einem angeregten Zustand, der über mehrere Kaskaden in den Grundzustand zerfällt.

Es wurde die Linearpolarisation der Übergangsstrahlung in ^{144}Nd analysiert, um deren Strahlungscharakter zu bestimmen. Im Poster wird der EXILL-Aufbau und die Methode der Compton-Polarimetrie anhand der verwendeten Clover-Detektoren erklärt.

Exemplarische Ergebnisse werden anhand von einigen Kaskaden in ^{144}Nd vorgestellt.

Gefördert durch die DFG (KR 1796/2-1).

HK 48.33 Wed 17:00 C/Foyer

Measurement of picosecond lifetimes in odd neutron-rich Xe isotopes — Michael Habib, •Stoyanka Ilieva, and Thorsten Kröll for the EXILL-FATIMA-Collaboration — Institut für Kernphysik, TU Darmstadt

The nuclear properties in the region around the doubly magic nucleus ^{132}Sn are of special interest. Theory relies on nuclei near closed shells for predicting other, more complex systems. Our interest lies in particular on the neutron-rich Xe isotopes ($^{138-144}$Xe), as they exhibit both quadrupole and octupole collective properties. The lifetime of an excited state is a direct measure for the strength of the transition and thus allows us to study both phenomena.

Within the EXILL&FATIMA campaign at the experimental nuclear reactor at ILL, Grenoble, the lifetimes of the excited states, populated in the neutron-induced fission of ^{235}U and ^{241}Pu targets, were measured. Using the generalized centroid difference method to analyse the data from the fast timing array (FATIMA) allows us to determine lifetimes down to $\approx$ 10 ps [1]. The high-resolution EXILL (EXOGAM@ILL) detector gives us the possibility to identify the nuclides of interest among the big amout of produced fission fragments. In this contribution we present the first measurement of lifetimes of low-lying excited states in the odd isotopes ^{139}Xe and ^{141}Xe.

[1] *J.-M. Régis et al., Nucl. Instr. Meth. Phys. Res. A 763 (2014) 210*

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HK 48.34 Wed 17:00 C/Foyer

New Mass Analysis and Results for Neutron Rich Nuclei performed with Isochronous Mass Spectrometry — •Marcel Diwisch[1], Ronja Knöbel[1,2], Zygmunt Patyk[3], Hans Geissel[1,2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2], and Helmut Weick[2] — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Soltan Institute for Nuclear Studies, Warsaw, Poland

The Isochronous Mass Spectrometry (IMS) allows to measure masses of rare exotic nuclei in a storage ring in a timescale of tens of μs. The ring is operated in an isochronous mode, i.e. such that particles with different velocities but same mass-to-charge ratio (m/q) travel different paths in the ring arcs (faster ions travel longer paths whereas slower ions travel shorter paths). This means that for each m/q a fix revolution time exists and can be measured by a time-of-flight (TOF) detector which then yields the masses of the nuclei for known charge states. A new analysis approach of IMS data with a correlation matrix method allowed combining data with different quality. The latest production run was using an additional determination of the magnetic rigidity which increased the resolving power of the experiment. Combining this experiment with previous experiments one can increase the statistics and accuracy of the overall mass determination. It was possible to deduce mass values of neutron rich isotopes which have not been measured before. One of those isotopes is ^{130}Cd which is a very important nuclei involved in the r-process. Those mass values and a comparison to theoretical predictions will be presented in the poster.

HK 48.35 Wed 17:00 C/Foyer

Messung der Fragmenteigenschaften von ^{232}Th in Niederenergie Photonen-induzierter Spaltung am S-DALINAC — •Martin Freudenberger[1], Joachim Enders[1], Martin Espig[1], Alf Göök[2], Andreas Oberstedt[3], Stephan Oberstedt[2] und Markus Wagner[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]European Commission, DG Joint Research Center (IRMM), Geel, Belgien — [3]Fundamental fysik, Chalmers tekniska högskola, Göteborg, Schweden

Die korrelierte Winkelverteilung sowie die totale kinetische Energie der Spaltfragmente aus der Photonen-induzierten Spaltung von ^{232}Th wurden im Bereich 6.0 MeV - 8.0 MeV am Darmstädter supraleitenden Elektronenlinearbeschleuniger S-DALINAC mit Hilfe von Bremsstrahlungsphotonen bestimmt. Besondere Aufmerksamkeit wurde dabei auf die Bestimmung des Anisotropieparameters B/A und dem Verhältnis der Quadrupolkomponente zur Dipolkomponente C/B bei Energien nahe der Spaltbarriere gelegt.

Diese Arbeit wurde in Teilen unterstützt durch den SFB 634 der DFG.

HK 48.36 Wed 17:00 C/Foyer

Search for two-proton radioactivity of ^{30}Ar by tracking its decay products — •Xiaodong Xu — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — Justus-Liebig-Universität Giessen, Giessen

Two-proton (2p) radioactivity is an exotic decay mode resulting in a simultaneous emission of two protons. It was predicted for a number of neutron deficient nuclei beyond the proton drip line [1]. The ground-state (g.s.) 2p radioactivity was discovered in 2002 [2,3].

In 2012, an in-flight decay experiment aimed to investigate the 2p radioactivity of previously unknown nucleus ^{30}Ar was performed with the fragment separator FRS of GSI. By tracking the decay products with silicon micro-strip detectors, 2p decays of ^{30}Ar in-flight have been observed for the first time. The decay vertices were reconstructed through the measured ^{28}S + p + p trajectories. In order to obtain the 2p decay energy and half-life, the angular correlations of fragments were analyzed. New data on the known 2p precursor ^{19}Mg has been also obtained. The decay energy of g.s. of ^{19}Mg has been deduced and it is consistent with the previously reported data [4].

[1] V. Goldansky, *Nucl. Phys.* **19**, 482 (1960)
[2] M. Pfützner, et al., *Eur. Phys. J. A* **14**, 279 (2002)
[3] J. Giovinazzo, et al., *Phys. Rev. Lett.* **89**, 102501 (2002)
[4] I. Mukha, et al., *Phys. Rev. C* **85**, 044325 (2012)

HK 48.37 Wed 17:00 C/Foyer

Influence of the measured work function fluctuation on the aSPECT spectrometer — •Christian Schmidt for the aSPECT-Collaboration — Institut für Physik, Johannes-Gutenberg Universität Mainz

The aSPECT retardation spectrometer measures the e-$\bar{\nu}_e$ angular correlation coefficient a in free neutron β decay by utilizing a MAC-E filter. 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 aSPECT had a successful beamtime at the Institut Laue-Langevin, Grenoble (France). The goal of this beamtime is to improve the current uncertainty of a from $\frac{\Delta a}{a} \approx 5$ % to about 1%. To achieve this goal the systematics of aSPECT have to be understood accordingly.

One sensitive parameter for the systematic error on a is the knowledge of the retardation voltage, which is defined by our decay volume and analysing plane electrode. Since the potentials are directly influenced by the work function of these electrodes, we utilised a scanning Kelvin probe to measure the work function fluctuations. To investigate the influence on a the measured fluctuations were implemented in a simulation program , the KASPER package, provided by the KATRIN collaboration.

This poster will present the first results of the influence of work function fluctuations on the aSPECT spectrometer using particle tracking.

HK 48.38 Wed 17:00 C/Foyer

Towards a new measurement of parity violation in ytterbium — •Dionysios Antypas[1], Nathan Leefer[1], Kostantin Tsigutkin[2], and Dmitry Budker[1,3] — [1]Helmholtz Institut-Mainz, Mainz, Germany — [2]ASML, Veldhoven, The Netherlands — [3]Johannes Gutenberg Universitaet-Mainz, Mainz, Germany

The ytterbium (Yb) atomic parity violation (APV) experiment has succeeded in measuring the largest APV effect yet observed in any atom. Because of its size, and the availability of a chain of seven stable isotopes (including two with non-zero nuclear spin), studying APV in Yb is promising for measurements of the neutron distributions of the nucleus as well as for probing the nuclear anapole moment. The experiment recently moved from UC Berkeley to Mainz, and a new apparatus is currently under construction. We present the current state of the project, with emphasis on the next generation apparatus features that will allow us to perform sensitive measurements of the anapole moment and neutron skin contribution to the APV effect.

HK 48.39 Wed 17:00 C/Foyer

Exploring Antihyperons Potentials in Nuclei by Antiproton-Nucleon Reactions — •Alicia Sanchez Lorente for the PANDA-Collaboration — Helmholtz Institut Mainz

The exclusive production of hyperon-Antihyperon pairs close to their production threshold in antiproton-nucleus collisions offers a unique and hitherto unexplored opportunity to study the behaviour of Antihyperons in nuclei. For the first time we analyse these reactions in a microscopic transport model using the Giessen Boltzmann-Uehling-Uhlenbeck Transportmodel (GiBUU). We find a substantial sensitivity of transverse momentum correlations of coincident AntiLambda-

Lambda-pairs to the assumed depth of the AntiLambda potential. Rather than diminishing this effect, secondary scattering effects which are more pronounced at deeper AntiLambda potentials enhance this sensitivity. Because of the high cross section for this process and the simplicity of this method our results pave the way for experimental studies at the FAIR facility.

HK 48.40 Wed 17:00 C/Foyer

ARGUS - The scintillating fibre tagging detector of the BGO-OD experiment — •Stefan Alef and Björn-Eric Reitz for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, 53115 Bonn

The BGO-OD experiment at the ELSA accelerator in Bonn is built to investigate baryon-resonances using meson-photoproduction off the nucleon. The photons are produced from the electron beam via bremsstrahlung. Linearly polarized photons are obtained by coherent scattering off a crystal. The degree of polarization is obtained from the measured energy spectrum of the electrons. At the moment the energy resolution is limited by the current tagging system. Therefore an additional tagging detector consisting of scintillating fibres was constructed.
A short overview of the detector and its properties along with some preliminary first results will be shown.
Supported by DFG (SFB/TR-16).

HK 48.41 Wed 17:00 C/Foyer

A recoil detector of Koala experiment at HESR — •Huagen Xu — Forschungszentrum Jülich

The concept of the luminosity detector for the PANDA experiment is based on measuring antiproton-proton elastic scattering in the Coulomb-nuclear interference region by 4 planes of HV-MAPS tracking detectors. The absolute precision is limited by the lack of existing data of the physics quantities σ_{tot}, ρ and b describing the differential cross section as a function of squared 4-momentum transfer t in the relevant beam momentum region. Therefore, the so-called Koala experiment has been proposed to measure antiproton-proton elastic scattering. The goal of Koala experiment is to measure a wide range of t-distribution to determine the parameters σ_{tot}, ρ and b. The idea is to measure the scattered beam antiprotons at forward angles by tracking detectors and the recoil target protons near 90° by energy detectors. In order to validate this method a recoil detector has been designed and built. Commissioning of the recoil detector by measuring proton-proton elastic scattering has been performed at COSY. Preliminary results of the commissioning will be presented.

HK 48.42 Wed 17:00 C/Foyer

Kalibrierung und Datenauslese eines Neutronendetektor-Arrays für (e,e'n) Experimente * — •Maxim Singer und Peter von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

Am supraleitenden Elektronenbeschleuniger S-DALINAC wurde ein Neutronendetektorball aufgebaut[1], welcher zur systematischen Untersuchung von Riesenresonanzen in koinzidenten Elektronen- und Photonenstreuexperimenten eingesetzt werden soll. Der Detektorball setzt sich aus 13 Flüssigszintillatordetektoren des Typs 5"× 2" BC-501A zusammen und deckt einen Raumwinkel von ungefähr 1.3 π ab. Präsentiert werden die Ergebnisse der Nachweiswahrscheinlichkeitsmessung für Neutronen für einzelne Detektoren und die Effizienz des Detektorballs für Mehrneutronenereignisse. Erste Konzepte zum digitalen Datenaufnahmesystem auf der Basis von Flash-ADCs in koinzidenter Schaltung mit dem QCLAM-Spektrometer werden diskutiert.
[1] M. Chernykh, Dissertation, D17, Technische Universität Darmstadt, (2008).
* Gefördert durch die DFG im Rahmen des SFB 634.

HK 48.43 Wed 17:00 C/Foyer

A teststation for submodules of the forward endcap of the PANDA electromagnetic calorimeter — •Merlin Rossbach, Matthias Kube, Ulrike Thoma, Christoph Schmidt, and Christoph Wendel for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany

The forward endcap of the electromagnetic calorimeter of the PANDA experiment is currently being constructed. Its crystals are grouped into submodules consisting of 16 or 8 crystals each. Before these modules are mounted in the detector careful testing is needed and a precalibration will be performed at -25°C, the defined working temperature of the detector. A teststation has been developed using cosmic particles transversing the $PbW0_4$-crystals. Cosmic events are selected by two compact trigger detectors. Each of them contains a 4x4 array of scintillators, which are read out by silicon photomultipliers (SiPMs). The poster presents the setup of the teststation discussing in detail the different electronic components used.
Supported by the BMBF.

HK 48.44 Wed 17:00 C/Foyer

Photonen-Nachweis und Untergrundstudien im HADES* RICH in Ni + Au und Au + Au Reaktionen — •Tobias Kunz für die HADES-Kollaboration — Physik Dept. E12, Technische Universität München

Im HADES-Experiment an der GSI, Darmstadt, werden Elektronen und Positronen mit einem hadronblinden RICH-Detektor identifiziert, der das Cherenkovlicht mit einem photosensitiven Gasdetektor nachweist. Für ein quantitatives Verständnis der e^+e^--Nachweiswahrscheinlichkeit wurde das Ansprechverhalten des Photonendetektors untersucht, der mit neuer Ausleseelektronik ausgestattet wurde. Dafür wurde der Detektor mit einer speziellen Lichtquelle bestrahlt, die bei einer Rate von ca. 500 Hz einzelne Photonen im VUV-Bereich emittiert. Die Signale wurden mit denen von e^+e^- induzierten Cherenkov-Ringen aus voll rekonstruierten π^0-Dalitz-Zerfällen ($\pi^0 \rightarrow \gamma e^+e^-$) in Au + Au Reaktionen bei E = 1.25 AGeV verglichen. Die erhaltenen Amplituden- und Padmultiplizitätsverteilungen für einzelne Photonen dienen als Grundlage für die vollständige Simulation des Detektors. Für die Analyse des von Hadronen induzierten Untergrundsignals im Detektor wurden Daten ohne Radiatorgas aus Ni + Au bei E = 1.25 AGeV verwendet.
* Unterstützt durch BMBF(05P12WOGHH) und Excellence Cluster Universe

HK 48.45 Wed 17:00 C/Foyer

Properties of hydrogen cluster-jets — •Esperanza Köhler, Daniel Bonaventura, Silke Grieser, Ann-Katrin Hergemöller, Benjamin Hetz, Fabian Hordt, Hans-Werner Ortjohann, Alexander Täschner, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

A highly intense cluster-jet beam represents a very attractive and extremely interesting target for studies at storage ring experiments (e.g. $\bar{\mathrm{P}}$ANDA/FAIR) as well as for laser-induced particle acceleration. Since the target beam or rather the cluster properties vary with increasing number of constituents, the theoretical description of these many-body systems holds a lot of challenges. Therefore, it is essential to perform systematic measurements on cluster beam characteristics, in particular: the velocity, beam density, and cluster mass. The study of these correlated parameters enables the optimisation of the target design for highest performance and allows for insights into the cluster production process. This presentation will give an overview of the hydrogen cluster-jet target prototype for the $\bar{\mathrm{P}}$ANDA experiment. Furthermore, the systematic investigation of these mentioned cluster properties and their recent results will be presented and discussed.
Supported by EU (FP7), BMBF, and GSI F+E.

HK 48.46 Wed 17:00 C/Foyer

Production, properties, and probing of Laval Nozzles for Cluster-Jet Targets — •Silke Grieser, Daniel Bonaventura, Ann-Katrin Hergemöller, Benjamin Hetz, Fabian Hordt, Esperanza Köhler, Alexander Täschner, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

A cluster-jet target achieves high and constant beam densities, which can be adjusted during operation. Therefore, it is highly eligible for storage ring experiments. By the expansion of pre-cooled gases within fine Laval nozzles a cluster source produces a continuous flow of cryogenic solid clusters. Essential for the production of clusters are the properties of the Laval nozzle. The production of such a nozzle with its complex inner geometry represents a major technical challenge. To ensure the production of these fine Laval nozzles for future internal targets, an improved production process based on the initial CERN production was recently developed at the University of Münster. Systematic investigations on Laval nozzles with modified geometries will clarify the outstanding questions of the cluster production process. Moreover, this is very important for the deeper understanding of the cluster beam characteristics, in particular: the density, velocity, and mass, affected by the geometry of the nozzle. The production process and initial measurements with these new nozzles at the $\bar{\mathrm{P}}$ANDA

cluster-jet target prototype will be presented and discussed.
Supported by EU (FP7), BMBF, and GSI F+E.

HK 48.47 Wed 17:00 C/Foyer

Design and Construction of the Cluster-Jet Target for PANDA — •Ann-Katrin Hergemöller, Daniel Bonaventura, Silke Grieser, Benjamin Hetz, Fabian Hordt, Esperanza Köhler, Alexander Täschner, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

Cluster-jet targets are highly suited as internal targets for storage ring experiments. Hence, the first target to be operated at the PANDA experiment at the future accelerator center FAIR will be a cluster-jet target. In such a target the cluster beam itself is formed due to the expansion of pre-cooled gases within a Laval nozzle. Afterwards an orifice, the skimmer, separates the cluster beam from the residual gas and a second orifice, the collimator, defines its final size and shape. A prototype for the cluster-jet target for PANDA has already been built up in full PANDA geometry at the University of Münster and operates successfully for years. In combination with a nozzle tilting system allowing for an adjustment of the nozzle system relative to the experimental setup, the prototype provides a target thickness of more than 2×10^{15} $\frac{\text{atoms}}{\text{cm}^2}$. Based on the results of the performance of this prototype, the final cluster-jet target source was designed and constructed in Münster as well. In this presentation an overview of the cluster-jet target design, various special features and first performance results will be presented and discussed.
Supported by EU (FP7), BMBF, and GSI F+E.

HK 48.48 Wed 17:00 C/Foyer

Commissioning of the scatter component of a Compton camera consisting of a stack of Si strip detectors — •S. Liprandi[1], S. Aldawood[1,2], T. Marinsek[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[1,4], I. Castelhano[1,5], R. Lutter[1], G. Dedes[1], R. Gernhäuser[3], D. R. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

At LMU Munich in Garching a Compton camera is presently being developed aiming at the range verification of proton (or ion) beams for hadron therapy via imaging of prompt γ rays from nuclear reactions in the tissue. The poster presentation focuses on the characterization of the scatter component of the Compton camera, consisting of a stack of six double-sided Si strip detectors (50×50 mm^2, 0.5 mm thick, 128 strips/side). The overall 1536 electronics channels are processed by a readout system based on the GASSIPLEX ASIC chip, feeding into a VME-based data acquisition system. The status of the offline and online characterization studies will be presented.

*Supported by the DFG Cluster of Excellence, MAP (Munich - Centre for Advanced Photonics)

HK 48.49 Wed 17:00 C/Foyer

Optical properties of the PANDA Barrel DIRC radiator bars — Grzegorz Kalicy[1,2], •Marvin Krebs[1,2], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI, Darmstadt — [2]Goethe Universität, Frankfurt

The PANDA experiment at the Facility for Antiproton and Ion Research in Europe (FAIR) at GSI, Darmstadt, will study fundamental questions of hadron physics and QCD. A fast focusing DIRC (Detection of Internally Reflected Cherenkov light) counter will provide hadronic particle identification (PID) in the barrel region of the PANDA detector. To meet the PID requirements, the Barrel DIRC has to provide precise measurements of the Cherenkov angle, which is conserved for Cherenkov photons propagating through the radiator by total internal reflection. The radiators, rectangular bars made from fused silica, have to fulfill very strict optical and mechanical requirements. This includes the squareness and parallelism of the sides of the bars, sharp corners, and a very smooth surface polish, ensuring that the Cherenkov photons reach the optical sensors without angular distortions. Currently the Barrel DIRC is at the final design stage and several different bar shapes and fabrication methods are being considered for the final detector. An optical setup, consisting of a computer-controlled positioning and a multi-wavelength laser system, is used to evaluate the radiator bars to obtain critical values like transmittance and reflectivity. The current results and techniques will be presented on this poster. Work supported by EU FP7 grant, contract no. 227431, HadronPhysics2, and HGS-HIRe

HK 48.50 Wed 17:00 C/Foyer

Characterization of Compton camera $LaBr_3$ absorber detector — •T. Marinsek[1], S. Aldawood[1,2], S. Liprandi[1], J. Bortfeldt[1], L. Maier[3], C. Lang[1], H. van der Kolff[1,4], I. Castelhano[1,5], R. Lutter[1], G. Dedes[1], R. Gernhäuser[3], D. R. Schaart[4], K. Parodi[1], and P. G. Thirolf[1] — [1]LMU Munich, Garching, Germany — [2]King Saud University, Riyadh, Saudi Arabia — [3]TU Munich, Garching, Germany — [4]TU Delft, The Netherlands — [5]University of Lisbon, Lisbon, Portugal

Detection of prompt γ rays from nuclear interactions between a particle beam and organic tissue using a Compton camera to determine the Bragg peak position is a promising way of ion-beam range verification in hadron therapy. The Compton camera consists of a stack of six double-sided Si-strip detectors acting as scatterers, while the other essential part - the absorber - is made of a $LaBr_3$ monolithic scintillator crystal ($50 \times 50 \times 30$ mm^3) with reflective side-surface wrapping, offering excellent time and energy resolution. Scintillation light induced in the crystal is detected by a 256-fold segmented multi-anode PMT. Prerequisite to reconstruct the γ source position is the determination of the photon interaction position in the crystal by applying "k-nearest neighbors" algorithm (van Dam et al., Nuclear Science (2011)) using the reference library of light distributions, obtained by performing a 2D scan of the detector using a strong collimated ^{137}Cs source. The status of the spatial resolution characterization will be presented.
* Supported by the DFG Cluster of Excellence, MAP (Munich-centre for Advanced Photonics).

HK 48.51 Wed 17:00 C/Foyer

TRITON and TILDA - Universal Control and Data Acquisition in Collinear Laser Spectroscopy Experiments. — •Simon Kaufmann for the TRIGA-SPEC-Collaboration — Institut für Kernchemie Mainz

TRIGA pyThon cONtrol system (TRITON) and TRIGA-Laser Data Acqusition (TILDA) are custom developments for the collinear laser spectroscopy (CLS) experiment TRIGA-Laser. The TRIGA-Laser experiment is a prototype for the LaSpec experiment at the low energy branch at the upcoming FAIR facility [1]. 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. In order to efficiently operate and control the setup, we have developed TRITON which is custom-built for the slow controls of our experiment. This will be completed by TILDA which will be responsible for the fast experiment control as well as time resolved data acquisition. The time resolution is necessary due to the bunched ion beam structure. Core of TILDA will be two field programmable gate arrays (FPGA)in a PXI rack. Modularity in TRITON and in TILDA is keeping both as flexible as possible and it is foreseen to use them in other CLS-setups like ALIVE and LaSpec. While TRITON is fully operational already, a prototype of TILDA with a small PCI-based FPGA was tested during commissioning.
TRITONs and TILDAs main features, specifications and status will be presented.
[1] D. Rodriguez et al., Eur. Phys. J. Special Topics 183, 1*123 (2010)

HK 48.52 Wed 17:00 C/Foyer

Ein schnelles Trigger-System für den CALIFA Detektor — Michael Bendel, Roman Gernhäuser, Benjamin Heiss, •Philipp Klenze, Patrick Remmels und Max Winkel — Physik Department E12, Technische Universität München

Das CALIFA Kalorimeter mit seinen etwa 2600 Szintillationskristallen ist eine der wesentlichen Komponenten des R^{3}B-Experiments. Für viele Experimente muss CALIFA komplexe Trigger-Entscheidungen, wie Energiesummen oder Multiplizitäten, mit minimaler Latenz treffen. Hier ist die Auswahl von bestimmten Triggermustern ein wesentliches Werkzeug zur präzisen Vorauswahl von relevanten Ereignissen.

Durch geschickte hierarchische Summation können die dazu notwendigen Informationen innerhalb von 1 μs gesammelt und verarbeitet werden. Die Summationsschritte erfolgen in FPGAs auf eigens entwickelten Aufsteckmodulen für die universelle digitale Plattform FEBEX (GSI Darmstadt), die bereits zur Digitalisierung und Auslese von CALIFA genutzt wird.

Gefördert durch das BMBF, Kennzeichen 05P12WOFNF und 05P12WONUE, sowie durch das GSI Darmstadt.

HK 48.53 Wed 17:00 C/Foyer

Simulation studies of the hypernuclear experiment at $\overline{\text{P}}$ANDA to optimize the production and detection rates of $\Lambda\Lambda$ hypernuclei — Sebastian Bleser[1], Jürgen Gerl[2], Felice Iazzi[3], Jasmina Kojouharova[2], Ivan Kojouharov[2], Marta Martinez Rojo[1], Josef Pochodzalla[1,4], Torben Rathmann[4], Alicia Sanchez Lorente[1], and •Marcell Steinen[1] for the PANDA-Collaboration — [1]Helmholtz-Inst. Mainz — [2]GSI, Darmstadt — [3]Politec. and INFN, Torino — [4]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 Ξ^- hyperons which are stopped and converted into two lambda hyperons in a secondary external target. This device is composed of a sandwich structure of layers of absorber material and silicon strip detectors for the formation of $\Lambda\Lambda$ hypernuclei and the detection of their charged decay pions. In particular the detection of these pions give a signature of a $\Lambda\Lambda$ hypernuclei and tag the event. The high resolution γ spectroscopy of the excited hypernuclei is performed by an array of germanium detectors.
This poster shows the simulation studies to optimize the setup concerning the production of the hypernuclei and the tracking of their decay pions. In addition the absorption of γ in the target material is taken into account. Furthermore the influence of background is studied since it might damage the germanium detectors and on the other hand is crucial to provide a good signal-to-noise ratio.

HK 48.54 Wed 17:00 C/Foyer

Detection system for forward emitted XUV photons from relativistic ion beams at the ESR — 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. We would like to study effects of electron-electron correlations in Be-like krypton ($^{84}Kr^{32+}$) via a laser spectroscopy measurement of the $^3P_1 - ^3P_0$ transition. For this purpose the krypton ions are stored at $\beta \approx 0.69$ in the Experimental Storage Ring (ESR). By interacting with counter-propagating laser pulses the laser frequency is Doppler shifted by more than one order of magnitude, thus being able to excite the krypton ions to the desired state. Additionally the large Doppler "boost" also shifts the fluorescence from $\lambda_0 \approx 17$ nm to $\lambda \approx 9$ nm and directs it into a narrow forward cone. To collect the light a movable cathode plate is brought into the vicinity of the beam. XUV photons hitting the plate produce mostly low energetic (<3 eV) secondary electrons. The electrons will be electromagnetically guided onto a MCP detector. The design and working principle, as well as results of first test measurements with the XUV detection system, will be presented. This work is supported by BMBF under contract number 05P12PMFAE. D. Winzen thanks HGS-HIRe for FAIR for funding his scholarship.

HK 48.55 Wed 17:00 C/Foyer

Simulation of the multi-neutron detection at NeuLAND with improved detector response — •Vadim Wagner[1], Joachim Enders[1], and Dmytro Kresan[2] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

The future large-area neutron detector NeuLAND for the R3B experiment at FAIR is bound to detect neutrons from reactions of exotic nuclei. Among the challenges are the detection of low-energy neutrons with good resolution as well as the simultaneous detection of up to four neutrons.

This contribution presents simulation results with an improved representation of the detector response for NeuLAND in the R3BRoot framework. From the present results, an energy resolution for a single neutron of 13 keV can be expected. A two-dimensional reconstruction of the neutron multiplicity allows 4n events to be reconstructed with an efficiency of about 56%, an increase of about 60% with respect to previous simulations.

Supported in part by the state of Hesse through the LOEWE center HIC for FAIR.

HK 48.56 Wed 17:00 C/Foyer

The STS-XYTER ASIC – a dedicated front-end chip for the CBM Silicon Tracking System — •Iurii Sorokin[1,2], Krzysztof Krzysztof[3], Rafal Kleczek[3], Piotr Otfinowski[3], Volker Kleipa[1], and Robert Szczygiel[3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Kiev Institute for Nuclear Research, Kiev — [3]AGH University of Science and Technology, Cracow

The STS-XYTER is a 128-channel charge-sensitive front-end chip, designed specifically for the Silicon Tracking System of the CBM experiment. The chip features a self-triggering architecture, which enables it to measure the signal amplitude and the time of arrival in each input channel autonomously, as soon as the signal in the given channel exceeds a predefined threshold. The design time resolution is about 10 ns, the dynamic range is 15 fC, and the amplitude is digitized with an integrated 5-bit flash ADC. Two shapers with distinct rise times are used to achieve low rate of noise hits in combination with the good time resolution, and low power consumption (6 mW/channel). The characterization of chips samples is ongoing. An overview of the chip architecture as well as the operation principle will be given.

HK 48.57 Wed 17:00 C/Foyer

Auslesekomponenten für den $\overline{\text{P}}$ANDA MVD Streifen-Detektor* — •Robert Schnell[1], Kai-Thomas Brinkmann[1], Valentino Di Pietro[1,5], Harald Kleines[3], André Goerres[2], Alberto Riccardi[1,5], Angelo Rivetti[5], Manuel Rolo[5], Helmut Sohlbach[4] und Hans-Georg Zaunick[1] für die PANDA-Kollaboration — [1]II. Physikalisches Institut, JLU Gießen — [2]IKP-1, FZ Jülich — [3]ZEA-2, FZ Jülich — [4]FH Südwestfalen, Iserlohn — [5]INFN - Sezione di Torino

Das $\overline{\text{P}}$ANDA-Experiment am zukünftigen Beschleunigerzentrum FAIR in Darmstadt wird Reaktionen von Antiprotonen mit stationären Targets (Wasserstoff und schwere Kerne) untersuchen. 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.

Bei den Entwicklungen für die Auslese des Streifen-Detektors sind die speziell für den $\overline{\text{P}}$ANDA MVD entwickelten ASICs besonders hervorstechend, zum einen der selbst-triggernde Front-End Chip zur Auslese der Streifen-Sensoren sowie der Module Data Concentrator Chip zur Bündelung und Reduzierung der Daten. Der Datentransfer soll durch den am CERN entwickelten GigaBit Transceiver (GBT) Link erfolgen. Die Daten werden mittels auf FPGA basierenden MTCA.4 Einschubkarten empfangen und an das globale System zur Ereignisauswahl weitergeleitet.

*Unterstützt vom BMBF, HICforFAIR und JCHP.

HK 48.58 Wed 17:00 C/Foyer

Current status of the MR-TOF-MS at the FRS Ion Catcher — •Christine Hornung for the FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany

The multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) is part of the FRS Ion Catcher, which is a test facility for the future Low-Energy Branch (LEB) of the Super-FRS at FAIR. At the FRS Ion Catcher, projectile and fission fragments are produced at relativistic energies, separated in-flight and range-focused at the FRS. Further they are slowed-down and thermalized in a cryogenic stopping cell (CSC) to kinetic energies of a few eV. In the MR-TOF-MS the ions are accumulated, cooled and ejected in bunches by a linear RF-trap. In the analyzer they are reflected multiple times to enlarge their flight path by orders of magnitude to enhance the resolution. The MR-TOF-MS can perform high precision mass measurements and in addition it can separate the ion of interest from isobaric contaminations for further experiments. It is a well suitable diagnostic device for operation of the CSC.

The performance of the MR-TOF-MS has been enhanced by increasing the kinetic energy of the ions to 1300 eV and improving the stability of the voltages. In the recent experiment the mass resolving power has been increased to exceed 400.000 FWHM for several fission fragments.

HK 48.59 Wed 17:00 C/Foyer

Aufbau eines automatischen Infrarot-Laser-Teststands für Silizium-Streifen-Detektoren* — •Martin Kesselkaul, Kai-Thomas Brinkmann, Tommaso Quali, Robert Schnell, Benjamin Wohlfahrt und Hans-Georg Zaunik für die PANDA-Kollaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen

Im Rahmen des $\overline{\text{P}}$ANDA-Experiments am zukünftigen Beschleunigerzentrum FAIR sollen Vernichtungsreaktionen des Antiprotonenstrahls mit Protonen des stationären Targets (Wasserstoff und schwere Kerne) untersucht werden. Als Teil des Trackingdetektors soll der Mikro-Vertex-Detektor hoch auflösendes Tracking und das Erkennen sekundärer Vertizes ermöglichen.
Dieser Beitrag betrachtet den Aufbau eines Infrarot-Laser-Teststands sowie die Entwicklung einer entsprechenden Laseransteuerung. Mittels eines hochpräzisen xy-Tisches wird die auf 50 nm genaue Positionierung des Lasers realisiert. Dies ermöglicht die Charakterisierung und Qualitätskontrolle von doppelseitigen Silizium-Streifen-Detektoren für den $\overline{\text{P}}$ANDA MVD. Dabei müssen Laseransteuerung, Positionierung und Datenerfassung für die Halbleiter-Sensoren synchronisiert werden. Einzelne Komponenten und der Betrieb des Gesamtsystems werden vorgestellt.

* Gefördert durch BMBF und HIC for FAIR.

HK 48.60 Wed 17:00 C/Foyer

Towards multi-hit readout of TPCs for exotic beam tracking — •Timothy Allred[1], Joachim Enders[1], Jan-Paul Hucka[1], Chiara Nociforo[2], Stephane Pietri[2], Andrej Prochazka[2], and Steffen Schlemme[1] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

The Super-FRS [1] beam diagnostics system supports the set up and adjustment of the separator and provides tracking and event-by-event particle identification. A TPC-type detector with GEM amplification and with multi-hit single-strip readout is proposed to be used as a tracking detector. The main challenges for such a detector are position resolution below 1 mm, high dynamic range (1000) and high-efficiency tracking up to 10 MHz ion rate.

One of the planned improvements towards a high-rate capability of single-ion tracking is the multi-hit readout of the TPC detectors [2]. Present TPC detectors with delay-line readout were tested with multi-hit electronics at the GSI fragment separator FRS [3] with Au beam at 1 GeV/nucl. up to 150 kHz. Results will be presented in comparison to single-hit readout.

[1] M. Winkler et al., NIM B 266 (2008) 4183
[2] R. Janik et al., NIM A 640 (2011) 54
[3] H. Geissel et al., NIM B 70 (1992) 286

Supported in part by the State of Hesse through the LOEWE center HIC for FAIR.

HK 48.61 Wed 17:00 C/Foyer

Rate-dependent performance of ion chambers for particle-ID at the GSI fragment separator — •Jan-Paul Hucka[1], Timothy Allred[1], Joachim Enders[1], Roman Gernhäuser[2], Steffen Maurus[2], Chiara Nociforo[3], Stephane Pietri[3], and Andrej Prochazka[3] — [1]Institut für Kernphysik, TU Darmstadt — [2]Physik Department, TU München — [3]GSI Helmholtzzentrum für Schwerionenforschung

At the GSI Fragment Separator (FRS [1]), multi-sampling ion chambers (MUSIC [2]) emplyoing a Frisch grid are used for charge identification of secondary ion beams. At the FAIR Super-FRS, higher rates are expected, and an event-by-event determination of the charge of secondary ions will be needed at rates of several 100000 events per second. The comparison of results from test measurements for the MUSIC performance with that of a recently constructed [3] tilted-electrode gas ion chamber (TEGIC), which was designed similar to the one discussed in Ref. [4], will be presented.

[1] H. Geissel et al., NIM B 70, 286 (1992)
[2] http://www-w2k.gsi.de/frs/technical/FRSsetup/detectors/music80/music80_manual.pdf
[3] S. Maurus, Thesis, TU München; S. Maurus et al., this conference
[4] K. Kimura et al., NIM A 538, 608 (2005)

Supported in part by the State of Hesse through the LOEWE center HIC for FAIR.

HK 48.62 Wed 17:00 C/Foyer

Performance of a scintillator hodoscope for detecting entangled electron pairs — •Marius Peck[1], Steffen Schlemme[1], Kazimierz Bodek[2], Pawel Caban[3], Jacek Ciborowski[4], Michal Dragowski[4], Joachim Enders[1], Adam Kozela[5], Jakub Rembielinski[3], Dagmara Rozpedzik[2], Marta Wlodarczyk[4], and Jacek Zejma[2] — [1]TU Darmstadt, Darmstadt, Germany — [2]Jagiellonian University, Cracow, Poland — [3]University of Lodz, Lodz, Poland — [4]Warsaw University, Warsaw, Poland — [5]Institute of Nuclear Physics PAS, Cracow, Poland

In the framework of a Polish-German collaboration aimed at investigating quantum entanglement of ultra-relativistic electrons following Moeller scattering [1] a test experiment has been carried out at the superconducting Darmstadt electron linear accelerator S-DALINAC [2]. The Moeller pairs undergo polarization analysis by means of Mott scattering. In the test experiment, the scattered electrons were tracked in drift chambers and detected by a scintillator hodoscope. The properties of this detector arrangement has been investigated off-line with radioactive sources. Results will be presented and an outlook for future improvement of the setup will be given.

[1] K. Bodek et al., AIP Conf. Proc. 1563, 208 (2013).
[2] S. Schlemme et al., this conference.

Supported in part by DFG (SFB 634), DAAD, the Polish Ministry of Science and Higher Education, and the Polish National Science Centre grants UMO-2012/06/M/ST2/00430 and DEC-2013/08/S/ST2/00551.

HK 48.63 Wed 17:00 C/Foyer

Experimental considerations for quantum-entanglement studies with relativistic fermions — •Steffen Schlemme[1], Marius Peck[1], Kazimierz Bodek[2], Pawel Caban[3], Jacek Ciborowski[4], Michal Dragowski[4], Joachim Enders[1], Adam Kozela[5], Jakub Rembielinski[3], Dagmara Rozpedzik[2], Marta Wlodarczyk[4], and Jacek Zejma[2] — [1]TU Darmstadt, Darmstadt, Germany — [2]Jagiellonian University, Cracow, Poland — [3]University of Lodz, Lodz, Poland — [4]Warsaw University, Warsaw, Poland — [5]Institute of Nuclear Physics PAS, Cracow, Poland

The QUEST (Quantum entanglement of Ultra-relativistic Electrons in Singlet and Triplet states) project is aimed at the determination of the electron spin correlation function at relativistic energies. Electron pairs are created through Moeller scattering, and polarization observables are planned to be measured in Mott scattering. The predicted spin correlation function is energy dependent with values of several per cent at energies of 10 - 20 MeV.

The results of a first test experiment at the S-DALINAC were not sensitive enough to detect entangled and Mott-scattered electron pairs at the expected energies. Further steps are either to improve the former setup or design a new polarimeter for lower energies to improve statistics due to the higher scattering cross sections. This contribution presents general considerations, test results, and an outlook.

Supported in part by DFG (SFB 634), DAAD, the Polish Ministry of Science and Higher Education, and Polish Natl. Science Centre grants UMO-2012/06/M/ST2/00430 and DEC-2013/08/S/ST2/00551.

HK 48.64 Wed 17:00 C/Foyer

^{83m}Kr for Calibration and Energy Resolution Studies of GEM-TPCs — •Roman Schmitz for the GEM-TPC-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

Time Projection Chambers are excellent detectors for full three-dimensional tracking of particles. The number of readout channels is usually of the order $\mathcal{O}(10^3 - 10^5)$ and therefore a precise calibration is necessary to achieve optimal energy resolution and particle identification performance. Radioactive ^{83m}Kr is a perfectly suited source for calibration of such a detector. It delivers an energy spectrum matching the typical energy loss of different particle types inside the detector and has a sufficiently short half-life to perform normal operation after a few hours.
Results on absolute and relative calibration of two GEM-TPCs with ^{83m}Kr are shown as well as the impact on specific energy loss performance. Resolution studies have been performed taking into account theoretically possible performance and noise contributions.
This work is supported by DFG SFB/TR 16.

HK 48.65 Wed 17:00 C/Foyer

A Time Projection Chamber for the Crystal Barrel experiment at ELSA — •Dimitri Schaab, Markus Ball, Reinhard Beck, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — HISKP Bonn University, Nussallee 14-16, D-53115 Bonn

The CBELSA/TAPS experiment focuses on baryon spectroscopy by photoproduction processes off nucleons. For this purpose the experiment consists of an inner detector and an outer detector. The outer Crystal Barrel detector mainly measures photons from the decaying resonance. For charged particle identification and in order to obtain their direction, the Inner Detector consists of three layers of scintillating fibers. This inner detector will be replaced by a Time Projection Chamber (TPC). It offers improved track reconstruction capabilities, a robust pattern recognition and, if operated in a magnetic field, an

excellent momentum resolution. Moreover, one obtains a particle identification of charged particles via the specific energy loss.

A TPC has been developed for the FOPI experiment which also fits to the Crystal Barrel dimensions. It operates in continuous mode using Gas Electron Multipliers (GEM) as pre-amplification stage. For the TPC detector the calibration of the detector is crucial since parameters such as drift velocity or field inhomogenities have a direct impact on the detector performance. For the CBELSA TPC a calibration system is planned, which is based on the T2K calibration system. Here, the photoelectric effect is used to release electrons at well-known positions on the cathode, which drift towards the readout plane and show the integrated spatial distortions.

HK 48.66 Wed 17:00 C/Foyer

Effects of high count rates on the signals from GEM-based detectors — •Konstantin Münning[1], Bernhard Ketzer[1], Markus Ball[1], and Christian Lippmann[2] for the ALICE-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]GSI - Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

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 poster is presenting the work on quantifying the common mode effect as a function of rate and the result of application of different filters in the digital data path. The results are needed for the design finalization of the read out electronics to be used at ALICE and other experiments.

Supported by the BMBF and the EU.

HK 48.67 Wed 17:00 C/Foyer

The NUSTAR Data Acquisition — •B. Löher[1,2], J. Agramunt[3], M. Bendel[4], A. Charpy[5], P. Coleman-Smith[6], A. Czermak[7], R. Gernhäuser[4], A. Heinz[5], H.T. Johansson[5], N. Kurz[2], I.H. Lazarus[6], T. Le Bleis[4], C. Nociforo[2], S. Pietri[2], V.F.E. Pucknell[6], H. Schaffner[2], H. Scheit[1], H. Simon[2], J. Taieb[8], H.T. Törnqvist[1,2], and M. Winkel[4] — [1]TU Darmstadt — [2]GSI — [3]IFIC, CSIC, Spain — [4]TU München — [5]Chalmers University of Technology, Sweden — [6]STFC Daresbury, UK — [7]IFJ, Poland — [8]CEA, France

The diversity of upcoming experiments within the NUSTAR collaboration, including experiments in storage rings, reactions at relativistic energies and high-precision spectroscopy, is reflected in the diversity of the required detection systems. A challenging task is to incorporate the different needs of individual detectors within the unified NUSTAR Data AcQuisition (NDAQ). NDAQ takes up this challenge by providing a high degree of availability via continuously running systems, high flexibility via experiment-specific configuration files for data streams and trigger logic, distributed timestamps and trigger information on km distances, all built on the solid basis of the GSI Multi-Branch System. NDAQ ensures interoperability between individual NUSTAR detectors and allows merging of formerly separate data streams according to the needs of all experiments, increasing reliability in NUSTAR data acquisition. An overview of the NDAQ infrastructure and the current progress is presented. *Supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and BMBF project 05P12RDFN8

HK 48.68 Wed 17:00 C/Foyer

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.

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. This will increase the trigger efficiency especially for final states with only neutral particles substantially.

To increase the possible data readout rate, which is currently limited by the digitization stage (LeCroy QDC 1885F) to ≈ 2 kHz, the implementation of a new Sampling-ADC (SADC) readout is being prepared.

Based on the 64-channel PANDA-SADC, the CB-SADC design was modified and adapted to the needs of the CBELSA/TAPS experiment. It offers 64 channels in one NIM module, together with modular analog or FPGA-based digital shaping. The data transfer will be realized by two standard gigabit links. Using an FPGA together with SADCs 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.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 49: Invited Talks 4

Time: Thursday 11:00–13:00 Location: T/HS1

Invited Talk HK 49.1 Thu 11:00 T/HS1

Strong Interactions and the Unitary Limit — •Hans-Werner Hammer — Institut für Kernphysik, Technische Universität Darmstadt — ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

Particles with strong interactions have universal low-energy properties independent of the details of the short-distance dynamics. Such systems occur in many areas of physics, including ultracold atoms, hadrons, and nuclei. In the unitary limit of infinite scattering length, the interactions do not provide a length scale. Thus the effective field theory describing such a system is invariant under scale and conformal transformations. I will discuss recent applications of this theory and future challenges with an emphasis on nuclear and particle physics.

Invited Talk HK 49.2 Thu 11:40 T/HS1

Solare Neutrinospektroskopie in BOREXINO — •Michael Wurm — für die Borexino-Kollaboration; Institut für Physik + Excellence Cluster PRISMA, Johannes-Gutenberg Universität Mainz

Das Borexino-Experiment am italienischen Gran-Sasse Labor nimmt seit 2007 eine spektroskopischen Messung des von der Sonne emittierten niederenergetischen Neutrinoflusses vor. Der Nachweis der solaren Neutrinos erfolgt dabei über deren elastische Streuung an den Elektronen des 270 Tonnen umfassenden Flüssig-Szintillatortargets. Essentiell für die Beobachtung ist neben der niedrigen Energieschwelle von nur 200 keV und der exzellenten Abschirmung von kosmischer Strahlung im Untergrundlabor vor allem die radioaktive Reinheit der verwendeten Detektormaterialien: Im Szintillatortarget beträgt der Anteil von Uran und Thorium weniger als 10^{-18} g/g.

Seit Aufnahme des Betriebs im Jahr 2007 hat Borexino sukzessive die Beiträge unterschiedlicher Fusionsreaktionen zum solaren Neutrinospektrum vermessen. Nach ^{7}Be, ^{8}B und pep-Neutrinos gelang 2014 die erste spektrale Messung der pp-Neutrinos, die aus dem grundlegendsten Reaktionsschritt der pp-Kette, der Fusion von zwei Protonen, stammen. Die Entstehung der pp-Neutrinos ist eng verknüpft mit der von der Sonne im elektromagnetischen Spektrum abgestrahlten Leistung und erlaubt einen Test der solaren Neutrinooszillationen im niederen Energiebereich. Die in Borexino gemessene Ereignisrate bestätigt einmal mehr die Vorhersagen des Standardsonnenmodells und des etablierten MSW-LMA Oszillationsszenarios.

Invited Talk HK 49.3 Thu 12:20 T/HS1

Precision mass measurements of rare isotopes in nuclear physics — •Jens Dilling — TRIUMF, Vancouver, Canada & University of British Columbia

From our current knowledge, we expect that there are up to 8000 different isotopes in the universe, out of those, 288 isotopes are stable or very long lived; the other isotopes are short-lived rare isotopes. At world-wide facilities, we have so far investigated about 3000 isotopes, to the extent that we know basic properties, like decay-modes, half-

lives, or mass. The mass plays a particular important role, as it gives access to the binding energy and hence the underlying forces that hold the protons and neutrons together. The rare isotopes are produced at accelerator facilities, often only in minuscule quantities, and with half-lives as short as few milliseconds, hence the name rare. To overcome the research obstacles of rare isotopes and extract information about the atoms and their fundamental interactions dedicated instruments are required. We have developed very sensitive and fast methods using ion trap techniques at TITAN (TRIUMF's Ion Trap of Atomic and Nuclear science). Ion traps can be employed to measure atomic masses, using one single ion in as short as a 1/100 of a second with 10 parts per billion precision. One example is to probe into the world of so-called nuclear halos. Teetering on the edge of stability, the properties of halo nuclei have long been recognized as the most stringent test parameters of our understanding of the strong force. In this talk I will report on these measurements and new investigations of very extreme rare isotopes.

HK 50: Instrumentation 15

Time: Thursday 14:30–16:30 Location: M/HS1

Group Report HK 50.1 Thu 14:30 M/HS1

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

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

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

This presentation outlines the design of the CBM First-level Event Selector and summarizes the results from first prototype systems.

HK 50.2 Thu 15:00 M/HS1

The PASTA Chip - A Free-Running Readout ASIC for Silicon Strip Sensors in PANDA — •André Goerres[1], Tobias Stockmanns[1], James Ritman[1], and Angelo Rivetti[2] for the PANDA-Collaboration — [1]Forschungszentrum Jülich GmbH, Jülich, Germany — [2]INFN Sezione di Torino, Torino, Italy

The PANDA experiment is a multi purpose detector, investigating hadron physics in the charm quark mass regime. It is one of the main experiments at the future FAIR accelerator facility, using $\overline{\mathrm{p}}\mathrm{p}$ annihilations from a 1.5-15 GeV/c anti-proton beam. Because of the broad physics spectrum and the similarity of event and background signals, PANDA does an event selection based on the complete raw data of the detector. The innermost of PANDA's sub-systems is the Micro Vertex Detector (MVD), consisting of silicon pixel and strip sensors. The latter will be read out by a specialized, free-running readout front-end called PANDA Strip ASIC (PASTA).

It has to face a high event rate of up to 40 kHz/ch in an radiation-intense environment. To fulfill the MVD's requirements, it has to give accurate timing information to incoming events (< 10 ns) and determine the collected charge with an 8-bit precision. All this has to be done with a very low power design (< 4 mW/ch) on a small footprint with less than 21 mm^2 and 60 μm input pitch for 64 channels per chip. Therefore, a simple, time-based readout approach with two independent thresholds is chosen.

In this talk, the conceptual design of the full front-end and some aspects of the digital part will be presented.

HK 50.3 Thu 15:15 M/HS1

Abschätzung der strahlungsbedingten Fehlerrate in der CBM-ToF Frontendelektronik — •Sebastian Manz und Udo Kebschull für die CBM-Kollaboration — Infrastruktur und Rechnersysteme in der Informationsverarbeitung (IRI), Frankfurt, Deutschland

Für die Auslese der Frontendelektronik des Time-Of-Flight (ToF) Detektors des CBM Experiments sind SRAM basierte FPGAs angedacht. SRAM basierte Elektronik kann durch radioaktive Strahlung, insbesondere durch hochenergetische Hadronen, in der Funktion gestört werden.

Einen besonderen Störfaktor in SRAM basierten FPGAs stellen sogenannte "Sinlge Event Upsets" dar. Um diesem Störfaktor entgegenzuwirken können verschiedene Techniken eingesetzt werden.

Solche Techniken wurden für ein existierendes Auslesedesign implementiert. Hierbei wurden Kompromisse eingegangen um die Kosten des Detektors in realistischen Grenzen zu halten. Die Effizienz dieser Kompromisslösung wurde 2012 und 2013 in Strahltests gemessen.

Nach der Auswertung der Strahltestergebnisse kann nun eine etwas genauere Abschätzung der erwarteten strahlungsbedingten Fehlerraten in der Ausleseelektronik des CBM-ToF Detektors erstellt werden.

HK 50.4 Thu 15:30 M/HS1

Development of the timing branch electronics for the Crystal Barrel Calorimeter — •Peter Klassen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The excitation spectrum of baryons consists of many resonances which contribute selectively to distinct decay channels. To be able to measure purely neutral reactions on a polarized neutron target with high efficiency, the Crystal Barrel Detector which consists of 1320 CsI(Tl) crystals has to be integrated into the first level trigger. This requires an exchange of the existing PIN photo diode 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 crystal. The processing of these trigger signals requires an introduction of a previously not existent timing branch to the readout chain of the main calorimeter.

The final concept and current development status of the timing backend will be presented. It utilizes FPGA based boards for rise time compensation, time to digital conversion and the cluster finding.

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

HK 50.5 Thu 15:45 M/HS1

ALICE Common Read-Out Receiver Card Status and HLT Implementation — •Heiko Engel and Udo Kebschull for the ALICE-Collaboration — IRI, Goethe-Universitaet Frankfurt am Main

The ALICE Common Read-Out Receiver Card (C-RORC) is an FPGA based PCIe read out board with optical interfaces primaryly developed to replace the previos ALICE High-Level Trigger (HLT) and Data Acquisition (DAQ) Read-Out Receiver Cards from Run1 with a state of the art hardware platform to cope with the increased link rates and event data volume of Run2. The large scale production of the C-RORCs for Run2 has been completed in cooperation with ATLAS and the boards are installed in the productive clusters of ALICE HLT, ALICE DAQ and ATLAS TDAQ ROS. This contribution describes the hardware and firmware of the C-RORC in the ALICE HLT application and its online processing capabilities. Additionally, a high level dataflow description approach to implement hardware processing steps more efficiently is presented.

HK 50.6 Thu 16:00 M/HS1

Self-Triggering Readout System for the Neutron Lifetime Experiment PENeLOPE — •Dominic Gaisbauer and Dominik Steffen for the PENeLOPE-Collaboration — Technische Universität München

The aim of PENeLOPE is a high-precision measurement of the neutron lifetime and thereby an increase of the parameter's precision by one order of magnitude. In order to achieve an increasingly higher

accuracy, modern experiments naturally require state-of-the-art readout electronics, as well as high-performance data acquisition systems. This talk will therefore present the readout system for the neutron lifetime experiment PENeLOPE, which is currently being designed at the department of physics at Technische Universität München.

The system's readout chain involves preamplifier, shaper, sampling ADC, and a data processing stage implemented on field programmable gate arrays (FPGAs). Due to the incorporated signal detection, the system is able to process data from 1,000 self-triggering channels, each of which is hit by 10 particles/sec. The corresponding data rate of 1.5 MB/sec is transferred to the outside of the experiment by a high-speed optical interface, which has been developed to meet the special experimental requirements of PENeLOPE. The main focus of the talk will be set on the performance and tests of the trigger algorithm as well as on characteristics and properties of the optical interface. The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

HK 50.7 Thu 16:15 M/HS1

Towards self-triggered digitization and data readout in 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 for heavy systems like Au+Au and the need to identify experimental signatures of probes like multi-strange hyperons in the online data stream place challenging demands on the experiment's data acquisition system. Each detector subsystem in CBM implements a self-triggered digitization and readout chain fitted to the respective front-end electronics sending continuous data streams to a high-performance computing farm called the First-Level Event Selector (FLES). Here, events are reconstructed online to identify the physically most interesting ones as only a fraction of the enormous data rate (up to 1 TB/s) can be stored permanently for later offline analysis. The time-of-flight (TOF) wall of CBM is composed of high-resolution timing multi-gap resistive plate chambers (MRPCs) which are estimated to deliver signal rates of up to 500 kHz per electronics channel. Prototypical readout schemes currently under test which are able to transport this high payload will be presented and an outline towards inclusion in the FLES network will be given. The project is partially funded by BMBF 05P12VHFC7 and by EU/FP7-HadronPhysic3/WP19.

HK 51: Instrumentation 16

Time: Thursday 14:30–16:30 Location: M/HS2

Group Report HK 51.1 Thu 14:30 M/HS2

Status of the neutron detector NeuLAND in 2014 — •Kenjiro Miki[1], Thomas Aumann[1,2], Konstanze Boretzky[2], Christoph Caesar[1], Igor Gasparic[3], Michael Heil[2], Heiko Scheit[1], and Haik Simon[2] for the R3B-Collaboration — [1]IKP, TU-Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]RBI, Zagreb, Croatia

We report on the present status of the new neutron detector NeuLAND designed for the R3B facility at FAIR. The NeuLAND is a segmented large-volume plastic scintillation detector with a designed volume of 2.5 (width) × 2.5 (height) × 3.0 (depth) m^3, which will provide high efficiency, good timing resolution and high multi-neutron resolving power. Ten planes of scintillator walls, corresponding to the depth of 0.5 m, have been constructed and tested so far. The performance of this NeuLAND demonstrator was studied with fast neutrons from heavy-ion beams in GSI. The ^{48}Ca, ^{58}Ni and ^{236,238}U beams with incident energies from 400 to 800 MeV/u were impinged on C, Pb, or U target, and neutrons produced around 0 degrees were detected by the NeuLAND. Neutron hit distributions were obtained for one and multiple neutron events, allowing us for detailed response studies. An excellent timing resolution of typically 150 psec (σ) was determined online. The presentation will include the detailed explanation of the experimental setups and obtained results. The outlook comprises further NeuLAND construction and data taking during the next year.

This work is supported by HIC for FAIR, GSI–TU Darmstadt cooperation, ENSAR, and the BMBF project 05P12RDFN8.

HK 51.2 Thu 15:00 M/HS2

Chemical shifts of manganese K X-rays — •Malkhaz Jabua — Forschungszentrum Juelich, Juelich, Germany — Georgian Technical University, Tbilisi, Georgia

High resolution X-ray spectroscopy offers a powerful tool to study the complex electron-electron interaction in the atomic shells. Experimentally, this requires an energy resolution below one electron volt, which is achievable only with crystal spectrometers in the few keV range. Crystal spectrometry in this energy range exploits the so called Bragg's law, which measures a wavelength precisely via the diffraction angle. The goal of the experiment held at the institute of nuclear physics at Forschungszentrum Juelich is the measurement of K X-ray energies for various chemical compounds at ultimate precision. The measurements were performed with a Bragg spectrometer set up in Johann geometry. It allows to record simultaneously an energy interval according to the width of the X-ray source when using a correspondingly extended X-ray detector. A series of measurements for various manganese compounds has been completed. X-ray energies were determined to an accuracy of 10-20 meV confirming the known overall behavior of decreasing line energy with increasing ionization state of Mn atom. The talk is focused to describe the setup of the Bragg spectrometer and to present recent results of the comprehensive data analysis.

HK 51.3 Thu 15:15 M/HS2

A new digital pulse generator for the CALIFA detector — Michael Bendel, Roman Gernhaeuser, Benjamin Heiss, Philipp Klenze, •Patrick Remmels, and Max Winkel for the R3B-Collaboration — Physik Department E12, Technische Universität München

The 4π-calorimeter CALIFA ist one of the major detectors of the R3B-experiment at the upcoming Facility for Antiproton and Ion Research in Darmstadt. The monitoring of stability, single channel properties, temperature effects and rate dependency in a high resolution, high granularity calorimeter is essential for the success of the whole experiment. A new digital pulse generator will emulate the complex signal of the CsI(Tl) crystals in order to fine tune the online pulse shape analysis for particle identification, background suppression, energy calibration and for deadtime and pileup studies. The total pulse generator firmware is implemented into the digital readout platform FEBEX used in CALIFA. The FPGA and a small analog add on board allow for highly flexible parameter adjustment. New applications are easy to implement and even very complex shapes are produced by simple lookup tables. The concept, features and implementation of a prototype and a first application in the CALIFA Demonstrator Experiment in October 2014 at GSI in Darmstadt will be presented.
Supported by BMBF under contract 05P12WOFNF, and by GSI Darmstadt.

HK 51.4 Thu 15:30 M/HS2

The Photon Tagger NEPTUN at S-DALINAC: Current Status and Research Program — •Diego Semmler, Michaela Arnold, Thomas Aumann, Martin Baumann, Michael Beckstein, Alexander Blecher, Nebojsa Cvejin, Florian Hug, Christopher Lehr, Norbert Pietralla, Heiko Scheit, Dmytro Symochko, Christopher Walz, and Tim Wessels — Institut für Kernphysik, Darmstadt, Germany

The low energy photon tagger NEPTUN at the S-DALINAC delivers a quasi-monoenergetic photon beam between about 1 MeV and 20 MeV with a resolution of approximately 25 keV. Tagged photons provide the possibility to measure the full dipole strength of nuclei in the energy range below and above the neutron threshold. The highly efficient $LaBr_3$:Ce based spectrometer GALATEA will be used to detect not only the direct decays to the ground state, but also cascading decays can be measured with suitable efficiency. To measure (γ, n)- and $(\gamma, n\gamma)$-reactions the setup will be extended by neutron detectors based on liquid scintillators.

The data will be combined with experiments at Duke University, GSI

and RIKEN to obtain a complete picture of dipole strength function evolution in Sn isotopes.

This talk will cover the link between the different experiments and focus on the setup and status of the NEPTUN commissioning program. If available, data from the first runs with Sn will be shown.

Supported by DFG (SFB 634)

HK 51.5 Thu 15:45 M/HS2

Ergebnisse der iPhos-Energierekonstruktion hochenergetischer Protonen — •Michael Bendel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze und Max Winkel für die R3B-Kollaboration — Physik-Department E12, Technische Universität München

Im R^3B-Experiment, das an der neuen Experimentiereinrichtung FAIR (Darmstadt) aufgebaut wird, soll die gesamte Targetregion von dem grossvolumigen Kalorimeter CALIFA eingeschlossen werden.
Dieses Kalorimeter bestehend aus 2500 CsI(Tl)-Kristallen mit einer Auslese durch Avalanche-Photodioden, ist ein sehr vielseitiges Instrument, das eine Schlüsselrolle in der Realisation von kinematisch vollständigen Messungen spielt. Die wesentlichen Anforderungen sind eine hohe Effizienz, eine gute Energieauflösung im Bereich von 5% bei 662keV γ-Strahlung und ein riesiger dynamischer Bereich, der es erlaubt gleichzeitig γ-Quanten mit wenigen 100keV, aber auch gestreute Teilchen mit mehreren 100MeV nachzuweisen. In Kernreaktionen bei relativistischen Strahlenergien erhalten leichte geladene Teilchen vorallem in Vorwärtsrichtung sehr hohe Energien bis zu 700MeV. Im Rahmen dieses Vortrags stellen wir experimentelle Ergebnisse der neuen iPhos-Rekonstruktionsmethode vor, die mit Protonen bei kinetischen Energien bis zu 480MeV am TRIUMF in Vancouver, Kanada erfolgreich getestet wurde. Gefördert durch BMBF (05P12WOFNF, 05P12WONUE), GSI Darmstadt und TRIUMF Vancouver.

HK 51.6 Thu 16:00 M/HS2

Monte-Carlo studies of BGO Compton-suppression shields for the MINIBALL spectrometer — •Dawid Rosiak, Peter Reiter, and Michael Seidlitz — 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. Beam energies up to 10 MeV/u will allow for direct reactions and fusion-evaporation reactions, populating excited nuclei at higher excitation energy than the existing REX-ISOLDE facility. Moreover, high angular-momentum transfer will cause events with 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. In future the triple-cluster detectors will be optionally surrounded by BGO Compton-suppression shields in order to cope with the scattering between detectors from high energetic γ-rays and with double hits from high multiplicity. A detailed Monte-Carlo study, based on the GEANT4 simulation toolkit [1], was performed for the full spectrometer by varying the geometry of the BGO detectors. The final result is a detector configuration with improved peak-to-total ratio of up to 55% and a reduced efficiency, which will be the basis of a first prototype detector.
[1] S. Agostinelli *et. al.*, Nucl. Instrum. Methods A 506, 250 (2003).

HK 51.7 Thu 16:15 M/HS2

Energie- und Effizienzeichung eines $LaBr_3$-Szintillations-Detektors mittels $^{27}Al(p,\gamma)^{28}Si$ — •Enno Hrivula[1], Meiko Voknandt[1], Klaus Eberhardt[2], Anne Endres[1], Matthias Fix[1], Tanja Heftrich[1], Arnd Junghans[3], Franz Käppeler[4], Alberto Mengoni[5], Rene Reifarth[1], Stefan Schmidt[1], Dorothea Schumann[6], Kurt Stiebing[1], Mario Weigand[1] und Norbert Wiehl[2] — [1]Goethe University Frankfurt, Germany — [2]Gutenberg University of Mainz, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [4]KIT, Germany — [5]Cern, Switzerland — [6]Paul-Scherrer-Institute Villingen, Switzerland

Die Messung des Neutroneneinfangquerschnittes des radioaktiven ^{10}Be ist derzeit nur mit Hilfe der Aktivierungsmethode möglich. Dies erfordert die Detektion des Zerfalls des kurzlebigen ^{11}Be, welches am besten anhand der hochenergetischen Gammalinie bei 6.79 MeV möglich ist. Das übliche verfahren zur Effizienzkalibration mit Standardquellen ist für diese Energien nicht ausreichend. Daher wurde die Kalibration auf Basis der ^{27}Al(p,γ)-Reaktion durchgeführt. Für Protonenenergien um 1 MeV läßt sich so anhand der Resonanzen dieser Reaktion die Detektoreffizienz für Gammaenergien von 2 MeV bis oberhalb von 10 MeV durchführen. Im Rahmen des Vortrages wird die Methode am Beispiel eines zylindrischen $LaBr_3$Detektors von 7.5 cm Durchmesser und 7.5 cm Dicke vorgestellt.

HK 52: Nuclear Astrophysics 3

Time: Thursday 14:30–16:15 Location: M/HS4

Group Report HK 52.1 Thu 14:30 M/HS4

The SNO+ Experiment for Neutrinoless Double-Beta Decay — •Valentina Lozza, Belina von Krosigk, Arnd Soerensen, and Kai Zuber — Institut für Kern- und Teilchenphysik, Zellescher Weg 19, 01069 Dresden, Germany

SNO+ is a large liquid scintillator based experiment that re-uses the Sudbury Neutrino Observatory detector. The detector, located 2 km underground in a mine near Sudbury, Canada, consists of a 12 m diameter acrylic vessel which will be filled with 780 tonnes of liquid scintillator. The main physics goal of SNO+ is to search for the neutrinoless double-beta (0n2b) decay of 130Te. During the double-beta phase, the liquid scintillator will be initially loaded with 0.3% natural tellurium (nearly 800 kg of 130Te). During this demonstration phase we anticipate that we will achieve a sensitivity in the region just above the inverted neutrino mass hierarchy. Recently the possibility to deploy up to 10 times more natural tellurium is being developed, by which SNO+ could explore, in the near future, deep into the parameter space for the inverted hierarchy. Designed as a general purpose neutrino experiment, SNO+ can additionally measure the reactor neutrino oscillations, geo-neutrinos in a geologically-interesting location, watch supernova neutrinos and measure low energy solar neutrinos. A first commissioning phase with the detector filled with water has started in autumn 2014, while full running with water will take place in 2015. Transition to the scintillator phase will start towards the end of 2015. The 0n2b decay phase is foreseen for the 2016. This work is supported by the German Research Foundation (DFG).

HK 52.2 Thu 15:00 M/HS4

FLUKA simulations of neutron transport 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 (HZDR), Dresden — [2]Technische Universität Dresden

A new underground ion accelerator with 5 MV acceleration potential is currently being prepared for installation in the Dresden Felsenkeller. The Felsenkeller 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. In order to exclude any possible effect by the new accelerator in tunnel VIII on the existing low-background γ-counting facility in tunnel IV, Monte Carlo simulations of neutron transport are being performed. A realistic neutron source field is developed, and the resulting additional neutron flux at the γ-counting facility is modeled by FLUKA simulations. – Supported by NAVI (HGF VH-VI-417).

HK 52.3 Thu 15:15 M/HS4

Entwicklung eines Detektors zur Bestimmung von (n,γ)-Wirkungsquerschnitte mittels ToF-Methode bei sehr kurzem Flugweg — •Clemens Wolf, Rene Reifarth und Mario Weigand — Goethe-Universität Frankfurt

Unter den Bedingungen des langsamen Neutroneneingangprozesses (s-Prozeß) sind die Neutroneneinfangsrate und die Betazerfallsrate von ^{85}Kr in der gleichen Größenordnung. Deshalb ist dieser Kern ein Verzeigungspunkt. Die genaue Kenntnis des (n,g)-Querschnittes erlaubt deshalb Rückschlüsse auf das Innere der Sterne während der Phase der Roten Riesen. Da ^{85}Kr jedoch nur in sehr geringen Mengen innerhalb eines Gammadetektors benutzt werden kann, reichen die Neutronenflüsse der aktuellen Experimente für eine erfolgreiche Messung nicht

aus. Daher wird versucht mittels einer Verkürzung des Flugweges auf wenige Zentimeter den Neutronenfluss von FRANZ soweit zu erhöhen, dass eine Bestimmung des Querschnittes möglich wird. Dies erhöht allerdings neben der Intensität des Gammablitzes auch den Neutronenuntergrund und stellt somit enorme Anforderungen an den Detektoraufbau. Deshalb die Geometrie, das Szintilationsmaterial, sowie der Moderator mittels GEANT 3 Simulationen optimiert.

HK 52.4 Thu 15:30 M/HS4

Herstellung von ^{91}Nb für eine ^{91}Nb(p,γ)-Messung an FRANZ — •Benedikt Thomas[1], Kerstin Sonnabend[1], Anne Endres[1], Stefan Fiebiger[1], Ulrich Giesen[2], Jan Glorius[1] und Ole Hinrichs[1] — [1]Goethe Universität Frankfurt a. M., Germany — [2]Physikalisch Technische Bundesanstalt (PTB), Braunschweig, Germany

Die hohen Protonenströme, die FRANZ (Frankfurter Neutronen Quelle am Stern-Gerlach-Zentrum) liefern wird, werden es möglich machen (p, γ) und (n, γ)-Reaktionen an Targets mit geringer Targetkernzahl zu untersuchen. Ein Beispiel dafür ist ^{91}Nb. Ziel der Messung ist es den Wirkungsquerschnitt der Reaktion ^{91}Nb(p, γ)^{92}Mo bei 2 MeV Protonenenergie und damit im astrophysikalisch relevanten Bereich für einen möglichen Protoneneinfang-Prozess zu bestimmen. Dafür muss das instabile Isotop ^{91}Nb ($t_{1/2}$ = 680 a) in ausreichender Zahl hergestellt werden. Eine mögliche Methode zur Herstellung von ^{91}Nb ist die Aktivierung von ^{92}Mo mit Protonen mit etwa 20 MeV. Durch die bei diesen Energien dominanten Reaktionskanäle (p, pn) und (p, 2p) und anschließendem Zerfall sollte es möglich sein ausreichend ^{91}Nb herzustellen. In einem ersten Aktivierungsexperiment an der PTB, Braunschweig, wurden die Produktionsquerschnitte der beteiligten Reaktionen überprüft.

Dieses Projekt wird durch die Deutsche Forschungsgemeinschaft (SO907/2-1), HIC for FAIR im Rahmen von LOEWE des Bundeslandes Hessen, Deutschland und dem European Research Council im siebten Rahmenprogramm (FP/2007-2013) der Europäischen Kommission / ERC Grant Agreement Nr. 615126 unterstützt.

HK 52.5 Thu 15:45 M/HS4

NeuLAND - Der Neutronendetektor zur Messung astrophysikalisch relevanter Reaktionen — •Tanja Heftrich für die R3B-Kollaboration — Goethe-Universität Frankfurt, GER

Während der Nukleosynthese in Sternen finden neben Neutroneneinfangreaktionen -(n,γ)-Reaktionen- auch γ-induzierte Reaktionen statt. In beiden Fällen wird die Messung der (γ,n)-Reaktionen an radioaktiven Kernen benötigt. Am GSI Helmholtzzentrum für Schwerionenforschung ist es möglich radioaktive Strahlen zu erzeugen und die Eigenschaften der Kerne zu untersuchen.
Der radioaktive Strahl wird auf 500 AMeV beschleunigt und in den LAND/R^{3}B-Aufbau geleitet. Nach Wechselwirkung mit dem Coulombfeld eines Bleikerns kann das eingehende Isotop ein Neutron dissoziieren. Im Rahmen der Coulombaufbruchmethode kann aus dieser Reaktion der Wirkungsquerschnitt für die (γ,n)-Reaktion abgeleitet werden. Insbesondere nahe der Schwelle sind diese Reaktionen aus astrophysikalischer Sicht wichtig. Dies erfordert jedoch eine hohe Orts- und Zeitauflösung, die mit dem bisher verwendeten Large Acceptance Neutron Detector (LAND) nicht erreicht werden kann. Im Rahmen der R^{3}B-Kollaboration wurde deshalb ein neuer Neutronendetektor (NeuLAND) entworfen und ein Demonstrationsdetektor bereits erfolgreich getestet. Der Detektor wird an der im Bau befindlichen Beschleunigeranlage FAIR eingesetzt werden. Im Rahmen des Vortrages werden erste Ergebnisse der Testexperimente und der Fortschritt durch NeuLAND für die nukleare Astrophysik dargestellt. *unterstützt von HIC4FAIR und BMBF (06FY71051).

HK 52.6 Thu 16:00 M/HS4

Verhalten des geplanten Flugzeit-Datenaufnahmesystems an der Neutronenquelle FRANZ — •Stefan Schmidt[1], Jan Glorius[1], Ralf Plag[2], René Reifarth[1], Kerstin Sonnabend[1] und Benedikt Thomas[1] — [1]Goethe Universität, Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Um Neutroneneinfangreaktionen zu messen, die beim *s*-Prozess in Roten Riesen ablaufen, werden Neutronenquellen mit hohen Neutronenflüssen immer wichtiger. Die Frankfurter Neutronenquelle am Stern-Gerlach-Zentrum (FRANZ) wird mit einem intensiven Protonenstrahl und mit Hilfe der ^{7}Li(p, n)-Reaktion hohe Neutronenflüsse von bis zu $10^7/(\mathrm{cm}^2\,\mathrm{s})$ im Energiebereich zwischen 1 und 200 keV erreichen.

Das geplante Datenaufnahmesystem für Flugzeitmessungen an FRANZ besteht aus mehreren achtkanaligen V1751-Modulen der Firma CAEN, die die DPP-PSD-Firmware nutzen. In jedem Kanal wird das Signal mit einer Rate von 10^9/s abgetastet, ein Prozessor verarbeitet das digitalisierte Signal auf dem Modul. Dazu analysiert er das Spannungssignal und beginnt eine kurze und eine lange Integration nach Überschreitung eines Schwellwertes.

Dieser Beitrag soll das Ergebnis einer Versuchsreihe vorstellen, in der diese Verarbeitung untersucht wurde, und daraus folgende Implikationen für die Flugzeitmessungen an FRANZ aufzeigen.

Dieses Projekt wird gefördert durch den GIF Research Grant No. G -1051-103.7/2009, die Helmholtz Nachwuchsgruppe VH-NG-327, das Nuclear Astrophysics Virtual Institute (NAVI) und das CHANDA-Projekt.

HK 53: Heavy Ion Collisions and QCD Phases 6

Time: Thursday 14:30–16:30 Location: T/HS1

Group Report HK 53.1 Thu 14:30 T/HS1

(Anti-)nuclei production and exotica searches with ALICE at the LHC — •Benjamin Dönigus for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt, Frankfurt, Germany

The high collision energies reached at the LHC lead to significant production yields of light anti- and hyper-nuclei in proton-proton and, in particular, Pb-Pb collisions. The excellent particle identification capabilities from the Time Projection Chamber, using the specific energy loss (dE/dx), and the time-of-flight measurement, allow for the detection of these rarely produced particles. Further the Inner Tracking System gives the possibility to seperate primary nuclei from those coming from the decay of heavier systems. This altogether offers the unique opportunity to search for exotica like the bound state of a Λ and a neutron which would decay into deuteron and pion, or the bound state of two Λs, and also allows for the topological identification of the hyper-triton via its mesonic decay ($^3_\Lambda$H $\rightarrow ^3$He+π).

In this group report we will show results for (anti-)deuterons, (anti-)tritons, (anti-)^{3}He and (anti-)^{4}He and give an overview on the ongoing searches. The results will also be compared with the expectations from thermal and coalescence models.

HK 53.2 Thu 15:00 T/HS1

Anti-Alpha production in $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV Pb–Pb collisions with ALICE at the LHC — •Nicole Löher for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum fürSchwerionenforschung, Planckstraße 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

ALICE is the experiment at the CERN LHC dedicated to the investigation of nucleus–nucleus collisions at the highest energies ever reached in the laboratory. The excellent particle identification capabilities allow for the measurement of many particle species, spanning a wide range in mass, from the light electrons to the heavy ^{4}He nuclei. In this talk we present results from a sample of Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV. The anti-alpha is the heaviest anti-nucleus observed up to now. These particles have been identified based on their specific energy loss in the Time Projection Chamber and the velocity information from the Time-Of-Flight detector. The production yield dN/dy is presented and the result is compared with thermal model calculations.

HK 53.3 Thu 15:15 T/HS1

Searching for a Dark Photon with HADES — •Carina Ungethuem for the HADES-Collaboration — TU Darmstadt

Approximately 25 % of our universe consists of dark matter (DM). It is possible that the DM (DM) interacts with the visible matter via a U(1) gauge boson, the so called U-boson (A', γ' or dark photon). The standard model (SM) is thereby supplemented with an additional sector characterized by the U(1)' symmetry, which gives the counterpart to the SM U(1) symmetry. The kinetic mixing of the U(1) and U(1)'

symmetry groups gives a natural connection between the SM and DM. The dark photon is constrained to be in the MeV to GeV range and should have a small width of $\Gamma_u \ll 1$ MeV/c^2. Such models are also proposed to explain some recent puzzling astrophysical observations, as well as to solve the sofar unexplained deviation between the measured and calculated values of the muon anomaly. We present a search for the e^+e^- decay of such a hypothetical dark photon in inclusive dielectron spectra measured by HADES in the Au (1.23 GeV) + Au reaction. An upper limit on the kinetic mixing parameter at 90% CL has been obtained for a mass range lower than 0.6 GeV/c^2 and is compared with the present world data set. We are aiming at a lowering of the upper limit for masses below 0.1 GeV/c^2 in order to exclude a further part of the parameter region favored by the muon g-2 anomaly.
Supported by: VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI

HK 53.4 Thu 15:30 T/HS1

Deep sub-threshold strangeness production in nuclear collisions with the UrQMD transport model — •Jan Steinheimer[1], Gunnar Graef[1], Feng Li[3], and Marcus Bleicher[1,2] — [1]FIAS, Frankfurt am Main — [2]ITP, Goethe Universität, Frankfurt am Main — [3]Texas *A&M* University, College Station, USA

I will present results on deep sub threshold strangeness production in nuclear collisions, with the UrQMD transport model. Introducing antikaon+baryon and hyperon+hyperon strangeness exchange reactions we obtain a good description of experimental data on single strange hadron production in Ar+KCl reactions at E_{lab} = 1.76 A GeV. We find that the hyperon strangeness exchange is the dominant process contributing to the Ξ^- yield, however remains short of explaining the large Ξ^-/Λ ratio measured with the HADES experiment while agreeing well with a thermal fit to the data. I will further discuss open problems in the microscopic description of strangess production at SIS18 energies, including the surprisingly high ϕ/K^- ratio measured with the HADES experiment as well as uncertainties arising from unknown resonance branching ratios.

HK 53.5 Thu 15:45 T/HS1

A new approach to detect hypernuclei in the QMD/HSD phase space distribution at relativistic energies — •Arnaud Le Fèvre[1], Yvonne Leifels[1], Jörg Aichelin[2], Christoph Hartnack[2], Elena Bratkovskaya[3], and Victor Kyreyev[4] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]SUBATECH, UMR 6457, Ecole des Mines de Nantes - IN2P3/CNRS - Université de Nantes, France — [3]FIAS, Francfort University, Germany — [4]JINR, Dubna, Russia

We developed an improved clusterisation algorithm which aims at predicting more realistically the yields of clusters in the framework of the Quantum Molecular Dynamics model. This new approach is able to predict isotope yields as well as hypernucleus production at relativistic energies. To illustrate its predicting power, we confront this new method to experimental data, with a close view on light hypernucleus yields and phase space distributions, and show the sensitivity on the parameters which govern the hypercluster formation, such as the hyperon-nucleon cross-section, the clusterisation time, the initial momentum distribution of nucleons and the asymmetry energy.

HK 53.6 Thu 16:00 T/HS1

Fast reconstruction of multi-strange hyperons in the CBM experiment — •Iouri Vassiliev for the CBM-Collaboration — GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The main goal of the CBM experiment 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. One of the promissing signatures of this new state is the enhanced production of multi-strange particles, therefore the reconstruction of multi-strange hyperons is essential for the understanding of the heavy ion collision dynamics. Another experimental challenge of the CBM experiment is online selection of open charm particles via the displaced vertex of the hadronic decay, Charmonium and low mass vector mesons in the environment of a heavy-ion collision. This task requires fast and efficient track reconstruction algorithms, primary vertex finder and particles finder. Results of feasibility studies of the multi-strange hyperons in the CBM experiment will be presented.

HK 53.7 Thu 16:15 T/HS1

Towards a Realistic Event Generator for In-Medium Signals — •Florian Seck for the HADES-Collaboration — TU Darmstadt

The most important task of theoretical heavy-ion physics is to link experimental observables to the bulk properties and the microscopic structure of the different phases of strongly interacting matter.

Until now the hadronic cocktails produced with the event generator Pluto for the HADES and CBM experiments only included a contribution from freeze-out ρ mesons modeled by a Breit-Wigner distribution around its pole mass.

However as dileptons are radiated from the fireball during the whole time evolution, medium effects like the broadening of the ρ should also be included in the simulations. Calculations of the in-medium ρ spectral function by R. Rapp and J. Wambach demonstrate, that a large part of the in-medium ρ mesons feed into the mass region below the ρ/ω pole mass down to zero masses.

The modular structure of Pluto makes it feasible to customize the event generator and incorporate models of in-medium physics, like the Rapp-Wambach spectral function, as plug-ins. For masses above 1 GeV/c^2 we include emission due to multi-pion annihilation and due to QGP radiation.

In this contribution first steps towards the implementation of such a plug-in into the event generator Pluto are presented.

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

HK 54: Heavy Ion Collisions and QCD Phases 7

Time: Thursday 14:30–16:30 Location: T/SR14

Group Report HK 54.1 Thu 14:30 T/SR14

Transport coefficients and spectral functions from the functional renormalization group — •Ralf-Arno Tripolt[1], Lorenz von Smekal[1,2], Jochen Wambach[1,3], Christopher Jung[1], and Alexander Stegemann[1] — [1]TU Darmstadt — [2]Justus-Liebig-Universität Gießen — [3]GSI Helmholtzzentrum für Schwerionenforschung

We present a method to obtain spectral functions and transport coefficients like the shear viscosity from the functional renormalization group approach. Our nonperturbative method is thermodynamically consistent, symmetry preserving and based on an analytic continuation from imaginary to real time on the level of the flow equations for two-point functions. We present results for mesonic spectral functions at finite temperature, density and external momentum, in particular near the critical endpoint in the phase diagram of the quark-meson model. Moreover, first results on the shear viscosity over entropy ratio are shown.

[1] Ralf-Arno Tripolt, Lorenz von Smekal, and Jochen Wambach, Phys. Rev. D 90, 074031 (2014).

[2] Ralf-Arno Tripolt, Nils Strodthoff, Lorenz von Smekal, and Jochen Wambach, Phys. Rev. D 89, 034010 (2014).

HK 54.2 Thu 15:00 T/SR14

Directed flow in heavy-ion collisions from PHSD transport approach — Wolfgang Cassing, Volodya Konchakovski, and •Alessia Palmese — Institute for Theoretical Physics, Justus-Liebig-Universität, Gießen, Germany

We study the proton and kaon directed and elliptic flows for Au+Au collisions at AGS energies (E_{Lab}=2-8 AGeV) and low SPS energies up to $\sqrt{s_{NN}}$=7.7 GeV within the Parton-Hadron-String-Dynamics (PHSD/HSD) transport models. PHSD is a microscopic off-shell transport approach, which successfully describes heavy-ion collisions in a wide range of energies, and HSD represents the hadronic sector of PHSD. We compare our results with data from the E895 and STAR Collaborations and we investigate the sensitivity of the flow observables with respect to momentum-dependent hadronic potentials. This analysis can provide important information on these potentials, since they are known from the G-matrix theory approximately up to twice nuclear matter density and consequently extrapolations at higher baryon

densities and large momenta have to been probed. We also explore the possibility that the flow observables are influenced by chiral symmetry restoration, that is expected to occur at high density and/or temperature.

HK 54.3 Thu 15:15 T/SR14

Local thermalization in a coarse-grained transport approach — •Dmytro Oliinychenko[1,3] and Hannah Petersen[1,2] — [1]Frankfurt Institute for Advanced Studies, D-60438 Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Goethe-Universität, D-60438 Frankfurt am Main, Germany — [3]Bogolyubov Institute for Theoretical Physics, Kiev 03680, Ukraine

State of the art simulations of heavy ion collisions employ so-called hybrid models, which involve relativistic (possibly viscous) hydrodynamics coupled to a transport model. Switching between these two approaches should be done in the region, where the system is approaching thermodynamical equilibrium. In practice, when the initial state of hydrodynamics is generated from transport, pressure anisotropies can be present and non-diagonal components of energy-momentum tensor can be significant. In this talk, the energy-momentum tensor is explored in a coarse-grained transport and the hypersurface is found, where local equilibrium is reached.

HK 54.4 Thu 15:30 T/SR14

Elliptischer und Triangulärer Fluss bei ultrarelativistischen A+A- und p+A-Stößen mittels BAMPS — •Kai Gallmeister und Carsten Greiner — Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, D-60438 Frankfurt, Germany

Mithilfe des mikroskopischen Transportmodells BAMPS untersuchen wir die Ausbildung von Ekzentrizität und Triangularität in ultrarelativistischen A+A- und p+A-Stößen in verschiedenen Glauber Formulierungen. Desweiteren untersuchen wir, wie sich diese in einen elliptischen und tringulären Fluss im Laufe der Zeitpropagation übersetzen. Hierduch wird ein Zugang zu der Frage geschaffen, ob und wie weit eine hydrodynamische Beschreibung, speziell für den Fall der Proton-induzierten Stöße, gültig ist.
Gefördert durch das Land Hessen, das BMBF und durch die Exzellenz-Initiative LOEWE des Landes Hessen durch Helmholtz International Center for FAIR (HIC for FAIR).

HK 54.5 Thu 15:45 T/SR14

Elliptic Flow Measurement of Heavy-Flavour Decay Electrons in Pb-Pb Collisions at 2.76TeV with ALICE — •Theodor Rascanu for the ALICE-Collaboration — Goethe-Universität Frankfurt, Institut für Kernphysik, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

In heavy-ion collisions, charm and beauty quarks are produced in initial hard scattering processes. They then propagate and interact strongly with the created medium, the Quark Gluon Plasma (QGP), and thus allow to probe its properties.

One way to measure heavy-quarks is via electrons from the semileptonic decays of open charm and beauty hadrons. At low transverse momentum, the level of thermalization of heavy quarks can be studied via the azimuthal anisotropy of the heavy flavour electron emission in the transverse plane, the elliptic flow v_2. At high p_T, v_2 provides insight on the path length dependence of parton energy-loss.

In this talk we present v_2 measurements of electrons from heavy flavour decays with the central barrel of ALICE at mid rapidity in Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV as function of the centrality of the collision. The electrons are identified using the Inner Tracking System, the Time-Of-Flight detector and Time Projection Chamber at low momenta, as well as the Electromagnetic Calorimeter at higher momenta.

We report on the performance of the electron identification and explain how the non-heavy flavour electron background is subtracted. Finally the results are compared to different theoretical models.

HK 54.6 Thu 16:00 T/SR14

Particle flow with the HADES detector — •Christina Deveaux for the HADES-Collaboration — Justus-Liebig-Universität Gießen

The high densities and pressures of the nuclear fireball created in heavy ion collisions modify the momenta of the emitted particles. Particle azimuthal anisotropies (flow) form therefore one of the most sensitive observables to the equation of state of the matter created in such collisions. We studied the flow of protons and pions in Au+Au collisions at 1.23 GeV/u beam energy based on data which was recorded with the High Acceptance Di-Electron Spectrometer (HADES) in 2012. First and preliminary results of the study will be shown and the option to extend the study to the flow of direct photons will be discussed.
Supported by BMBF and HICforFAIR.

HK 54.7 Thu 16:15 T/SR14

Event characterization and high order flow components of Au-Au collisions at 1.23 AGeV with HADES — •Behruz Kardan, Christoph Blume, and Maja Subotic for the HADES-Collaboration — Goethe-Universiät, Frankfurt am Main

HADES provides a large acceptance combined with a high mass resolution and therefor 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 April/May 2012 also the investigation of higher order flow harmonics is possible.

Collective flow is a sensitive probe for the properties of extreme QCD matter. However, its interpretation relies on the understanding of the initial conditions e.g. the eccentricity of the fireball created in the nuclear overlap region.

Based on Glauber Monte Carlo calculations the initial conditions of nuclear collisions, with special emphasis on the correlations between participating nucleons, were examined. Observables of event-by-event flow fluctuations with respect to the reaction centrality are deduced from geometrical properties of the initial state and compared to the measured data.

Supported by Helmholtz Alliance EMMI, GSI and HIC for FAIR.

HK 55: Structure and Dynamics of Nuclei 11

Time: Thursday 14:30–16:15 Location: T/SR19

Group Report HK 55.1 Thu 14:30 T/SR19

Location of the maximum of collectivity in $N > 40$ Fe and Cr isotopes* — •V. Werner[1,2], C. Louchart-Henning[1], C. Santamaria[3], A. Obertelli[3], P. Doornenbal[4], and F. Nowacki[5] for the SEASTAR-Collaboration — [1]TU Darmstadt — [2]Yale University — [3]CEA Saclay — [4]RIKEN — [5]IPHC, CNRS/IN2P3 and Université Louis Pasteur

The liquid-hydrogen target and TPC system MINOS has been combined with the DALI2 detector device for the first time at RIKEN-RIBF within the SEASTAR project. In the first experiment campaign, excited-state energies in neutron-rich Fe and Cr isotopes, as well as ^{78}Ni have been measured. The RIKEN-RIBF cyclotrons delivered a 345 MeV/u ^{238}U beam with an intensity of about 13 pnA, impinging on a Be target. Fission fragments were separated and identified using the BigRIPS spectrograph, and reaction products were analyzed using the ZeroDegree spectrograph behind the secondary target. First results on 2_1^+ and 4_1^+ energies give an indication for the location of the maximum of collectivity in the Fe and Cr isotopic chains. The new MINOS/DALI2 setup, experiment details, and first results on the Fe and Cr isotopes will be presented.
*Supported by German BMBF Grant No. 05P12RDFN8 and U.S. DOE Grant No. DE-FG02-91ER-40609.

HK 55.2 Thu 15:00 T/SR19

Reactions of neutron-rich Sn isotopes investigated at relativistic energies at R^{3}B — •Fabia Schindler[1], Thomas Aumann[1], Konstanze Boretzky[2], Jacob Johansen[1], and Philipp Schrock[1] for the R3B-Collaboration — [1]IKP, TU Darmstadt — [2]GSI Helmholtzzentrum

Reactions of neutron-rich tin isotopes in a mass range of A=124 to A=134 have been measured at the R^{3}B setup at GSI in inverse kinematics. Due to the neutron excess, which results in a weaker binding of the valence neutrons such isotopes are expected to form a neutron skin. The investigation of this phenomenon is an important goal in

nuclear-structure physics.

Reactions of the tin isotopes with different targets have been performed kinematically complete. The taken data set therefore allows for the extraction of the neutron-skin thickness from two independent reaction channels. These are dipole excitations on the one hand and nuclear-induced reactions on the other hand. This contribution focuses on the latter mechanism. The analysis techniques which are used to extract the total charge-changing as well as the total neutron-removal cross section are presented using the example of ^{124}Sn. The total neutron-removal cross section is of particular interest because of its high sensitivity to the neutron-skin thickness.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, NAVI and the BMBF project 05P12RDFN8.

HK 55.3 Thu 15:15 T/SR19

Entwicklung der Scherenmode in Gd Isotopen* — •Jacob Beller, Tobias Beck, Udo Gayer, Laura Mertes, Haridas Pai, Norbert Pietralla, Philipp Ries, Christopher Romig, Volker Werner und Markus Zweidinger — Institut für Kernphysik TU Darmstadt, Darmstadt, Deutschland

Kürzlich wurde in ^{154}Gd eine Kopplung der $J^\pi = 1^+$ Scherenmode zu anderen intrinsischen Anregungsmoden beobachtet [1]. Zum Studium der Scherenmode und ihrer Zerfallskanäle entlang des Gestaltphasenübergangs von sphärischen zu deformierten Kernen wurden die Nachbarisotope ^{152,156}Gd untersucht. Dazu wurden Experimente mit der Methode der Kernresonanzfluoreszenz am DHIPS Setup der TU Darmstadt und am HIGS Setup der Triangle Universities Nuclear Laboratory, NC, USA, durchgeführt. Messmethoden und Ergebnisse werden vorgestellt sowie ihre Sensitivität hinsichtlich des Phasenübergangs diskutiert.

[1] J. Beller *et al.*, PRL **111**, 172501 (2013).

*Gefördert durch die DFG im Rahmen des SFB 634

HK 55.4 Thu 15:30 T/SR19

Investigation of reduced transition-strengths in neutron-rich chromium isotopes — •Thomas Braunroth[1], Alfred Dewald[1], Christoph Fransen[1], Hironori Iwasaki[2], Antoine Lemasson[3], Silvia Lenzi[4], and Julia Litzinger[1] — [1]Institut für Kernphysik, Universität zu Köln, Germany — [2]National Superconducting Cyclotron Laboratory, MSU, USA — [3]GANIL, Laboratoire Commun DSM/CEA, France — [4]Department of Physics and Astronomy, University of Padova and INFN Sezione di Padova, Italy

Neutron-rich nuclei close to $N = 40$ are known for their rapid changes in nuclear structure. While ^{68}Ni exhibits signatures of a shell closure, experimental data - e.g. excitation energies of the 2_1^+-state and B(E2;$2_1^+ \rightarrow 0_1^+$)-values - along the isotopic chains in even more exotic Fe and Cr-isotopes suggest a sudden rise in collective behaviour for $N \rightarrow 40$. Lifetimes of low-lying yrast states in ^{58,60,62}Cr were measured with the Recoil Distance Doppler-shift (RDDS) technique at NSCL, MSU (USA) to deduce model independent B(E2)-values. After fragmentation of a primary ^{82}Se beam (E=140 AMeV) on a ^{9}Be target and subsequent filtering with the A1900 fragment separator, high purity ^{59,61,63}Mn-beams ($E \sim 95$ AMeV) impinged on the ^{9}Be plunger target, where excited states in the above mentioned Cr-isotopes were then populated in one proton knockout reactions. The S800 spectrograph allowed a clear recoil identification, which then lead to clean γ-spectra as measured by the Segmented Germanium Array (SeGA). Final results of this experiment will be shown and discussed in the context of state-of-the-art shell-model calculations.

HK 55.5 Thu 15:45 T/SR19

Neutronskin studies in heavy nuclei with coherent π^0 photoproduction — •Maria Isabel Ferretti Bondy for the A2-Collaboration — Institut für Kernphysik - Johannes Gutenberg Universität Mainz

The charge distribution of nuclei is known with very high accuracy, i.e. in electron scattering experiments, conversely, the mass distribution is experimentally less accessible and therefore less precisely known. An accurate determination of the neutron density distribution is of particular interest. Especially in nuclei with N » Z, a strong neutron skin is expected, since the excess neutrons are pushed outwards against surface tension by the coulomb forces. With the precise experimental determination of the neutron skin thickness essential constraints for the nuclear equation of state (EOS) can be provided and thus allowing to draw conclusions on the size of neutron stars.

The method of coherent π^0 photoproduction, $A(\gamma, \pi^0)A$, provides a powerful tool to determine the mass distribution of various nuclei. In a novel experimental campaign carried out in 2012 within the A2 collaboration at the Mainz Microtron (MAMI), five nuclei have been measured: ^{58}Ni, $^{116,120,124}Sn$, ^{208}Pb. The tin targets are of special interest because most of the systematic errors due to pion-nucleon interaction can be neglected, and they allow a precise investigation along an isotopic chain.

First results of these studies will be presented in this talk.

HK 55.6 Thu 16:00 T/SR19

Quasi-free one nucleon knockout reactions on neutron-rich Oxygen Isotopes — •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 shown a reduction of spectroscopic strengths to 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 secondary beams containing $^{14-24}$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 05P12RDFN8.

HK 56: Hadron Structure and Spectroscopy 11

Time: Thursday 14:30–16:30 Location: T/SR25

Group Report HK 56.1 Thu 14:30 T/SR25

Baryon Spectroscopy: Recent Photoproduction Results from the CBELSA/TAPS Experiment — •Andrew Wilson for the CBELSA/TAPS-Collaboration — HISKP, University of Bonn, Nussallee 14-16, 53115 Bonn

The recent results from the CBELSA/TAPS experiment show how there is still much to learn about the baryon resonances. Using photon beams up to 3.2 GeV in energy from the ELSA accelerator in Bonn, our experiment is providing crucial information on the baryons with masses up to 2.5 GeV/c^2. Since baryon resonances are broad and therefore overlapping, in addition to unpolarized cross sections the measurement of polarization observables are essential for the identification of these states. To measure these observables, this experiment utilizes polarized photon beams, polarized targets, and an excellent reconstruction efficiency for mesons decaying to photons. Our results, which feature several double polarization observables, show how the state-of-the-art partial wave analyses can be updated and more can be learned about the pattern and decays of baryon resonances.

Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16)

HK 56.2 Thu 15:00 T/SR25

Complete Experiments for pseudoscalar meson photoproduction — •Yannick Wunderlich for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The investigation of the nucleon excitation spectrum has been an im-

portant experimental and theoretical task in the recent years. Once this highly complicated bound system of strongly interacting particles is understood, it will yield valuable insights into the workings of QCD. One of the most interesting reactions is the production of mesons by impinging photons off a nucleon target. When only one pseudoscalar meson φ is produced in the reaction $\gamma N \to \varphi N$, 16 polarization observables (not completely independent) can be accessed via the spin degrees of freedom of the incident and final states.
A so called 'Complete Experiment' allows the unambiguous extraction of the underlying amplitudes. It has been shown that at least 8 carefully selected observables have to be measured for this purpose. For a truncated partial wave expansion, considering only the partial waves that contribute significantly in the energy range of interest, fewer observables can be already sufficient. This presentation will discuss such truncated analyses with special focus on the influence of measurement uncertainties. Supported by the Deutsche Forschungsgemeinschaft (SFB/TR16).

HK 56.3 Thu 15:15 T/SR25

A new PWA method to extract dynamic amplitudes of two-particle subsystems embedded into multi-particle final states — •Fabian Krinner — Technische Universität München Physik-Department E18

Modern hadron spectroscopy experiments such as Compass have collected huge data sets of tens of millions of events. Therefore, analyses in spectroscopy are often dominated by systematic effects. A very common method to analyze these data is Partial-Wave Analysis (PWA). For more than two particles in the final state PWA usually assumes subsequent two-particle decays, i.e. the isobar model. Here, fixed mass shapes for the appearing intermediate states, the so-called isobars, have to be assumed. These shapes, which e.g. may be given by Breit-Wigner amplitudes, have to be put into the analysis beforehand and therefore may introduce a model dependence and thus increase systematic uncertainties. We present a new method, which allows to extract isobar shapes directly from the data in a more model-independent way. As a first application diffractively produced $\pi^-\pi^+\pi^-$ events are analyzed and the validity and limitations of this method are shown via various Monte-Carlo studies. Since the method allows free isobar shapes, the effects of non-resonant contributions to the amplitude may also be studied. A common non-resonant contribution is the Deck effect, for which the effective isobar shapes introduced by partial-wave projections decomposing its intensity will be presented.

HK 56.4 Thu 15:30 T/SR25

Status des Amplitudenanalyse-Frameworks ComPWA — •Mathias Michel[1,2], Florian Feldbauer[1,2], Miriam Fritsch[1,2], Klaus Goetzen[1,3], Wolfgang Gradl[2], Prometeusz Jasinski[1,2], Ralf Kliemt[1,3], Frank Nerling[1,3], Klaus Peters[1,3], Stefan Pflueger[1,2] und Peter Weidenkaff[2] — [1]Helmholtz-Institut Mainz — [2]Johannes Gutenberg-Universitaet Mainz — [3]GSI Helmholtzzentrum Darmstadt

Die Suche nach neuen konventionellen sowie exotischen hadronischen Zuständen, wie z.B. Hybriden oder Gluebällen, erfordert die Identizierung 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) anzupassen. Außerdem werden verschiedene Minimierungs- und Bewertungsstrategien zur Verfügung gestellt. Dabei wird die Software fortwährend mit Daten laufender Experimente wie z.B. BaBar oder BESIII validiert und getestet. In diesem Vortrag werden der Status der Frameworkentwicklung und dessen Werkzeuge sowie Ergebnisse von systematische Studien einer modellunabhängigen Dalitz-Plot Analysemethode vorgestellt.

HK 56.5 Thu 15:45 T/SR25

Analyse des Zerfalls $D^0 \to K^0_S K^+ K^-$ — •Peter Weidenkaff und Wolfgang Gradl für die BESIII-Kollaboration — Johannes-Gutenberg Universität, Mainz

Das BES-III Experiment am BEPCII e^+e^- Speicherring in Peking hat seit dem Start der Datennahme im Frühjahr 2009 bis zum Mai 2011 bereits ein 2.9 fb^{-1} großes Datensample an $\psi(3770)$ Zerfällen gesammelt. D-Mesonen aus $\psi(3770)$ Zerfällen werden in einem kohärenten Zustand erzeugt und legen somit wechselseitig den Teilchentyp fest. Durch die Rekonstruktion eines D Zerfalls kann der anti-D Zerfall mit geringem Untergrundbeitrag untersucht werden. BES-III bietet damit ideale Bedingungen, um Zerfälle von D-Mesonen zu studieren.

Wir analysieren den Zerfall ungeladener D Mesonen in den Endzustand der $K^0_S K^+ K^-$ indem wir die partielle Zerfallsrate messen sowie den Dalitzplot analysieren.

Dieser Vortrag gibt eine Einführung in das Experiment und stellt danach die Ereignisselektion und vorläufige Ergebnisse zur Messung der partiellen Zerfallsrate vor. Wir diskutieren das für die Dalitzplotanalyse verwendete Amplitudenmodell sowie die nötigen Korrekturen für Untergrund und Selektionseffizienz. Abschliessend werden vorläufige Resultate der Amplitudenanalyse präsentieren.

HK 56.6 Thu 16:00 T/SR25

Analysis of the reaction p + p -> p + K^+ + Λ with Partial Waves* — •R. Münzer[1], S. Lu[1], E. Epple[1], L. Fabbietti[1], J. Ritman[2], E. Roderburg[2], and F. Hauenstein[2] — [1]E12,Physik Department,Excellence Cluster Universe - Technische Universität München — [2]Forschungszentrum Jülich

The investigation of the kaon-nucleon interaction currently has been intensified in the last years by some contradicting results on the existence of the ppK^- bound state. Such results are heavily discussed since they can lead to new knowledge about the $\bar{K}$-N interaction. In the last years the reaction $pp- > pK^+\Lambda$ has been measured at the GSI with the FOPI and the HADES Spectrometer at beam energies of 3.1 GeV and 3.5 GeV, respectively. The reconstructed exclusive events were analyzed within the Bonn Gatchina PWA framework, which provides a coherent solution including several resonant and non-resonant production channels, which allowed the extraction of an upper limit for the cross-section for the production of the ppK^-. Based on these results an analysis of further experimental results obtained by the COSY-TOF collaboration will be analysed with these methods with the goal of a further improvement of the common understanding of the production mechanism, including final state interaction and the Σ-N cusp effect. In this talk the analysis method of the PWA, the extracted value for the ppK^- and the results from the ongoing combined analysis will be shown.
*supported by the DFG Project FA 898/2-1, BMBF 05P12WOGHH, Excellence Cluster Universe.

HK 56.7 Thu 16:15 T/SR25

Coupled-channel approach for $\pi N \to \pi N$, $2\pi N$ transitions — •Vitaly Shklyar, Horst Lenske und Ulrich Mosel — Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 16, D-35392 Giessen

A unitary coupled-channel Giessen model (GiM) is developed for study pion-induced reactions in the nucleon resonance energy region. The two-pion production is treated in the isobar approximation with the σN, $\pi\Delta$ etc. in the intermediate channel. As a first application of the developed approach we perform the partial wave analysis of the $\pi^- p \to \pi^0\pi^0 p$ experimental data in the first resonance energy region. The πN elastic scattering amplitudes are constrained by the single energy solutions from GWU (SAID) group. We obtain $R_{\sigma N}(1440) = 27^{+4}_{-9}\,\%$ and $R_{\sigma N}(1440) = 12^{+5}_{-3}\,\%$ for the σN and $\pi\Delta(1232)$ decay branching ratios of $N^*(1440)$ respectively. The extracted πN inelasticities and reaction amplitudes are consistent with the results from other groups. The work is supported by Transregio SFB/TR16, project B.7.

HK 57: Astroparticle Physics 3

Time: Thursday 17:00–18:45 Location: K/HS1

Group Report HK 57.1 Thu 17:00 K/HS1

Nuclear currents for WIMP-nucleus scattering based on chiral effective field theory⋆ — •Philipp Klos[1,2], Javier Menéndez[1,2,3], and Achim Schwenk[1,2] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]The University of Tokyo

Interactions of nuclei with external probes are crucial for understanding various new physics processes. The nuclear currents involved can be described in the framework of chiral effective field theory, which provides a consistent treatment of both nuclear forces and currents based on the same chiral Lagrangian. We include the currents at the one-body level and the leading two-body currents, which we have derived for axial-vector currents at finite momentum transfers for the first time. As an application we will present results for spin-independent and spin-dependent structure factors for WIMP-nucleus scattering necessary for the evaluation of dark matter experiments.

⋆This work was supported in part by the DFG through grant SFB 634, the ERC Grant No. 307986 STRONGINT, the Helmholtz Alliance HA216/EMMI, and a BMBF ARCHES Award.

Group Report HK 57.2 Thu 17:30 K/HS1

Status and first data of the EDELWEISS-III experiment — •Silvia Scorza for the EDELWEISS-Collaboration — Karlsruher Institut für Technologie, Institut für Experimentelle Kernphysik, Postfach 3640, Karlsruhe

The EDELWEISS-III collaboration is operating an experiment for the direct detection of Weakly Interacting Massive Particle (WIMPs) dark matter in the low radioactivity environment of the Modane Underground Laboratory. It consists of 36 advanced FID germanium detectors operating at 18 mK in a dilution refrigerator in order to identify eventual rare nuclear recoils induced by elastic scattering of WIMPs from our Galactic halo. I will discuss the current EDELWEISS-III program, including improvements of the background, data-acquisition and the current installation. FID detector performances and a first analysis of data acquired in a long-term campaign will be presented. The FID detector technology is not limited to EDELWEISS-III but can be further employed in the next generation of cryogenic detector experiments.

HK 57.3 Thu 18:00 K/HS1

Displaying results of direct detection dark matter experiments free of astrophysical uncertainties — •Ludwig Rauch and XENON100 Collaboration — Max Planck Institut für Kernphysik, Heidelberg

A number of experiments try to measure WIMP interactions by using different detector technologies and target elements. Hence, energy thresholds and sensitivities to light or heavy WIMP masses differ. However, due to large systematic uncertainties in the parameters defining the dark matter halo, a comparison of detectors is demanding. By mapping experimental results from the traditional cross section vs. dark matter mass parameter-space into a dark matter halo independent phase space, direct comparisons between experiments can be made. This is possible due to the monotonicity of the velocity integral which enables to combine all astrophysical assumptions into one parameter common to all experiments. In this talk the motivation as well as the mapping method will be explained based on the XENON100 data.

HK 57.4 Thu 18:15 K/HS1

Photomultiplier tests for XENON1T — •Dominick Cichon on behalf of the XENON collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

The upcoming dark matter direct-detection experiment XENON1T will employ photosensors with high detection efficiencies and low intrinsic radioactivity. This is necessary for the experiment to reach its projected sensitivity to interaction cross sections down to $\sigma \sim 2 \cdot 10^{-47} \mathrm{cm}^2$ fo the case of a dark matter particle with mass $\sim 50 \mathrm{GeV/c}^2$ interacting with a nucleon.

This talk illustrates how photomultiplier tubes (PMTs) for XENON1T are tested in order to decide whether they fulfill the experiment's requirements. The general testing procedure will be outlined, with a focus being placed on PMT testing facilities at the MPIK in Heidelberg used for this task, where PMT properties at room temperature and at liquid xenon temperature are measured.

HK 57.5 Thu 18:30 K/HS1

Removal of noble gases out of xenon by a cryogenic distillation column for the XENON1T experiment — •Alexander Fieguth, Michael Murra, Stephan Rosendahl, Gianmarco Bruno, Sergej Schneider, Christian Weinheimer, and Christian Huhmann — Institut für Kernphysik, WWU Münster

The upcoming XENON1T experiment is the next step for the dark matter particle search. It will surpass current limits on the WIMP-nucleon cross section set by liquid xenon detectors as LUX and XENON100 by more than an order of magnitude, which leads to an expected sensitivity of $2.0 * 10^{-47}$ cm^2 for WIMPs with a mass of 50 GeV/c^2 after a 2.2 ton-year live-time. For achieving new sensitivity limits the reduction of internal background sources as ^{85}Kr and ^{222}Rn is of crucial importance. Taking advantage of the different boiling points of these noble gas impurities and xenon, they can be separated by a cryogenic distillation column in different steps. The improvement of the krypton removal by distillation for the XENON1T experiment and a first test setup on radon distillation at the XENON100 experiment will be presented. Different aspects of this project have been funded by DFG-Großgeräte, BMBF and Helmholtz-Alliance for Astroparticle Physics (HAP).

HK 58: Nuclear Astrophysics 4

Time: Thursday 17:00–18:45 Location: K/HS2

HK 58.1 Thu 17:00 K/HS2

Alpha-Induced Production Cross Sections of ^{77,79}Kr and ^{77}Br — •Zuzana Slavkovská[1], Stefan Fiebiger[1], Ulrich Giesen[2], Tanja Heftrich[1], René Reifarth[1], Stefan Schmidt[1], Benedikt Thomas[1], and Mario Weigand[1] — [1]Goethe-Universität Frankfurt — [2]Physikalisch-Technische Bundesanstalt, Braunschweig

Measurements of reaction cross sections help to constrain models predicting stellar reaction rates and can therefore improve our understanding of the stellar nucleosynthesis. The production cross sections of ^{77,79}Kr and ^{77}Br following the α-irradiation of natural selenium were determined between the α-energies of 11 MeV and 15 MeV using the activation technique.

The irradiation of $^{\mathrm{nat}}$Se targets with doubly-charged He^{2+} ions extracted from a cyclotron was conducted at Physikalisch-Technische Bundesanstalt in Braunschweig. The spectroscopic analysis of the reaction products was performed using a HPGe detector. As the α-beam was stopped inside the targets, the thick target yields were determined. The corresponding energy-dependent cross sections were calculated from the difference of the thick target yields at various beam energies. The determined values were compared to theoretical predictions based on the TALYS code.

This project was funded by the Europian Research Council under the European Union's Seventh Framework Programme (FP/2007-2013)/ERC Grant Agreement n. 615126.

HK 58.2 Thu 17:15 K/HS2

Gogny-HFB calculation for r-process nucleosynthesis: towards a fully-converged microscopic mass table. — •Alexander Arzhanov[1,2], Tomás R. Rodríguez[1,3], and Gabriel Martínez-Pinedo[1,2] — [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. In recent years there has been a lot of progress in developing microscopic mass models based on energy density functional techniques. We have performed a large-scale calculation of nuclear masses based on Hartree-Fock-Bogolyubov (HFB) approach with Gogny-type functionals. We analyze in detail the convergence properties of the computed masses, which are related to the finite size of the working basis used in the self-consistent HFB calculations. We find a lack of convergence in the previously published results, and perform a systematic study of recently proposed extrapolation techniques to an infinite working basis size. We also discuss its applicability to global calculations of nuclear masses.

HK 58.3 Thu 17:30 K/HS2

Neutrino oscillations and nucleosynthesis of elements — •Meng-Ru Wu[1], Gabriel Martínez-Pinedo[1,2], Yong-Zhong Qian[3], and Maximilian Enders[1] — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerioneneforschung, Darmstadt, Germany — [3]School of Physics and Astronomy, University of Minnesota, Minneapolis, U.S.A.

Neutrinos play an essential role in determining the outcome of formation of nuclei in core-collapse supernovae or in the neutrino-driven winds of neutron star mergers. It has been shown in recent years that neutrino oscillations among active flavors or between the active and a possible sterile state may happen in these astrophysical environments to influence the result of nucleosynthesis. We have examined in detail the effect of neutrino oscillations on different nucleosynthesis processes in these astrophysical environments and the results will be discussed.

This work was partly supported by the Helmholtz Association (HGF) through the Nuclear Astrophysics Virtual Institute (VH-VI-417).

HK 58.4 Thu 17:45 K/HS2

Impact of (α, n) reactions 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 für Schwerionenforschung GmbH — [3]National Superconducting Cyclotron Laboratory, Michigan State University, USA — [4]Joint Institute for Nuclear Astrophysics, http://www.jinaweb.org

Neutrino-driven winds that follow core-collapse supernova explosions are an exciting astrophysical site for the synthesis of heavy elements. Although recent hydrodynamical simulations show that the conditions in the wind are not extreme enough for a r-process up to uranium, neutrino-driven winds may be the astrophysical site where lighter heavy elements between Sr and Ag are produced. However, it is still not clear if the conditions in the wind are slightly neutron-rich, proton-rich or turn proton-rich for some time. In neutron-rich winds, (α, n) reactions are key to move matter beyond the Fe-group towards heavier elements. Due to the deficit of experimental information, the relevant reaction rates have mostly been calculated with codes based on Hauser-Feshbach models. Although these codes have been cross-checked with experimental data in regions close to stability, their accuracy is questionable as one moves towards more exotic regions. We present the impact of (α, n) reactions on the nucleosynthesis of elements between Sr and Ag in neutrino-driven winds.

HK 58.5 Thu 18:00 K/HS2

Nucleosynthesis in Neutrino-driven Winds after Neutron Star Mergers* — •Dirk Martin[1], Albino Perego[1], and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Neutron star mergers (NSMs) are a unique site in astrophysics. They are the most promising scenario for the origin of heavy elements via the rapid neutron capture process (r-process). Moreover, coalescing neutron stars represent also a major source of gravitational waves and are the best candidates to explain short gamma-ray bursts.

NSMs comprise three kinds of neutron-rich ejecta: dynamic ejecta due to tidal torques, neutrino-driven winds and evaporating matter from the accretion disc by viscous heating as well as recombination.

We carried out nucleosynthesis calculations based on a recent simulation of the neutrino-driven wind from a NSM [1]. We find that elements up to the second r-process peak ($A \lesssim 130$) are created in the disk ejecta [2]. These yields complement the robust formation of heavy elements including the third r-process peak ($A \sim 195$) in the dynamic ejecta. Our results also reveal dependencies on the observation angle and the black hole formation time.

[1] A. Perego et al., 2014, MNRAS, 443, 3134.
[2] D. Martin et al., in preparation.

* Supported by Helmholtz-University Young Investigator grant No. VH-NG-825.

HK 58.6 Thu 18:15 K/HS2

Cross-section measurement of the ^{130}Ba(p,γ)^{131}La reaction for γ process nucleosynthesis — •Jan Mayer, Lars Netterdon, Philipp Scholz, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The γ process is an important nucleosynthesis mechanism to explain the abundances of the majority of p nuclei, which are bypassed by neutron capture processes. To improve the accuracy of reaction rates predicted by theoretical models, precise experimental data is required.

Total reaction cross-section values of the ^{130}Ba(p,γ)^{131}La reaction were measured by means of the activation method [1]. Proton beams with energies between 3.6 MeV and 5 MeV were provided by the 10 MV FN-Tandem accelerator at the University of Cologne. After the irradiation, the reaction yield was determined by use of γ-ray spectroscopy using two clover-type high-purity germanium detectors.

The measured cross-section values are compared to Hauser-Feshbach calculations using the Statistical Model codes TALYS and SMARAGD with different proton+nucleus optical model potentials. In addition, an experimentally supported recommendation for the stellar proton-capture reactivity is given. Supported by the DFG (INST 216/544-1).

[1] L. Netterdon *et al.*, Phys. Rev. C **90** (2014) 035806

HK 58.7 Thu 18:30 K/HS2

Neutrino Nucleosynthesis in Core-Collapse Supernoava explosions — •Andre Sieverding[1], Lutz Huther[1], Gabriel Martínez-Pinedo[1], and Karlheinz Langanke[2] — [1]Insitut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstatdt, 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.

^{7}Li, ^{11}B and ^{19}F are produced by neutrino processes. Furthermore, we have explored the impact of ν-nucleosynthesis on the production of long-lived radioactive nuclei. Our calculations are based on modern simulations of neutrino spectra that turn out to predict substantially lower average neutrino energies than used in previous ν-nucleosynthesis studies. We explore the sensitivity to the neutrino spectra for a large set of solar metallicity progenitor models. 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 International Center for FAIR in the context of the LOEWE initiative and by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute.

HK 59: Instrumentation 17

Time: Thursday 17:00–19:00 Location: M/HS1

Group Report HK 59.1 Thu 17:00 M/HS1

Results of the first Tests Measurements using the Prototype Trigger-Less Data Acquisition for the $\overline{\text{P}}$ANDA Experiment — •Milan Wagner, Thomas Gessler, Wolfgang Kühn, Sören Lange, Björn Spruck, and Marcel Werner for the PANDA-Collaboration — JLU Gießen

The $\overline{\text{P}}$ANDA detector will be a located at the high energy storage ring (HESR), at the facility for anti protons and ion research (FAIR) in Darmstadt, Germany. It will operate with a very high average interaction rate of about 20 MHz, in a free streaming mode without hard-

ware trigger. Instead of triggering, 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 background reduction by a factor of >1000. Parts of the $\overline{\text{P}}$ANDA detector will be pre-assembled and tested at the Forschungszentrum Jülich, before being transported to GSI at a later stage. A prototype trigger-less data acquisition (PTDAQ) will be used during this phase. The main component of the PTDAQ is the Compute Nodes (CN), a xTCA-compliant board based on a Virtex-5 FX70T FPGA, with a μTCA-formfactor. Synchronization is done via a Synchronization Of Data Acquisition (SODA) source. Parts of the functionality were tested in a setup using a 210 MeV electrons beam with a rate of 1 MHz at the Mainz Microtron. In this contribution, we present the first results of test measurements using the PTDAQ system. This work is supported by BMBF(05P12RGFPF), HGS-HIRe for FAIR and the LOEWE-Zentrum HICforFAIR.

HK 59.2 Thu 17:30 M/HS1

The Next Generation CBM MVD Front-end Electronics — •Michael Wiebusch, Jan Michel, Philipp Klaus, and Joachim Stroth for the CBM-MVD-Collaboration — Goethe-Universität, Frankfurt

The Micro Vertex Detector (MVD) for the CBM experiment is a highly granular precision tracking device. Due to the ambitious requirements regarding spatial resolution, radiation hardness, read-out speed and material budget, monolithic active pixel sensors (MAPS) are the most suited detector technology for this purpose. A full read-out chain for these sensors was designed and prototyped, comprising a multi-purpose FPGA platform and specialized front-end electronics. During the last year an updated version of the front-end electronics was produced and successfully commissioned. The current front-end electronics incorporate additional configuration and monitoring capabilities which shall be used to optimize the concept of biasing and routing critical analog signals to the sensor. Tests regarding these issues are ongoing. Recent efforts aim at building a quarter of an MVD station with more than a dozen individual MAPS sensors. This requires the adaption of the front-end electronics to the spacial constraints of the set-up. Also the schematics have to be streamlined based on the insights from the abovementioned tests. This contribution will present the outcomes of the adaption and optimization procedures. *This work has been supported by BMBF (05P12RFFC7), GSI and HIC for FAIR.

HK 59.3 Thu 17:45 M/HS1

A flexible COME and KISS QDC and TDC Read-out Scheme for PMT, MAPD and Diamond Detector Applications — •Adrian Rost for the HADES-Collaboration — Technische Universität Darmstadt, Darmstadt

A flexible COME & KISS Charge-to-Digital-Converter (QDC) and Time-to-Digital-Converter (TDC) read-out scheme will be presented which can be used in a wide range of read-out applications in high energy physics experiments. The focus is on a calorimeter detector read-out via photomultiplier tubes (PMTs) or via multi-pixel avalanche photo-diodes (MAPDs), as well as on diamond detectors for the HADES and CBM experiments at 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 an commercial (COME: Use **Com**mercial **E**lements) FPGA as a discriminator. The well-established TRBv3 platform will provide a precise 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. In this contribution the current status of the read-out concept will be shown.

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

HK 59.4 Thu 18:00 M/HS1

Overview of DAQ developments for the CBM experiment — •David Emschermann for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at the future Facility for Antiproton and Ion Research (FAIR) is a a fixed-target setup operating at very high interaction rates up to 10 MHz. The high rate capability can be achieved with fast and radiation hard detectors equipped with free-streaming readout electronics. A high-speed data acquisition (DAQ) system will forward data volumes of up to 1 TB/s from the CBM cave to the first level event selector (FLES), located 400 m apart. This presentation will showcase recent developments of DAQ components for CBM. We will highlight the anticipated DAQ setup for beam tests scheduled for the end of 2015.

HK 59.5 Thu 18:15 M/HS1

A viable on-chip FPGA configuration memory scrubbing approach for CBM-ToF — •Andrei-Dumitru Oancea, Christian Stüllein, Sebastian Manz, Jano Gebelein, and Udo Kebschull for the CBM-Collaboration — Infrastruktur und Rechnersysteme in der Informationsverarbeitung (IRI), Goethe-Universität, Senckenberganlage 31, 60325 Frankfurt am Main

The ToF Detector of the CBM Experiment will be equipped with FPGA-based read-out boards (ROBs). These ROBs will be operated in a radiation environment, and therefore need a mitigation mechanism against soft errors in the SRAM-based configuration memories of the FPGAs.

The proposed approach combines intrinsic on-chip single upset correction with extrinsic selective frame scrubbing for multiple-bit upsets. The slow control is realized using the GBT-SCA, which is capable of handling interrupts. This enables the new approach of event-driven configuration frame correction. While conventional blind scrubbing leads to a continuous load on the control path, the selective frame scrubbing reduces this load to a minimum.

For verification purposes, radiation tests with a proton beam were performed at COSY, Juelich. The occurred soft errors were classified into single and multiple- bit upsets, enabling an estimation of the rate at which extrinsic intervention is necessary.

HK 59.6 Thu 18:30 M/HS1

Design and prototyping of a readout aggregation ASIC — Frank Lemke[1], •Sven Schatral[1], Indranil Som[2], Tarun Bhattacharyya[2], and Ulrich Bruening[1] for the CBM-Collaboration — [1]ZITI, Universitaet Heidelberg — [2]Indian Institute of Technology Kharagpur

In close collaboration between the Indian Institute of Technology Kharagpur (IITKGP) and the Institute for Computer Engineering (ZITI) at the University of Heidelberg a readout aggregation ASIC was designed. This happened in the context of the Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR). The ASIC is designed in 65nm TSMC technology. Its miniASIC tapeout to verify the analog and high-speed components is scheduled to the first quarter of 2015. This mixed-signal ASIC consists of a full-custom 5Gb/s serializer/deserializer, designed by the IITKGP including design elements such as phase-locked loop, bandgap reference, and clock data recovery, and a digital designed network communication and aggregation part designed by the ZITI. In addition, there are test structures and an I2C readout integrated to ease bring up and monitoring. A specialty of this test ASIC is the aggregation of links featuring different data rates, running with bundles of 500 MB/s LVDS. This enables flexible readout setups of mixed detectors respectively readout of various chips. As communication protocol, a unified link protocol is used including control messages, data messages, and synchronization messages on an identical lane. The design has been simulated, verified, and hardware emulated using Spartan 6 FPGAs.

HK 59.7 Thu 18:45 M/HS1

LAND/R3B DAQ developments — •Hans Törnqvist[1], Thomas Aumann[1], Haik Simon[2], Håkan Johansson[3], and Bastian Löher[1] for the R3B-Collaboration — [1]Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Chalmers Institute of Technology, Göteborg, Sweden

Existing experimental setups aim to exploit most of the improved capabilities and specifications of the upcoming FAIR facility at GSI. Their DAQ designs will require some re-evaluation and upgrades. This presentation summarizes the R3B experimental campaigns in 2014, where the R3B DAQ was subject to testing of several new features that will aid researchers in using larger and more complicated experimental setups in the future. It also acted as part of a small testing ground for the NUSTAR DAQ infrastructure. In order to allow to extract correlations between several experimental sites, new suggested triggering and timestamping implementations were tested over significant distances. Also, with growing experimental complexity comes a greater risk of problems that may be difficult to characterize and solve. To

this end, essential remote monitoring and debugging tools have been used successfully.

HK 60: Instrumentation 18

Time: Thursday 17:00–18:45 Location: M/HS2

Group Report HK 60.1 Thu 17:00 M/HS2

The in-beam tracking detectors for R3B — •Stefanos Paschalis[1], Michael Heil[2], Jacob Johansen[1], Thomas Aumann[1,2], Heiko Scheit[1], and Anatoly Krivshich[3] for the R3B-Collaboration — [1]Institut für Kernphysik, Technische Universität, D 64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany — [3]PNPI St. Petersburg, 188300 Gatchina, Russia

The R3B experiment is part of the NUSTAR pillar at FAIR. One of the great strengths of the R3B experiment is the kinematically complete measurement of reactions with exotic ions with energies of up to 1 AGeV. Key components of the R3B experiment are the neutron detector NeuLAND, the γ and charge-particle calorimeter CALIFA, the Si Tracker and the in-beam tracking detectors. A cornerstone instrument of the setup is the new dipole magnet (GLAD) which bends and momentum analyses the high-rigidity beams. A precise tracking of the charged particles through the magnetic field is crucial to resolve the masses of heavy ions and measure the momentum of the fragments with high resolution. In this contribution we present the technical design details of the in-beam tracking detectors that will be used in the R3B experiment together with recent results obtained from in-beam prototype testing. In particular, we discuss Si detectors, detectors based on plastic-scintillator fibers and paddles, straw-tube gas detectors and the overall performance of the system. This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, and the BMBF project 05P12RDFN8.

Group Report HK 60.2 Thu 17:30 M/HS2

Status of the FRS Ion Catcher and future prospectives at FAIR — •Moritz Pascal Reiter for the FRS Ion Catcher-Collaboration — Justus-Liebig-University Giessen

At the LEB of the Super-FRS at FAIR, projectile and fission fragments will be produced at relativistic energies, separated in-flight, range-bunched, slowed-down and than thermalized in a cryogenic stopping cell (CSC) filled with ultra pure helium gas to kinetic energies of a few eV. After thermalization the ions are delivered to the high precision experiments MATS and LaSpec. A prototype CSC for the LEB has been successfully commissioned at the FRS Ion Catcher, consisting of the FRS, CSC and a multiple-reflection time-of-flight mass-spectrometer (MR-ToF-MS). During these experiments high total efficiencies (15 %), average extraction times of 24 ms, mass resolving powers beyond 400.000 have been measured for several projectile and fission fragments.

To make full use of the beams delivered by the Super-FRS the areal density of the CSC has to be increased even further. The future CSC follows a new approach and will have an order of magnitude higher areal density, while at the same time allowing extraction times down to 5 ms. The future design will be presented and discussed in detail.

HK 60.3 Thu 18:00 M/HS2

Investigations of space charge effects in the cryogenic gas filled stopping cell for the FRS Ion Catcher — •Fabian Heisse[1,3], Timo Dickel[2,3], Wolfgang Plass[2,3], Moritz Pascal Reiter[2], Ann-Kathrin Rink[2], Hans Geissel[2,3], Christoph Scheidenberger[2,3], and Kai Zuber[1] for the FRS Ion Catcher-Collaboration — [1]IKTP TU Dresden — [2]II. Physikalisches Institut JLU Giessen — [3]GSI Helmholtzzentrum für Schwerionenforschung

At the FRS Ion Catcher experiment precision mass measurements of short lived projectile and fission fragments are performed. Therefore highly charged ions with relativistic energies need to be thermalized to kinetic energies of several eV. This process takes place in the cryogenic gas filled stopping cell (CSC). All stopping cells suffer at large ion rates under space charge effects, which lead to decreasing efficiencies and can also influence the extraction time.

Thus the understanding of space charge effects is of greatest importance to make full use of the higher yields at future rare ion beam facilities like FAIR. For this purpose simulation with the software SIMION® concerning space charge effects were done.

In this presentation the calculated transport efficiency of the CSC for different intensities, electric fields and spill structures are discussed and compared with measured results. Furthermore an outlook and first results of the simulation for the new CSC for the Low-Energy Branch at FAIR will be given.

HK 60.4 Thu 18:15 M/HS2

Development of a large area TEGIC-Detector for Heavy Ions — Steffen Maurus[1], Roman Gernhäuser[1], •Max Winkel[1], Ludwig Maier[1], Chiara Nociforo[2], and Stephane Pietri[2] — [1]Technische Universität München, E12 — [2]GSI Darmstadt

New accelerator facilities like the Facility for Antiproton and Ion Research (FAIR) at the GSI with higher beam intensities for secondary and primary beam experiments taking established detector system to their limit of operation. In order to separate fragments of interest a new Super FRagment Separator (Super-FRS) is under development. Regarding the identification of the proton number of the fragment beam cocktail produced by fragmentation or fission of heavy beams at the Super-FRS target a new promising concept is the tilted electrode gas ionisation chamber (TEGIC) consisting of a series of plane electrodes tilted with respect to the beam axis. The detector was also equipped with additional position sensitive sections.
A design concept of a TEGIC with a position sensitive extension was developed and realized with the construction of a full scale detector. In addition a test experiment was performed at the fragment separator of GSI with a secondary beam from uranium fragmentation at 700 MeV/u using a fully digital readout system for pile up handling.
We will report on a systematic study of the energy loss measurement and its particle rate dependency for ions in the range of Z $\sim$ 50.
This work is supported by MLL München and GSI Darmstadt.

HK 60.5 Thu 18:30 M/HS2

Investigation of the Pulse Shape Analysis for the position sensitive γ-ray spectrometer AGATA — •Lars Lewandowski, Benedikt Birkenbach, and Peter Reiter for the AGATA-Collaboration — Institut für Kernphysik Köln

The next generation of γ-ray spectrometers like AGATA will provide high quality γ-ray spectra by the new Gamma-Ray Tracking technique (GRT) [1]. Position sensitive HPGe detectors will allow for precise Doppler correction and small broadening of lines for spectroscopy at relativistic energies. GRT is based on the interaction position of the γ-rays within the volume of the highly segmented germanium detectors provided by Pulse Shape Analysis (PSA) methods. The proof of principle of GRT was already demonstrated with great success however systematic deviations from expected results occur. The parameterization of the following detector properties and their impact on PSA were thoroughly investigated and optimized: electron and hole mobility, crystal axis orientation, space charge distributions, crystal impurities, response functions of preamplifiers and digitizers, linear and differential crosstalk, time alignment of pulses and the distance metric. Results of an improved PSA performance will be presented.

[1] S. Akkoyun *et al.*, Nucl. Instr. Meth. A668 (2012) 26.

HK 61: Astroparticle Physics 4

Time: Thursday 17:00–19:00 Location: M/HS4

Group Report HK 61.1 Thu 17:00 M/HS4

Search for the neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge: GERDA Phase II commissioning — •Tobias Bode for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Deutschland

After successful completion of Phase I the Gerda (Germanium Detector Array) experiment underwent a major upgrade of the experimental apparatus. These upgrades include additional 20 kg of custom-made detectors with improved background rejection capabilities, accompanied by improved front-end electronics and an active liquid argon scintillation light veto. A sensitivity on the neutrinoless double beta decay half-life ($T^{0\nu}_{1/2}$) of 10^{26} yr should be reached after a few years of data taking (Phase II). First results of Phase II commissioning and latest results from Phase I analyses will be presented in this talk. This work was partly funded by BMBF 05A14W03.

Group Report HK 61.2 Thu 17:30 M/HS4

Das Double Chooz Experiment – Messung des Neutrinomischungswinkels θ_{13} — •Julia Haser für die Double Chooz-Kollaboration — Max-Planck-Institut für Kernphysik, Heidelberg

Ziel des Double Chooz Reaktorneutrinoexperiments ist eine Präzisionsmessung des Neutrinomischungswinkels θ_{13}. Am Kernkraftwek in Chooz, Frankreich, beobachtet man das energieabhängige Defizit im Neutrinospektrum. Hierfür stand bisher ein Detektor in einer Entfernung von etwa 1 km gefüllt mit Gadolinium beladenem Flüssigszintillator zur Verfügung. Für die Analyse des Koinzidenzsignals nach dem inversen Beta-Zerfall werden mehrere komplementäre Ansätze verwendet: Neben einer Analyse, die sich rein auf die Informationen der gemessenen Neutrinorate beschränkt, fließt in einer genaueren Bestimmung des Mischungswinkels auch das Energiespektrum mit ein. Darüberhinaus kann θ_{13} durch einen Kanal bestimmt werden, der unabhängig vom Untergrundmodel ist. Schliesslich konnten aufgrund der niedrigen Untergrundrate auch die statistisch unabhängigen Neutrinosignale ausgewertet werden, bei denen die Neutronen an Wasserstoff anstatt an Gadolinium eingefangen wurden. Im Vortrag werden die aktuellsten Ergebnisse mit einer verbesserten Selektion des Neutrinosignals und präziserem Verständnis des Untergrunds vorgestellt. Das Signal zu Untergrund Verhältnis konnte gegenüber früheren Analysen merklich erhöht werden. Im Bereich der Energieskala und bei der Nachweiseffizienz gab es große Fortschritte. Mit der Fertigstellung des zweiten nahen Detektors 2014 wird die bisher dominante Unsicherheit durch die Vorhersage des Reaktorneutrinoflusses stark reduziert werden.

HK 61.3 Thu 18:00 M/HS4

Setup and commissioning of the precision high voltage system of the KATRIN experiment — •Oliver Rest — 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. To achieve 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 precision of 3 ppm.
For this purpose the potential will be measured directly via two high precision voltage dividers, which were developed in cooperation with the Physikalisch-Technische Bundesanstalt Braunschweig. In addition the high voltage will be compared to a natural standard given by mono-energetic conversion electrons from the decay of ^{83m}Kr at the MAC-E type monitor spectrometer.
To fine-tune the shape of the electric field individual voltages can be applied to different parts of the wire electrode system inside the main spectrometer.
This talk will give a short overview of the setup of the HV system and show first results of the measurements performed during the main spectrometer commissioning phase.

This project is supported by BMBF under contract number 05A11PM2.

HK 61.4 Thu 18:15 M/HS4

Identifikation von ^{210}Pb als Untergrundquelle für das KATRIN-Experiment — •Fabian Harms für die KATRIN-Kollaboration — Karlsruher Institut für Technologie

Das Ziel des **Ka**rlruher **Tri**tium **N**eutrino Experiments ist die modellunabhängige Bestimmung der effektiven Masse des Elektron-Antineutrinos mit einer bis dato unerreichten Sensitivität von 200 meV/c^2 (90% C.L.). Dies geschieht durch eine kinematische Untersuchung der Elektronen aus dem Tritium β-Zerfall mittels einem auf dem MAC-E Filterprinzip basierenden Spektrometer. Auf Grund einer zu erwartenden Signalrate von wenigen mHz im für KATRIN relevanten Endpunktsbereichs des β-Spektrums, ist ein Untergrund im mHz-Bereich von entscheidender Bedeutung für den Erfolg des Experiments.
Im Zuge einer zweiten Messkampagne zur Inbetriebnahme des KATRIN Hauptspektrometers im Spätjahr 2014, konnte eine bis dato unbekannte Untergrundquelle innerhalb des Spektrometers identifiziert werden. Hierbei handelt es sich um Elektronen aus dem Zerfall von, in den Wänden des Spektrometers implantierten, geringen Mengen an ^{210}Pb. In diesem Vortrag wird, neben theoretischen Betrachtungen zum Ursprung des Bleis, auf die Erkenntnisse zur Größe dieses Untergrundbeitrags sowie den sich daraus ergebenden Konsequenzen für das KATRIN-Experiment eingegangen.

HK 61.5 Thu 18:30 M/HS4

Alignment Messungen des KATRIN Hauptspektrometer- und Detektorsystems — •Herbert Ullrich für die KATRIN-Kollaboration — Insitut für Experimentelle Kernphysik, Karlsruher Institut für Technologie (KIT)

Das Karlsruhe Tritium Neutrino Experiment (KATRIN) misst das Energiespektrum von Elektronen aus dem Beta-Zerfall von Tritium im Bereich des Endpunktes um die Masse des Elektron-Antineutrinos mit einer Sensitivität von 200 meV zu bestimmen. Das KATRIN Hauptspektrometer ist als MAC-E-Filter aufgebaut (Magnetic Adiabatic Collimation followed by Electrostatic Filter). Um die Signal-Elektronen von der Quelle zur Detektion auf den Fokalebenendetektor zu führen, spielt somit die präzise Anordnung der gesamten durch ein Magnetfeld geführten Elektronenbahn von der Tritiumquelle bis zur Detektion eine entscheidende Rolle. Um unter anderem die korrekte Anordnung der Magnete im Spektrometer- und Detektorbereich zu verifizieren, wurden im Rahmen der zweiten Kommissionierungsmessungen Experimente mit einer Elektronenkanone durchgeführt um die höchstpräzise Ausrichtung der Komponenten zu bestätigen. Im Rahmen dieses Vortrages werden, nach einer Einführung in das KATRIN-Experiment, Simulationen zu den beschriebenen Messungen und die dazugehörigen Ergebnisse vorgestellt. Diese Arbeit wurde gefördert durch das BMBF mit der Fördernummer 05A11VK3 und die Helmholtz-Gemeinschaft.

HK 61.6 Thu 18:45 M/HS4

Efficient Field Calculations for the KATRIN experiment by Fast Fourier Transformation on Multipoles — •Wolfgang Gosda for the KATRIN-Collaboration — Institut für Experimentelle Kernphysik, KIT, Karlsruhe

The aim of the KArlsruhe TRItium Neutrino experiment (KATRIN) is to measure the electron anti neutrino mass with a sensitivity of 200 meV by measuring the energy spectrum of electrons from the tritium beta decay at the end point. Designed for high energy resolution, the main spectrometer has been built as a huge and complex vacuum vessel, 23 m long and 10 m in diameter. It features more than 46.000 wires along the inner walls to provide electric shielding against cosmic ray events. For studying transmission and electro-magnetic properties of the KATRIN main spectrometer, detailed field computations have to be performed. For fast and realistic three-dimensional computations, special methods like the Fast Fourier Transformation on Multipoles (FFTM) are indispensable. Together with the open source software Kassiopeia developed by the KATRIN Collaboration, FFTM can be used for both the calculation of the surface charge densities via boundary element methods and the fast evaluation of the ensuing fields. This talk introduces fast multiplication methods, explains the basic concepts of FFTM and presents the results of performance tests on the Kassiopeia implementation. This work was supported by the BMBF under grant no. 05A11VK3 and by the Helmholtz Association.

HK 62: Nuclear Astrophysics 5

Time: Thursday 17:00–19:00 Location: P/H1

Group Report HK 62.1 Thu 17:00 P/H1

The COBRA experiment - Status report — •Thomas Quante for the COBRA-Collaboration — Technische Universität Dortmund, Otto-Hahn-straße 4, 44221 Dortmund

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

For this purpose a detector array made up of 64 Cadmium-Zinc-Telluride (CdZnTe) semiconductor detectors in coplanar grid configuration was designed and realised at the Gran Sasso Underground laboratory (LNGS) in Italy. It is used to gather information about the long term stability in low background operation and the identification of potential background components.

Simulations of the whole demonstrator setup are ongoing to reproduce the measured spectra for each detector. As the "detector=source" principle, the 0nbb signal can happen all over the detector. Therefore, events that occur on the detector surface are most likely background events. The pulse shape analysis gives the opportunity to reject these events, which lowers the the overall background in the region of interest by more than one order of magnitude. In this talk an overview of the detector technology and analysis techniques is given. In addition the recent progress and future plans will be discussed.

HK 62.2 Thu 17:30 P/H1

Long-time hydrodynamical simulations of core-collapse supernovae — •Carlos Mattes[1] and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH

Core-collapse supernovae are one of the major contributors to the chemical enrichment in the universe: they eject elements that were synthesized during the life of stars (e.g., oxygen and carbon) and they produce new and heavier elements (e.g., 1/3 of the iron in our galaxy). We will present the first long-time hydrodynamic simulations with FLASH code [1] that follow the supernova explosion from the collapse phase to several seconds after bounce. Our neutrino-driven explosions are triggered by enhancing the neutrino energy deposition [2]. In order to calculate the explosive nucleosynthesis, we have included a reduced alpha network and two equations of state that allow us to study regions from nuclear density to very low density.

[1] Couch S. M. 2013, ApJ, 775, 35
[2] O'Connor E. & Ott C. D. 2010, CQGra, 27, 114103

HK 62.3 Thu 17:45 P/H1

Impact of bremsstrahlung on the neutrinosphere for muon and tau neutrinos* — •Hannah Yasin[1], Almudena Arcones[1,2], and Alexander Bartl[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Core-collapse supernovae present a challenging and exciting problem that strongly depends on all forces (strong, weak, electromagnetism, and gravity). Neutrinos, although weakly interacting, are key to transporting energy and momentum. Therefore, detailed treatment of neutrino reactions is critical to understand these high energy events. We have studied the impact of different neutrino reactions on the position of the neutrinosphere (i.e., region where neutrinos decouple from matter). Since the density in this region is high the effect of nuclear interactions has to be considered for bremsstrahlung [1]: $N + N \rightarrow N + N + \nu + \bar{\nu}$. We have employed new, improved approaches [2] to calculate the inverse process and show the effect on the position of the neutrinosphere for muon and tau neutrinos.

[1] S. Hannestad and G. Raffelt, Astrophysical Journal 507 (1998) 339.
[2] A. Bartl, C. J. Pethick, and A. Schwenk, Physical Review Letters 113 (2014) 081101.

* Supported by Helmholtz-University Young Investigator grant No. VH-NG-825.

HK 62.4 Thu 18:00 P/H1

Neutron star equations of state with optical potential constraint — •Sofija Antic[1,2] and Stefan Typel[1] — [1]GSI, Darmstadt, Germany — [2]TU Darmstadt, Germany

Nuclear matter and compact neutron stars are studied in the framework of an extended relativistic mean-field (RMF) model that includes higher-order derivative and density dependent couplings of nucleons to the meson fields. Generalized Euler-Lagrange equations follow from the principle of least action and the most general expresions for current and energy-momentum tensor are derived. The equation of state (EoS) of infinite nuclear matter is obtained for different non-linear derivative coupling functions. From experimental constraints on the optical potential the appropriate energy dependence of the regulator functions is chosen. The thermodynamical consistency of the model is demonstrated.

Spherical, non-rotating stars are described with the new EoS considering charge neutrality and β-equilibrium conditions. The stellar structure is calculated by solving the Tolman-Oppenheimer-Volkov (TOV) equations and the results for neutron stars are shown in terms of mass-radius relations.

This work is supported by the Helmholtz Association (HGF) through the Nuclear Astrophysics Virtual Institute (NAVI, VH-VI-417).

HK 62.5 Thu 18:15 P/H1

Role of nuclear reactions on stellar evolution of intermediate-mass stars — •Heiko Möller[1], Samuel Jones[2], Tobias Fischer[3], Raphael Hirschi[4], Ken'ichi Nomoto[5], and Gabriel Martínez-Pinedo[1] — [1]TU Darmstadt — [2]University of Victoria — [3]Uniwersytet Wrocławski — [4]Keele University — [5]Kavli IPMU

The evolution of intermediate-mass stars (8 - 12 solar masses) represents one of the most challenging subjects in nuclear astrophysics. Their final fate is highly uncertain and strongly model dependent. They can become white dwarfs, they can undergo electron-capture or core-collapse supernovae or they might even proceed towards explosive oxygen-burning and a subsequent thermonuclear explosion. We believe that an accurate description of nuclear reactions is crucial for the determination of the pre-supernova structure of these stars and show that weak rates involving sd-shell nuclei are of particular importance. We argue that due to the possible development of an oxygen-deflagration, a hydrodynamic description has to be used. We implement a nuclear reaction network with ∼200 nuclear species into our implicit hydrodynamic code AGILE. The reaction network considers all relevant nuclear electron captures and beta-decays. For selected relevant nuclear species, we include a set of updated reaction rates based on shell-model calculations, for which we discuss the role for the evolution of the stellar core, at the example of selected stellar models. We find that the final fate of these intermediate-mass stars depends sensitively on the density threshold for weak processes that deleptonize the stellar core.

This work is supported by the DFG through contract SFB 634.

HK 62.6 Thu 18:30 P/H1

Neutrino interactions with supernova matter* — •Alexander Bartl[1,2], Christopher J. Pethick[3,4], Achim Schwenk[2,1], and Maria Voskresenskaya[2,1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]The Niels Bohr International Academy, The Niels Bohr Institute, Copenhagen, Denmark — [4]NORDITA, Royal Institute of Technology and Stockholm University, Stockholm, Sweden

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 a unified treatment of the energy transfer due to inelastic neutrino scattering on interacting nucleons and due to nuclear recoil. We will show that nuclear interaction effects can be a significant contribution to the total energy transfer and hence should be included in supernova simulations. In addition, we discuss the impact of neutrino rates involving strongly interacting nucleons in these simulations.

*This work was supported by the Studienstiftung des Deutschen Volkes, ARCHES, the Helmholtz Alliance HA216/EMMI and the ERC Grant No. 307986 STRONGINT.

HK 62.7 Thu 18:45 P/H1

Neutrino-driven winds from neutron star merger remnants* — •Albino Perego[1], Almudena Arcones[1], Ruben Cabezon[2], Roger Kaeppeli[3], Oleg Korobkin[4], Dirk Martin[1], and Stephan Rosswog[4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Physics Department, University of Basel, Switzerland — [3]Seminar for applied Mathematics, ETH Zürich, Switzerland — [4]The Oskar Klein Centre, Department of Astronomy, AlbaNova, Stockholm University, Sweden

During the merger of two neutron stars, matter can be ejected in the interstellar medium through different channels. The ejection mechanism, as well as the expansion timescale, can influence deeply the matter properties and, eventually, the subsequent nucleosynthesis. In this talk, I will present results regarding the formation and the properties of a neutrino-driven wind in the aftermath of a binary neutron star merger, in presence of a long living hyper massive neutron star [1]. Implications in terms of nucleosynthesis, electromagnetic counterparts and gamma-ray burst engine will be also discussed [1,2].

[1] A. Perego et al., 2014, MNRAS, 443, 3134.
[2] D. Martin et al., in preparation.

* Supported by Helmholtz-University Young Investigator grant No. VH-NG-825.

HK 63: Structure and Dynamics of Nuclei 12

Time: Thursday 17:00–18:45 Location: P/H2

Group Report HK 63.1 Thu 17:00 P/H2

Decay properties of the Pygmy Dipole Resonance — •J. Isaak[1,2], T. Aumann[3,4], T. Beck[3], N. Cooper[5], V. Derya[6], U. Gayer[3], J. Kelley[7,8], B. Löher[3,4], N. Pietralla[3], C. Romig[3], D. Savran[1,2], M. Scheck[9,10], H. Scheit[3], J. Silva[1,2], W. Tornow[7], H. Weller[7], V. Werner[3], A. Zilges[6], and M. Zweidinger[3] — [1]EMMI, Darmstadt — [2]FIAS, Frankfurt — [3]IKP, TU Darmstadt — [4]GSI, Darmstadt — [5]WNSL, Yale University, New Haven, USA — [6]IKP, Universität zu Köln — [7]Department of Physics, Duke University, TUNL, USA — [8]Department of Physics, NCSU, USA — [9]School of Engineering, UWS, Paisley, UK — [10]SUPA, Glasgow, UK

The so-called Pygmy Dipole Resonance (PDR) has been investigated in stable and in a few unstable nuclei in the past decades. So far, decay properties have been determined only in an indirect or model-dependent way. An excellent tool to extend the study of the decay pattern of the PDR is provided by the γ^3-setup [1] at the High Intensity γ-ray Source (HIγS). The combination of the γ-γ-coincidence method and the quasi-monochromatic photon beam at HIγS allows to observe primary transitions directly with high sensitivity and to obtain information on the decay behavior of individual states as well as extracting averaged quantities in a model-independent way. Recent experimental results for nuclei in the Z=50 and N=82 mass region will be presented.

[1] B. Löher *et al.,* NIM A 723 (2013) 136.

* Supported by the Alliance Program of the Helmholtz Association (HA216/EMMI), DFG (SFB 634 and ZI 510/4-2).

HK 63.2 Thu 17:30 P/H2

Selective excitation of the Pygmy Dipole Resonance in ^{120}Sn via the (d,pγ)-reaction — •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) by a single-neutron transfer-reaction was investigated in ^{120}Sn, using a ^{119}Sn(d,pγ)-experiment and the combined setup SONIC@HORUS at the 10 MV Tandem accelerator in Cologne. The setup consisting of 14 HPGe and 6 ΔE-E silicon telescope detectors for the coincident detection of γ-rays and charged particles, respectively, enables an offline selection of excitation and deexcitation channels. First results show that dipole states in the PDR region, i.e. 5 MeV to 9 MeV, could be excited by the reaction. These dipole states were identified as PDR states by comparison with data from a Nuclear Resonance Fluorescence experiment [1]. The contribution will present the experiment and principles of the data analysis needed to select transitions from or to $J^\pi = 1^-$ states. Using results from the experiment, features of the PDR will be discussed, including possible particle-hole configurations. Supported by the DFG (ZI 510/4-2).

[1] B. Özel *et al.*, Phys. Rev. C **90** (2014) 024304

HK 63.3 Thu 17:45 P/H2

Pygmy-Resonanz im schweren deformierten Kern ^{154}Sm aus polarisierter Protonenstreuung unter 0°.* — •Andreas Krugmann[1], Sergej Bassauer[1], Michaela Hilcker[1], Dirk Martin[1], Peter von Neumann-Cosel[1], Norbert Pietralla[1], Vladimir Ponomarev[1] und Atsushi Tamii[2] für die EPPS0-Kollaboration — [1]Insitut für Kernphysik, TU Darmstadt — [2]Research Center for Nuclear Research, Osaka University

Am RCNP in Osaka wurde ein Protonenstreuexperiment mit polarisierten Protonen am deformierten Kern ^{154}Sm unter extremen Vorwärtswinkeln inklusive 0° durchgeführt. Mittels der Methode der Polarisationstransferobservablen konnte eine Trennung des Spinflipanteils und des Nicht-Spinflipanteils am gesamten Wirkungsquerschnitt vorgenommen werden. Im Falle der elektrischen Dipolstärke konnte zum ersten Mal die Pygmy Dipolresonanz in einem schweren deformierten Kern identifiziert werden. Eine Doppelstruktur mit Maxima bei 6 und 8 MeV wurde beobachtet. Als mögliche Interpretation wird eine Deformationsaufspaltung aufgrund der Erhaltung der K-Quantenzahl analog zur Dipolriesenresonanz gegeben. Für die magnetische Dipolstärke wurde eine breite Verteilung im Anregungsenergiebereich zwischen 6 und 12 MeV in relativ guter Übereinstimmung mit früheren Experimenten [1] gefunden.

[1] K. Heyde, P. von Neumann-Cosel and A. Richter, Rev. Mod. Phys. **82**, 2365 (2010).

* Gefördert durch die DFG im Rahmen des SFB 634 und durch Vorhaben NE 679/3-1.

HK 63.4 Thu 18:00 P/H2

Decay behaviour of 1^- states in ^{92,94}Mo observed with SONIC@HORUS — •Simon G. Pickstone, Vera Derya, Andreas Hennig, Mark Spieker, Michael Weinert, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

In the last decade, the Pygmy Dipole Resonance (PDR) has attracted a lot of interest both in experimental and theoretical nuclear physics. However, some key observables are still not easily accessible. One of these is the decay branching of the PDR to excited states, which is a sensitive measure of the wave functions. To gain access to this observable, the new setup SONIC@HORUS consisting of silicon and HPGe detectors at the Institute for Nuclear Physics in Cologne was used to investigate the two molybdenum isotopes ^{92}Mo and ^{94}Mo in inelastic proton scattering experiments. In these experiments, both the energy of the γ-ray and of the particle were measured in coincidence with high energy resolution and in the offline analysis, specific excitation and de-excitation patterns were studied.

The results of the ^{92}Mo(p,p'γ) experiment will be presented, giving insight into the state-to-state decay behaviour of the PDR. Additionally, preliminary results of the ^{94}Mo(p,p'γ) experiment will be shown, focussing on the same observable for this non-magic nucleus. Supported by the DFG (ZI 510/4-2).

HK 63.5 Thu 18:15 P/H2

Zerfallsverhalten tiefliegender dipolangeregter Zustände der $Z = 40$ Isotope ^{92,94}Zr* — •Markus Zweidinger[1], Tobias Beck[1], Jacob Beller[1], Udo Gayer[1], Johann Isaak[2,3], Bastian Löher[1,4], Laura Mertes[1], Haridas Pai[1], Norbert Pietralla[1], Philipp Ries[1], Christopher Romig[1], Deniz Savran[2,3], Marcus Scheck[5,6], Werner Tornow[7] und Volker Werner[1] — [1]IKP, TU Darmstadt — [2]EMMI, GSI, Darmstadt — [3]FIAS, Frankfurt — [4]GSI, Darmstadt — [5]School of Engineering, UWS, Paisley, UK — [6]SUPA, Glasgow, UK — [7]Duke University, Durham, USA

Zur Untersuchung der Dipolstärkeverteilung wurden am Darmstadt High Intensity Photon Setup am S-DALINAC der TU Darmstadt Photonenstreuexperimente an den Kernen ^{92}Zr und ^{94}Zr durchgeführt. Mit Hilfe von unpolarisierter Bremsstrahlung wurden Spinquantenzahlen der angeregten Zustände und Übergangsstärken bis zur jeweiligen Neutronenseparationsenergie ermittelt. Zusätzlich wurden an beiden Ker-

nen Messungen mit quasimonoenergetischen, polarisierten Photonen an der High Intensity γ-ray Source der Duke University, Durham, NC, USA, durchgeführt. Diese Messungen erlauben die Bestimmung von Paritätsquantenzahlen sowie die Untersuchung von Zerfällen in tieferliegende angeregte Zustände wie den 2_1^+ Zustand. Außerdem können für letztere mittlere Zerfallsverzweigungsverhältnisse gemessen werden. Die Ergebnisse beider Messkampagnen werden vorgestellt und diskutiert.

*Gefördert durch die DFG im Rahmen des SFB 634

HK 63.6 Thu 18:30 P/H2

The Dipole Response of ^{132}Sn — •Philipp Schrock[1], Thomas Aumann[1], Konstanze Boretzky[2], Jacob Johansen[1], Dominic Rossi[3], and Fabia Schindler[1] for the R3B-Collaboration — [1]IKP, TU Darmstadt — [2]GSI Helmholtzzentrum — [3]Michigan State University

The Isovector Giant Dipole Resonance (IVGDR) is a well-known collective excitation in which all protons oscillate against all neutrons of a nucleus. In neutron-rich nuclei an additional low-lying dipole excitation occurs, often denoted as Pygmy Dipole Resonance (PDR).

To study the PDR in exotic Sn-isotopes, an experiment has been successfully performed with the upgraded R^{3}B-LAND setup at GSI. The complete-kinematics measurement of all reaction participants allows for the reconstuction of the excitation energy and, hence, the extraction of the dipole strength. Presented are the main features of the experiment, the analysis concept and the current status of the analysis of the dipole response of the doubly-magic isotope ^{132}Sn.

This work is supported by HIC for FAIR, GSI-TU Darmstadt cooperation, Navi and the BMBF project 05P12RDFN8.

HK 64: Heavy Ion Collisions and QCD Phases 8

Time: Thursday 17:00–18:45 Location: T/HS1

Group Report HK 64.1 Thu 17:00 T/HS1

Understanding photon production in hadron collisions and the equilibrating QGP in the early stage of the heavy-ion collisions — •Olena Linnyk[1], Elena Bratkovskaya[2], and Wolfgang Cassing[1] — [1]Justus Liebig University of Giessen, Germany — [2]Goethe University Frankfurt am Main, Germany

We show that the differential spectra, elliptic flow v2, triangular flow v3 and the polarization of emitted real and virtual photons reflect the properties of the QCD matter under extreme conditions as created in relativistic heavy-ion collisions: its temperature, sheer viscosity, conductivity and degree of equilibration. The first several fm/c of the collision evolution are particularly interesting, because the properties of the system before it equilibrates to QGP or hadron matter are not yet established. On the other hand, photons are emitted by every moving charge, a multitude of sources has to be disentangled in order to access the signal of interest. The direct photons at low transverse momentum are dominated by the thermal radiation from the QGP and the secondary meson+meson and meson+baryon interactions, such as the two-to-two processes (pi+pi->rho+gamma, rho+n->n+gamma, etc) and the bremsstrahlung mechanism (h+h->h+h+gamma). The implementation of photon bremsstrahlung in transport approaches was based until now on the soft photon approximation (SPA); it is valid only at very low energy (and pT) of the produced photon. Presently, we go beyond the SPA and use a one-boson-exchange model. Understanding the conventional sources lets us access the novel mechanisms of photon radiation in the non-equilibrium QCD matter and Glasma

Group Report HK 64.2 Thu 17:30 T/HS1

Direct photon production in Pb-Pb collisions at the LHC with the ALICE experiment — •Friederike Bock — Physikalisches Institut, Heidelberg University — Lawrence Berkeley National Laboratory, Berkeley

Unlike hadrons, direct photons are produced in all stages of a nucleus-nucleus collision and therefore test our understanding of the space-time evolution of the produced medium. Of particular interest are so-called thermal photons expected to be produced in a quark-gluon plasma and the subsequent hadron gas. The transverse momentum spectrum of thermal photons carries information about the temperature of the emitting medium. In this presentation, direct-photon spectra from Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV and p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV will be shown. The results were obtained by measuring e^+e^- pairs from external conversions of photons in the detector material. The measured direct-photon spectra will be compared with predictions from state-of-the-art hydrodynamic models. In the standard hydrodynamical modeling of nucleus-nucleus collisions, thermal photons mostly come from the early hot stage of the collision. As collective hydrodynamic flow needs time to build up, the azimuthal anisotropy of thermal photons quantified with the Fourier coefficient v_2 is expected to be smaller than the one for hadrons. However, the PHENIX experiment and ALICE experiment observed v_2 values of direct-photons similar in magnitude to the pion v_2. We will present the inclusive photon v_2 and v_3 in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV and discuss implications for the v_2 and v_3 of direct-photons.

Group Report HK 64.3 Thu 18:00 T/HS1

First results on electromagnetic radiation from Au+Au collisions at $E_{\mathbf{beam}}$ = 1.23 GeV/u in HADES. — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

Investigations of heavy-ion collisions at low beam energies do not only reveal properties of vector mesons and baryonic resonances in hot/dense hadronic matter, but they also give access to the thermodynamics of QCD in the low T and high μ_B region of the phase diagram. Electromagnetic radiation emitted from such collisions provides a unique chance to study these issues in the laboratory. As photons and leptons are not subject to the strong force, they are able to deliver nearly undisturbed information on the processes in which they were produced. The High Acceptance Di-Electron Spectrometer installed at GSI has been used since many years to take these opportunities and study a wide range of colliding systems from NN and πN through NA to AA, including the Au+Au at E_{beam} = 1.23 GeV/u run from April-May 2012. Here, according to the non-linear scaling $\propto A_{\mathrm{part}}^{1.4}$ extracted from the former C+C and Ar+KCl results, much stronger in-medium radiation is expected.

In the current contribution, very non-trivial questions of e^+e^- identification, rejection of the strong contribution of γ-conversion and a proper treatment of combinatorics in such a background-dominated system will be addressed. A discussion of the obtained results on dilepton spectra will then follow.

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

HK 64.4 Thu 18:30 T/HS1

Isolated photon measurement with the ALICE EMCAL detector — •Marco Marquard for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt am Main, Germany

Isolated photons at high transverse momenta are produced in initial hard scattering processes in high energy p-p 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 p-p collisions.

This talk will focus on the current status of the isolated photon analysis with the ALICE EMCAL. We will discuss technical aspects of the analysis and present methods to define and identify isolated photons. We will show first results of the analysis in p-p collisions.

Supported by BMBF and the Helmholtz Association.

HK 65: Heavy Ion Collisions and QCD Phases 9

Time: Thursday 17:00–19:00 Location: T/SR14

HK 65.1 Thu 17:00 T/SR14

Graphene as a lattice field theory — •Dominik Smith[1], Lorenz von Smekal[1,2], and Michael Körner[1] — [1]Technische Universität Darmstadt, Deutschland — [2]Justus Liebig Universität Gießen, Deutschland

We report on the status of ongoing ab-initio simulations of the electronic properties of mono-layer graphene within the tight-binding description. Hereby we employ standard methods of lattice field theory, similar to those used in simulations of Quantumchromodynamics. We present results concerning the semimetal-insulator phase-transition, which is analogous to chiral symmetry-breaking in strongly interacting field theories, and concerning the topological neck-disrupting Lifshitz transition, which occurs at finite electron number-density.

Gefördert von der DFG im Rahmen der Projekte SFB 634.

HK 65.2 Thu 17:15 T/SR14

Generalizations of the excluded-volume mechanism — •Stefan Typel — GSI, Darmstadt, Germany

The excluded-volume mechanism is a simple approach in order to take the finite size of particles and their short-range repulsive interaction into account in models for the nuclear matter equation of state. It can also be used to simulate the suppression of cluster formation with increasing density that is caused by the action of the Pauli principle. The excluded-volume mechanism can be seen more generally as a means to describe a change in the number of effective degrees of freedom. Thermodynamic consistency requires the occurrence of particular rearrangement contributions in a generalized formulation. Examples for the application of this extended approach to hadron and quark matter are discussed.

This work is supported by the Helmholtz Association (HGF) through the Nuclear Astrophysics Virtual Institute (NAVI, VH-VI-417)

HK 65.3 Thu 17:30 T/SR14

Phasespace dynamics of strongly interacting bose systems — •Eduard Seifert — Institut für Theoretische Physik, Gießen, Deutschland

The equilibration of many-body systems far out-off equilibrium has always been a major topic of research. With increasing calculational power more complicated systems can be studied numerically in acceptable time. A complete off-shell transport approach based on the detailed balance relation is used to simulate a spatially homogeneous system of scalar bosons in the ϕ^4-theory in two spatial dimensions including bose-enhancement factors. The scalar ϕ^4-theory is chosen as the interacting theory because of its simplicity and comparability to known solutions of the Kadanoff-Baym equations (KBE) for spatially homogenous systems. The transport equation is solved within a finite box with periodic boundary conditions employing an off-shell test particle ansatz with relativistic Breit-Wigner spectral functions. Three stages of equilibration (kinetic, spectral and chemical equilibration) are studied for different initial momentum distributions, particle densities and coupling strengths. The transport approach propagates the system for moderate coupling strengths comparably to the KBE solutions but deviates for strong coupling strengths.

HK 65.4 Thu 17:45 T/SR14

Baryon-Meson Model with Mirror Assignment beyond Mean-Field — •Johannes Weyrich[1], Nils Strodthoff[2], and Lorenz von Smekal[1,3] — [1]TU Darmstadt — [2]Universität Heidelberg — [3]Justus-Liebig-Universität Gießen

Nuclear matter has been studied intensively making use of the Walecka model and the chiral Walecka model since the 1970s. It was noted early on, however, that the chiral model (on mean-field level) leads to massless Lee-Wick nuclear matter in the chirally restored phase.

A promising candidate to describe nuclear matter and chiral symmetry restoration consitently is the parity doublet model (or mirror model). It has already been treated in a mean-field (MF) approach and showed promising results.

We studied the parity doublet model in an extended mean-field (eMF) approach as well as with full mesonic fluctuations, using a functional renormalization group (FRG) framework.

HK 65.5 Thu 18:00 T/SR14

The magnetic equation of state in effective chiral models — •Gabor Almasi[1], Wojciech Tarnowski[1,4], Bengt Friman[1], and Krzysztof Redlich[2,3] — [1]Helmholtzzentrum für Schwerionenforschung (GSI), 64291 Darmstadt, Germany — [2]University of Wrocław - Faculty of Physics and Astronomy, PL-50-204 Wroclaw, Poland — [3]Helmholtzzentrum für Schwerionenforschung (GSI) - ExtreMe Matter Institute (EMMI), 64291 Darmstadt, Germany — [4]Jagiellonian University, PL-30-059 Cracow, Poland

The chiral properties of QCD are often studied using effective models like the Quark-Meson model. In these models the gauge sector of QCD is integrated out and the models do not show confinement, but they are significantly easier to deal with. Concerning chiral properties they are constructed to be in the same universality class as QCD, so sufficiently close to the chiral phase transition they have the same universal properties (e.g. critical exponents). A finite current quark mass however breaks chiral symmetry explicitly rendering it an approximate symmetry both in QCD and in effective models. This causes violation of the scaling laws at the chiral phase transition. The measure of the violation in QCD and the effective model is in general different. However the better the model is, the closer the deviations from the scaling should be to the deviations in QCD. In this talk the scaling violations in effective models of QCD will be discussed and the results will be compared with lattice data on the magnetic equation of state.

HK 65.6 Thu 18:15 T/SR14

Quark number susceptibilities within the dynamical quasiparticle model — •Thorsten Steinert and Wolfgang Cassing — Institut für Theoretische Physik, Universität Giessen, 35392 Giessen, Germany

QCD thermodynamics can be well described with effective quasiparticle models. We present such a model that treats quarks and gluons as fully dressed particles with effective masses and widths. This dynamical quasiparticle model (DQPM) is tuned to reproduce the equation of state from recent lattice QCD calculations at vanishing quark chemical potential as well as different correlators describing e.g. the shear and bulk viscosities, the electric and heat conductivities. We discuss various methods to extend the model to finite chemical potential and check their validity by calculating the quark number susceptibilities and compare them with recent lattice QCD results.

HK 65.7 Thu 18:30 T/SR14

Chiral symmetry breaking in continuum QCD — •Mario Mitter, Jan M. Pawlowski, and Nils Strodthoff — Universität Heidelberg - Institut für Theoretische Physik, Deutschland, Heidelberg

We present a quantitative analysis of chiral symmetry breaking in two-flavour continuum QCD in the quenched limit. The theory is set-up at perturbative momenta, where asymptotic freedom leads to precise results. The evolution of QCD towards the hadronic phase is by means of dynamical hadronisation in the non-perturbative functional renormalisation group approach. We use a vertex expansion scheme based on gauge-invariant operators and discuss its convergence properties and the remaining systematic errors. In particular we present results for the quark propagator, the full tensor structure and momentum dependence of the quark-gluon vertex, and the four-fermi scatterings.

HK 65.8 Thu 18:45 T/SR14

Gluonic Vertices of Landau Gauge Yang-Mills Theory in the Dyson-Schwinger Approach — •Anton Konrad Cyrol[1], Markus Huber[2], and Lorenz von Smekal[1,3] — [1]Technische Universität Darmstadt, Institut für Kernphysik, Theoriezentrum, 64289 Darmstadt, Germany — [2]University of Graz, Institute of Physics, 8010 Graz, Austria — [3]Justus-Liebig-Universität Gießen, Institut für Theoretische Physik, 35392 Gießen, Germany

We report on a self-consistent solution of the Landau gauge four-gluon vertex DSE. Our calculation includes all perturbatively leading one-loop diagrams, which constitutes the state-of-the-art truncation. As only input we use results for lower Green functions from previous Dyson-Schwinger studies that are in good agreement with lattice results. Within the truncation, no higher Green functions enter. Hence, the results depend only indirectly on models of Green functions. Our self-consistent solution resolves the full momentum dependence of the four-gluon vertex but is limited to the tree-level tensor structure. We

calculate a few exemplary dressings of other tensor structures and find that they are suppressed compared to the tree-level structure except for the deep infrared where they diverge logarithmically. We employ the results to derive a running coupling. Furthermore, we study the coupled system of the three- and the four-gluon vertices to reduce the model dependence and to explore the convergence of the system of DSEs within the truncation scheme employed. For the scaling solution we establish a solution of the coupled system of vertices which provides promising evidence for the convergence.

HK 66: Structure and Dynamics of Nuclei 13

Time: Thursday 17:00–18:45 Location: T/SR19

HK 66.1 Thu 17:00 T/SR19

Microscopic description of nuclear fission properties in the superheavy region — •Samuel Andrea Giuliani[1,2], Gabriel Martinez-Pinedo[1], and Luis Miguel Robledo[2] — [1]Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]Departamento de Física Teorica, Universidad Autónoma de Madrid, E-28049 Madrid, Spain

In previous studies the fission properties of the Barcelona-Catania-Paris-Madrid energy-density functional were compared with available experimental data. Given its encouraging results, we explored the fission properties of nuclei in the superheavy region ($92 \leq Z \leq 120$ and $158 \leq N \leq 202$). Potential energy surfaces as well as collective inertias relevant to the fission process are obtained within a mean-field approach. Spontaneous fission half-lives are computed using the semiclassical Wentzel-Kramers-Brillouin formalism. As tracks of possible magic numbers in the superheavy region, combinations of neutron and proton number leading to an enhanced stability against the spontaneous fission process are discussed. The agreement with other theoretical models is also studied. This work was supported by the Helmholtz Association through the Nuclear Astrophysics Virtual Institute (VH-VI-417) and the Bundesministerium für Bildung und Forschung (BMBF) No. 06DA7047I

HK 66.2 Thu 17:15 T/SR19

Study of fission barriers in neutron-rich nuclei using the (p,2p) reaction: Status of SAMURAI-Experiment NP1306 SAMURAI14 — •Sebastian Reichert for the NP1306-SAMURAI14-Collaboration — TU Munich

Violent stellar processes are currently assumed to be a major origin of the elements beyond iron and their abundances. The conditions during stellar explosions lead to the so called r- process in which the rapid capture of neutrons and subsequent β decays form heavier elements. This extension of the nuclei stops at the point when the repulsive Coulomb energy induces fission. Its recycling is one key aspect to describe the macroscopic structure of the r-process and the well known elemental abundance pattern. The RIBF at RIKEN is able to provide such neutron rich heavy element beams and a first test with the primary beam 238U was performed to understand the response of the SAMURAI spectrometer and detectors for heavy beams. The final goal is the definition of the fission barrier height with a resolution of 1 MeV (in sigma) using the missing mass method using (p,2p) reactions in inverse kinematics. Supported by DFG Cluster of excellence: "Origin and structure of the Universe"

HK 66.3 Thu 17:30 T/SR19

Preparations for an optical access to the lowest nuclear excitation in ^{229}Th * — •Lars v.d. Wense[1], Benedict Seiferle[1], Mustapha Laatiaoui[2], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität München — [2]GSI Helmholtzzentrum für Schwerionenforschung Darmstadt

The isomeric lowest excited nuclear level of ^{229}Th has been indirectly measured to be 7.6±0.5 eV (163±11 nm)[1]. This low transition energy, compared to energies typically involved in nuclear processes, would allow for the application of laser-spectroscopic methods. Also considering the isomeric lifetime of the excited state (estimated to be 10^3 to 10^4 s), which leads to an extremely sharp linewidth of $\Delta\omega/\omega \sim 10^{-20}$, the isomer becomes a strong candidate for a nuclear-based frequency standard. In order to directly detect the isomeric ground-state decay and improve the accuracy of its energy as a prerequisite for an all-optical control, ^{229m}Th is populated via a 2% decay branch in the α decay of ^{233}U. The Thorium ions are extracted and cooled with the help of a buffer-gas stopping cell and an RFQ-cooler. In order to suppress accompanying α decay chain products other than ^{229}Th, a quadrupole mass spectrometer (QMS) is used. Following the QMS, the Thorium isomeric decay is expected to be detectable. Internal conversion as well as photonic decay is probed via different detection techniques [2]. Latest results will be presented.

[1] B.R. Beck et al., PRL 98, 142501 (2007).
[2] L. v.d.Wense et al., JINST 8 P03005 (2013).

* Supported by DFG Grant TH956/3-1.

HK 66.4 Thu 17:45 T/SR19

Gamma-ray spectroscopy of neutron-rich actinides after multi-nucleon transfer reactions — •Andreas Vogt[1], Benedikt Birkenbach[1], Lorenzo Corradi[2], Peter Reiter[1], and Suzana Szilner[3] for the LNL 11.22-Collaboration — [1]IKP, Universität zu Köln — [2]INFN - LNL, Italy — [3]IRB Zagreb, Croatia

Excited states in neutron-rich actinide Th and U nuclei were investigated after multi-nucleon transfer reactions employing the AGATA demonstrator and PRISMA setup at LNL (INFN, Italy). A primary 1 GeV ^{136}Xe beam hitting a ^{238}U target was used to produce the nuclei of interest in the actinide region. Beam-like reaction products in the Xe-region were identified and selected by the magnetic spectrometer PRISMA. Hence, fission fragments can be discriminated against surviving nuclei, DANTE-MCPs were installed within the target chamber to exploit kinematic coincidences between the binary reaction products which allows for clean conditions for in-beam γ-ray spectroscopy. Coincident γ-rays from excited states in beam- and target-like particles were measured with the position-sensitive AGATA HPGe detectors. An improved Doppler correction for both beam- and target-like nuclei is based on the novel γ-ray tracking technique. An extension of the ground-state rotational band in ^{240}U and insights into n-rich Th isotopes were achieved. 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 66.5 Thu 18:00 T/SR19

Femtoscopy measurements in a p($T = 3.5$ GeV) + Nb system* — •Oliver Arnold for the HADES-Collaboration — Physik Department E12 and Excellence Cluster "Universe", Technische Universität München, 85748 Garching, Germany

In the 1950s, Hanburry-Brown and Twiss realized that there is a chance that photons are correlated after their emission from a light emitting astrophysical object like a star. They constructed a formalism, which allowed them to determine the angular size of the object by measuring the correlation signal between the emitted photons. Independently of this discovery, Goldhaber *et al.* measured later on an angular correlation for like-sign pion pairs in nuclear physics.

We use the technique of two-particle correlations in a femtoscopy measurement of proton and Lambda pairs, which were produced in proton-niobium collisions and detected with HADES, where the proton had a kinetic beam energy of 3.5 GeV. This allows us to extract the region of homogeneity for proton-lambda pairs and additionally study their interaction. For comparisons of the source size we constructed also the correlation functions of proton and pion pairs and measured the k_T dependence of the source. Our measurements allow us also to confront the experimental data with predictions of theoretical transport model calculations (UrQMD) to gain information about the emission dynamics of the particles.

*supported by BMBF(05P12WOGHH), Excellence Cluster "Universe" and FIAS/HGS-HIRe

HK 66.6 Thu 18:15 T/SR19

Untersuchung der neutronenarmen Kerne ^{178,180}Pt — •Christoph Fransen[1], Claus Müller-Gatermann[1], Thomas Braunroth[1], Alfred Dewald[1], Tuomas Grahn[2], Jan Jolie[1], Pe-

ter Jones[3], Rauno Julin[2], Julia Litzinger[1], Rick D. Smit[3], Mathis Wiedeking[3] und Karl-Oskar Zell[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Dept. of Physics, University of Jyväskylä, Finnland — [3]iThemba LABS, Faure/Kapstadt, Südafrika

Verschiedenste Kernmodelle wie das IBM, das General Collective Model, mikroskopische Rechnungen zu Energiedichte-Funktionalen und eine "beyond-mean-field" Beschreibung sagen eine oblat-prolate Formkoexistenz in neutronenarmen Kernen um $A = 180$ vorher. Es handelt sich um prolate Intruderzustände aus Protonenanregungen über den Schalenabschluss in Koexistenz mit fast-sphärischen oder leicht oblaten Zuständen. Andererseits zeigen die tiefliegendenen Banden von ^{176,178}Os Merkmale der X(5)-Symmetrie. Dies motiviert die Frage, inwieweit die oben genannten Modelle in dieser Region mit stark variierenden Kernstrukturen ein schlüssiges Bild liefern können. In diesem Beitrag werden erste Ergebnisse von Experimenten zur Bestimmung absoluter Übergangsstärken aus Zustandslebensdauern, gemessen mit der Recoil Distance Doppler-Shift Methode, in ^{178,180}Pt vorgestellt. Für diese Kerne lagen bisher unzureichende Daten vor, um die zugrundeliegende Kernstruktur zu identifizieren. Die Messung an ^{178}Pt war dabei das erste Plunger-Experiment am iThemba LABS in Südafrika. Gefördert durch die DFG, Fördernr. FR 3276/1-1, DE 1516/3-1 und die EU, Projekt ENSAR im Seventh Framework Programme.

HK 66.7 Thu 18:30 T/SR19

Recent results from the Penning-trap mass spectrometer ISOLTRAP — •Dinko Atanasov for the ISOLTRAP-Collaboration — Max-Planck Institute for Nuclear Physics, Heidelberg, Germany — IMPRS-PTFS, Heidelberg, Germany

ISOLTRAP is an experiment dedicated to precision Penning-trap mass measurements of radioactive nuclides produced by the ISOLDE facility at CERN. In this contribution we will present the results of recent ISOLTRAP measurements performed after the restart of the physics program at ISOLDE in 2014. The unique combination of four traps allowed the study of the neutron-rich $^{129-131}$Cd isotopes. Their masses are of great importance to model the astrophysical r-process, as the ^{130}Cd isotope is a major *waiting point* isotope. Furthermore, ISOLTRAP assisted in measuring the hyperfine structure of astatine isotopes in an ongoing in-source laser spectroscopy program. From the hyperfine structure, charge radii and electromagnetic moments can be extracted. Additionally, the nuclear masses of ^{101,102}Sr and ^{101,102}Rb were determined, extending further the investigations of the $A \approx 100$ nuclides in the shape transition region.

HK 67: Hadron Structure and Spectroscopy 12

Time: Thursday 17:00–19:00 Location: T/SR25

Group Report HK 67.1 Thu 17:00 T/SR25

Status of $d^*(2380)$ and Search for further Dibaryon Resonances*. — •Mikhail Bashkanov for the WASA-at-COSY-Collaboration — Physikalisches Institut der Universität Tübingen

After evidence for the existence of a narrow dibaryon resonance with $I(J^P) = 0(3^+)$ had been found in various np-induced two-pion production channels, its pole has been identified now in polarized $\vec{n}\vec{p}$ scattering. This qualifies the resonance as a genuine s-channel dibaryon resonance, denoted since then by $d^*(2380)$ [1]. Meanwhile, also all two-pion decay channels have been studied and decay branchings deduced.

Several new theoretical investigations in the framework of Faddeev or quark model treatments see this state at a mass close to the experimentally observed one – and partly also with the right width. Amazingly, the first prediction by Dyson and Xuong based on SU(6) symmetry breaking turns out to have been already very close.

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 will be reported.

[1] P. Adlarson *et. al.*, Phys. Rev. Lett. 112 (2014) 202301 and Phys. Rev. C 90 (2014) 035204

*supported by DFG(CL 214/3-1) and COSY-FFE (FZ Jülich)

HK 67.2 Thu 17:30 T/SR25

Chiral Nucleon-Nucleon Potential: 3π-exchange with virtual Δ-isobar excitations — •Norbert Kaiser — Physik Department T39, Technische Universität München

The status of the chiral nucleon-nucleon potential at order N^{4}LO is presented. While the net 3π-exchange at this order is moderate, one finds a sizeable and prevailingly repulsive contribution from the two-loop 2π-exchange, thus compensating the excessive attraction at lower orders. As a result, the phase shifts of the peripheral partial waves are in very good agreement with empirical determinations. The three-pion exchange with excitations of nucleons to virtual Δ-isobars is studied as well. The analytical calculation of the pertinent two-loop spectral functions (by exploiting unitarity) reveals that these mechanisms generate mainly a repulsive isoscalar central NN-potential of moderate size.

D. Entem, N. Kaiser, R. Machleidt and Y. Nosyk, arXiv: 1411.5335.
This work has been supported in part by DFG and NSFC (CRC110).

HK 67.3 Thu 17:45 T/SR25

Hyperons in nuclear matter based on 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

We investigate properties of hyperons in nuclear matter within conventional first-order Brueckner theory based on potentials calculated within the framework of SU(3) chiral effective field theory. The chiral potentials include contributions from one- and two-meson exchange as well as contact terms up to next-to-leading order. Promising results for the single-particle potentials of Λ and Σ hyperons in nuclear matter and pure neutron matter are found. These calculations are fundamental for a systematic study of hypernuclei and of dense baryonic matter, like neutron star matter.

This work has been supported in part by DFG and NSFC (CRC110).

HK 67.4 Thu 18:00 T/SR25

Hyperon interaction in free space and nuclear matter — •Madhumita Dhar and Horst Lenske — Institute for Theoretical Physics, Justus- Liebig- University Giessen

Baryon-baryon interactions within the SU(3)-octet are investigated in free space and nuclear matter.A meson exchange model based on SU(3) symmetry is used for determining the interaction. The Bethe-Salpeter equations are solved in a 3-D reduction scheme. In-medium effect has been incorporated by including a two particle Pauli projector operator in the scattering equation. The coupling of the various channels of total strangeness S and conserved total charge is studied in detail. Special attention is paid to the physical thresholds. The density dependence of interaction is clearly seen in the variation of the in-medium low-energy parameters. The approach is compared to descriptions derived from chiral-EFT and other meson-exchange models e.g. the Nijmegen and the Juelich model. This work is supported by HIC for FAIR and HGS-HIRe.

HK 67.5 Thu 18:15 T/SR25

Probing the existence of the Kaonic Nuclear Cluster "ppK^-" with help of a PWA — •Eliane Epple for the HADES-Collaboration — Physik Dept. E12, Technische Universität München, Garching — Excellence Cluster "Universe", 85748 Garching

The "ppK^-" is a well established state in theory and is a candidate for a new kind of hadronic matter formed by antikaons and nucleons. The HADES spectrometer at GSI has probed the existence of such a state by measuring its possible decay products p and Λ. These decay products have been studied specifically in the reaction $p+p \rightarrow p+K^+ +\Lambda$ at a beam kinetic energy of 3.5 GeV. A partial wave analysis, performed on this final state, helped in describing the event distributions, which is a necessary condition to search for an additional small signal in the statistic. We have found no indication for the production of a kaonic nuclear bound state in our data and have, thus, set an upper limit for its production cross section.

Furthermore, did we repeat the analysis of the DISTO collaboration in which a signal like distribution appeared in so-called deviation spectra. We can show that this method is error-prone in terms of the

applied selection cuts and is, thus, not reliable in order to make statements about the "ppK^-".
*supported by: BMBF(05P12WOGHH) and the Excellence Cluster 'Universe'

HK 67.6 Thu 18:30 T/SR25

Study of 2.13GeV Cusp in p + p → p + K^+ + Λ with Partial wave Analysis using Flatté distribution. — •S. Lu[1], R. Münzer[1], E. Epple[1], L. Fabbietti[1], J. Ritman[2], E. Roderburg[2], F. Hauenstein[2], and Hades and FOPI Collaboration[2] — [1]E12 Physik Department, Excellenz Cluster Universe - Technische Universität München — [2]FZ Jülich

In the last years, the analysis of the reaction p + p → p + K^+ + Λ has been carried out by the FOPI and Hades Collaboration in the search for Kaonic Cluster ppK^-. 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. In a new analysis campaign a combined analysis of several additional data sets from DISTO and COSY-TOF can be analysed. A pronounced narrow structure is observed in its projection on the pΛ-invariant mass. This peak structure, which appears around the ΣN threshold, has a strongly asymmetric structure and is interpreted a ΣN cusp effect. To get a more precise physical interpretation of the data, the Flatté parameterization, which also takes the influence, is used. The influences of the coupling strength of Λp and Σp are taken into account. In this talk, several results from partial wave analysis of cusp structure based on Flatté parameteration will be presented.
*supported by the DFG Project FA 898/2-1

HK 67.7 Thu 18:45 T/SR25

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

Investigations of charge symmetry breaking is one of the key topics for the WASA-at-COSY experiment. The study concentrates on the charge symmetry forbidden $dd \to {}^4\mathrm{He}\pi^0$ reaction. The aim is to compare the experimental results with Chiral Perturbation Theory predictions, probing hadronic effects of the up and down quarks mass difference.

It was found that previous data taken close to the reaction threshold were consistent with s-wave. In order to probe also p-wave contributions, new data at sufficiently high energy were required. The measurement should comprise the charge symmetry forbidden $dd \to {}^4\mathrm{He}\pi^0$ reaction and the charge symmetry conserving reaction $dd \to {}^3\mathrm{He}n\pi^0$ to provide additionally the experimental input for the description of the initial state interactions.

Results on the $dd \to {}^3\mathrm{He}n\pi^0$ and $dd \to {}^4\mathrm{He}\pi^0$ reactions with the WASA detector setup at a beam momentum of 1.2 GeV/c will be presented. In addition, the status of the recent high statistics run in spring 2014 will be discussed.

HK 68: Invited Talks 5

Time: Friday 11:00–13:00 Location: T/HS1

Invited Talk HK 68.1 Fri 11:00 T/HS1

The GBAR antimatter gravity experiment — •Patrice Perez — IRFU, CEA Saclay France

The GBAR project (Gravitational Behaviour of Antihydrogen at Rest) at CERN, will measure the free fall acceleration of ultracold neutral antihydrogen atoms in the terrestrial gravitational field. The experiment consists in preparing antihydrogen ions (one antiproton and two positrons) and sympathetically cool them with Be+ ions to a few 10 microK. The ultracold ions will then be photo-ionized just above threshold, and the free-fall time over a known distance measured. I will describe the project, the accuracy that can be reached by standard techniques, and with possible improvements using quantum reflection of antihydrogen on surfaces.

Invited Talk HK 68.2 Fri 11:40 T/HS1

Jet Physics with ALICE at the LHC — •Oliver Busch for the ALICE-Collaboration — University of Tsukuba, Japan — Physialisches Institut, Ruprecht-Karls Universitaet Heidelberg, Germany

Jets are defined in QCD as cascades of consecutive emissions of partons from an initial hard scattering. The process of parton showering and subsequent hadronisation is broadly known as fragmentation. High-energy nucleus-nucleus collisions allow us to probe parton fragmentation within a QCD medium and the properties of this medium via the modification of the jet spectrum and jet structure. Measurements in pp and p-Pb collisions provide an elementary baseline, allow us to investigate perturbative and non-perturbative aspects of particle production and to disentangle final state, potential nuclear initial state, and cold nuclear matter effects.

ALICE at the LHC is a general-purpose heavy ion experiment designed to study the physics of strongly interacting matter and the Quark-Gluon-Plasma, combining excellent charged particle reconstuction and identificitation over a wide momentum range with electromagnetic calorimetry. We present measurements of jet production cross sections, jet structure and jet fragmentation in pp, p-Pb and Pb-Pb collisions. First results on particle identified jet fragmentation will be shown. We will discuss perspectives for LHC run 2 starting in 2015.

Invited Talk HK 68.3 Fri 12:20 T/HS1

Penning-trap mass spectrometry for neutrino physics — •Sergey Eliseev[1], Klaus Blaum[1], Michael Block[2], Christine Böhm[1], Andreas Dörr[1], Christian Droese[3], Pavel Filianin[4], Mikhail Goncharov[1], Enrique Minaya Ramirez[1], Dmitriy Nesterenko[4], Yuri Novikov[4], Alexander Rischka[1], and Lutz Schweikhard[3] — [1]Max-Planck Institute for Nuclear Physics, Heidelberg, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Institut für Physik, Ernst-Moritz-Arndt-Universität, Greifswald, Germany — [4]Petersburg Nuclear Physics Institute, St. Petersburg, Russia

The discovery of neutrino oscillations has proven neutrinos are massive particles. However, this does not provide information on the type of the neutrino and its mass. An answer to these questions lies in a study of beta transitions, i.e., beta- and double-beta- decays as well as electron and double-electron captures. A crucial parameter in this study is the Q-value of the beta transitions, which has to be measured with an accuracy of 100 eV in the case of the determination of the neutrino type and better than 1 eV if the neutrino mass is concerned. Tremendous progress in Penning traps has finally allowed such high precision Q-value measurements. This contribution will be an overview of the results of the measurements performed with the Penning-trap mass spectrometer SHIPTRAP and present a physical program for the next generation Penning-trap mass spectrometer PENTATRAP, which is under construction at Max-Planck Institute for Nuclear Physics/Germany.

HK 69: Instrumentation 19

Time: Friday 14:30–16:30 Location: M/HS1

Group Report HK 69.1 Fri 14:30 M/HS1

Triggering with the ALICE TRD: Results and Prospects — •Jochen Klein[1], Yvonne Pachmayer[1], and Uwe Westerhoff[2] for the ALICE-Collaboration — [1]Physikalisches Institut, University of Heidelberg — [2]Institut fuer Kernphysik, Universitaet Muenster

The ALICE Transition Radiation Detector provides multiple level-1 trigger contributions. The signatures are based on tracks which are reconstructed in an FPGA array from chamber-wise track segments. The latter are calculated on the detector-mounted frontend electronics. The massive parallelization allows for the low latency trigger 8 us after the interaction.

We will show the performance of the triggers on electrons and

jets during LHC Run 1. Further, we will discuss improvements and prospects for Run 2. In particular, an online calculation of the distance of closest approach to the primary vertex shall be used to reject the dominant background from the conversion of photons at large radii. The combination of tracks over stack and sector boundaries will help to improve the efficiency of the jet trigger.

HK 69.2 Fri 15:00 M/HS1

Development of a Pico-Second Start Counter — •Michael Dickescheid, Matteo Cardinali, Oliver Corell, Matthias Hoek, Werner Lauth, Sören Schlimme, Concettina Sfienti, and Michaela Thiel — Institut für Kernphysik, Johannes Gutenberg Universität Mainz.

The goal is to develop a hodoscope with a time resolution of less than 50 ps. To achieve this level of precision, the obvious choice is to use the Cherenkov effect because of the prompt photon-production. The detector itself consists of 64 fused-silica radiator bars ($5\times5\times140\,mm^3$) in an 8×8 matrix attached to an microchannel plate photomultiplier tube with 64 pixels (one bar per pixel). The segmented radiator design allows improving the time resolution depending on the number of traversed radiator bars. Also the number of detected photons per pixel is important as it improves the time resolution. Signal discrimination will be done using custom-made front-end electronics and a TRB3 system [1] will be used for data acquisition.

The performance of the detector will be determined using a low intensity electron beam at the MAMI accelerator in Mainz with a momentum of 855 MeV/c. The obtained data will be compared to detailed Monte Carlo simulations. In this contribution the experimental setup will be described in more detail. Also first preliminary results from the test experiment will be shown.

[1] A. Neisser et al., INST 8 C12043 (2013).

HK 69.3 Fri 15:15 M/HS1

The CBM First-level Event Selector Input Interface — •Dirk Hutter and Volker Lindenstruth for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM First-level Event Selector (FLES) is the central event selection system of the upcoming CBM experiment at FAIR. Designed as a high-performance computing cluster, its task is an online analysis of the physics data at a total data rate exceeding 1 TByte/s.

To allow efficient event selection, the FLES has to combine the data from all given input links to self-contained, overlapping processing intervals and distribute them to compute nodes. This task can be performed efficiently by partitioning the detector data streams into specialized containers. The FLES Interface Board (FLIB), implemented as a custom FPGA board, receives these containers via optical links, prepares them for subsequent interval building, and transfers the data via DMA to the PC's memory.

A prototype of the FLIB has been implemented. The inclusion of features foreseen for other parts of the CBM read-out chain allows the evaluation of the interval building concept. Performance studies demonstrated high read-out bandwidth with low overhead. In addition, the FLIB has been used successfully as a readout device in testbeams and lab setups. An overview of the FLES Interface Board as well as results from latest studies will be presented.

HK 69.4 Fri 15:30 M/HS1

Test einer neuen Auslesekette für den CBM RICH Detektor — •Jörg Förtsch und Christian Pauly für die CBM-Kollaboration — Bergische Universität Wuppertal, Germany

Das Compressed Baryonic Matter experiment (CBM), welches derzeit als Teil der Facility for Antiproton and Ion Research (FAIR) aufgebaut wird, dient der Vermessung des QCD-Phasendiagramms bei hohen Netto-Baryonendichten und moderaten Temperaturen, sowie der Charakterisierung des Phasenübergangs hadronischer Materie zum Quark-Gluon Plasma. Eine wesentliche Komponente des CBM-Detektors ist ein Ring abbildender Cherenkov-Detektor (RICH), in welchem das Cherenkov-Licht schneller Teilchen ($v > c/n$) über sphärische Spiegel ringförmig auf den Photodetektor abgebildet wird. Die ortsaufgelöste Auslese der Cherenkov Photonen soll mittels Multianoden Photomultipliern oder MCPs erfolgen. Im Rahmen einer kürzlich durchgeführten Teststrahlzeit am CERN-PS Beschleuniger im November 2014 wurde hierfür eine neue Auslesekette getestet, basierend auf PADIWA frontend boards zur Signal Diskriminierung, und TRB3 FPGA-TDC boards zur Digitalisierung und Zeitmessung der Sensor Signale. Die Nutzung von standard FPGAs für Diskriminierung, Digitalisierung und Datentransport verspricht hierbei eine kostengünstige Lösung, welche eine sehr gute Zeitauflösung bietet (begrenzt durch den Sensor selbst). Die Messung der Signalamplitude soll hierbei über eine Time-over-Threshold Messung erfolgen. Wir berichten über Erfahrungen und erste Ergebnisse, welche im Rahmen der Strahlzeit gewonnen wurden. *gefördert durch BMBF 05P12PXFCE und GSI

HK 69.5 Fri 15:45 M/HS1

SRAM-Detektor gestützte Positionierung für Elektronik-Strahltests — •Christian Stüllein, Andrei-Dumitru Oancea, Jano Gebelein, Sebastian Manz und Udo Kebschull für die CBM-Kollaboration — Infrastruktur und Rechnersysteme in der Informationsverarbeitung (IRI), Goethe-Universität, Senckenberganlage 31, 60325 Frankfurt am Main

Die korrekte Ausrichtung von DUTs (device under test) auf den Strahl ist eine wichtige und zeitintensive Tätigkeit. Desweiteren ist eine Nachführung während des Experiments nicht ohne Weiteres möglich. Hierfür ist eine Unterbrechung des Strahls notwendig, wodurch auch andere parallel laufende Experimente beeinflusst werden. Ausserdem bedeutet ein manueller Eingriff eine zusätzliche Strahlenbelastung.

Durch das hier vorgestellte Projekt kann die Positionierung aus der Ferne gesteuert und überwacht werden. Der Aufbau ermöglicht eine genaue Ausrichtung der DUTs in x- und z-Richtung mittels durch Schrittmotoren angetriebener Linearachsen. Ein auf SRAM basierender Detektor ermöglicht durch kontinuierliche Erfassung von Single-Event Upsets (SEUs) eine Positionsbestimmung des Strahls zur Laufzeit. Dadurch können DUTs bei Bedarf entsprechend nachgeführt werden. Hiermit kann auch der Ausfall oder eine ungewollte Verschiebung des Strahls erkannt, und entsprechende Maßnahmen eingeleitet werden.

HK 69.6 Fri 16:00 M/HS1

A PandaRoot Interface for Binary Data in the PANDA Prototype DAQ System — •Sören Fleischer, Sören Lange, Wolfgang Kühn, Christopher Hahn, and Milan Wagner for the PANDA-Collaboration — 2. Physikalisches Institut, Uni Giessen

The PANDA experiment at FAIR will feature a raw data rate of more than 20 MHz. Only a small fraction of these events are of interest. Consequently, a sophisticated online data reduction setup is required, lowering the final output data rate by a factor of roughly 10^3 by discarding data which does not fulfil certain criteria. The first stages of the data reduction will be implemented using FPGA-based Compute Nodes.

For the planned tests with prototype detectors a small but scalable system is being set up which will allow to test the concept in a realistic environment with high rates.

In this contribution, we present a PandaRoot implementation of a state-machine-based binary parser which receives detector data from the Compute Nodes via GbE links, converting the data stream into the PandaRoot format for further analysis and mass storage.

This work is supported by BMBF (05P12RGFPF), HGS-HIRe for FAIR and the LOEWE-Zentrum HICforFAIR.

HK 69.7 Fri 16:15 M/HS1

Studies on high performance Timeslice building on the CBM FLES — •Helvi Hartmann for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

In contrast to already existing high energy physics experiments the Compressed Baryonic Matter (CBM) experiment collects all data untriggered. The First-level Event Selector (FLES), which denotes a high performance computer cluster, processes the very high incoming data rate of 1 TByte/s and performs a full online event reconstruction. For this task it needs to access the raw detector data in time intervals referred to as Timeslices. In order to construct the Timeslices, the FLES Timeslice building has to combine data from all input links and distribute them via a high-performance network to the compute nodes.

For fast data transfer the Infiniband network has proven to be appropriate. One option to address the network is using Infiniband (RDMA) Verbs directly and potentially making best use of Infiniband. However, it is a very low-level implementation relying on the hardware and neglecting other possible network technologies in the future. Another approach is to apply a high-level API like MPI which is independent of the underlying hardware and suitable for less error prone software development.

I would like to present the given possibilities and to show the results of benchmarks ran on high-performance computing clusters. The solutions are evaluated regarding the Timeslice building in CBM.

HK 70: Instrumentation 20

Time: Friday 14:30–16:30 Location: M/HS2

Group Report HK 70.1 Fri 14:30 M/HS2

Detection of Low-Energy Antinuclei in Space Using an Active-Target Particle Detector — •Thomas Pöschl[1], Daniel Greenwald[1], Igor Konorov[1], Martin Losekamm[1,2], and Stephan Paul[1] — [1]Physics Department E18, Technische Universität München — [2]Institute of Astronautics, Technische Universität München

Measuring antimatter in space excellently probes various astrophysical processes. The abundancies and energy spectra of antiparticles reveal a lot about the creation and propagation of cosmic-ray particles in the universe. Abnormalities in their spectra can reveal exotic sources or inaccuracies in our understanding of the involved processes. The measurement of antiprotons and the search for antideuterons and antihelium are optimal at low kinetic energies since background from high-energy cosmic-ray collisions is low. For this reason, we are developing an active-target particle detector capable of detecting ions and anti-ions in the energy range of 30 - 100 MeV per nucleon. The detector consists of 900 scintillating fibers coupled to silicon photomultipliers and is designed to operate on nanosatellites. The primary application of the detector will be the *Antiproton Flux in Space* (AFIS) mission, whose goal is the measurement of geomagnetically trapped antiprotons inside Earth's inner radiation belt. In this talk, we will explain our particle identification technique and present results from first in-beam measurements with a prototype. This work is supported by the Excellence Cluster 'Origin and Structure of the Universe'.

HK 70.2 Fri 15:00 M/HS2

A highly-segmented neutron detector for the A1 experiment at MAMI — •Matthias Schoth for the A1-Collaboration — Institut für Kernphysik, Mainz

Electric and magnetic form factors of the neutron, are one of the defining properties to characterize its structure quantitatively. A planned physics program to improve the data base significantly requires high performance detection of relativistic neutrons. Exploiting the full potential of the high luminosity supplied by the MAMI accelerator, a novel neutron detector is being developed in the scope of the A1 collaboration.

A large active detector volume of 0.96 m^3 is required to achieve a high raw detection efficiency. The detector is subdivided into 2048 plastic scintillators to be able to cope with high background rates. The light is extracted via wavelength shifting fibres and then guided to multi anode photomultiplier. The signal is read out with FPGA based TDCs (TRBv3 developed at GSI). The energy of the signal is obtained via time over threshold information in combination with a suitable shaping and discriminating circuit.

Prototype tests have been performed to optimize the choice of materials and geometry. The capability to detect neutrons in the relevant momentum range has been demonstrated using pion production.

A Geant4 simulation using tracking algorithms evaluating the deposited energy is able to optimize key detector properties like particle id efficiency, multiplicity or the effective analyzing power for double polarized scattering experiments.

HK 70.3 Fri 15:15 M/HS2

Performance of BEGe detectors for GERDA Phase II — •Andrea Lazzaro for the GERDA-Collaboration — Physik-Department E15, Technische Universität München, Germany

After the end of the data–taking for GERDA Phase I, the apparatus has been upgraded to fulfill the requirements of the second phase. Phase II sensitivity will be driven by 30 custom made BEGe detectors. This detectors are now available and can be operated in phaseII configuration in the GERDA cryostat together with the liquid argon scintillation veto.

The performances of BEGe detectors in liquid argon will be presented in this talk. Besides the spectroscopy capability, the focus will be placed on the expectations in terms of background rejection via pulse shape discrimination (PSD). In particular the main goal the BEGe's pulse shape analysis is to discriminate surface events produced by beta emitters (e.g. ^{42}K) present in the liquid Ar.

This work was supported in part by BMBF (05A14W03).

HK 70.4 Fri 15:30 M/HS2

Performance of the LAr scintillation veto of GERDA Phase II — •Christoph Wiesinger for the GERDA-Collaboration — Technische Universität München, Physik Dep., E15, James-Franck-Straße, 85748 Garching

Gerda is an experiment to search for the neutrinoless double beta decay in ^{76}Ge. Results of Phase I have been published in summer 2013 and Gerda is upgraded to Phase II. To reach the aspired background index of $\leq 10^{-3}$ 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, which simultaneously deposit energy in the LAr. The light instrumentation consisting of photomuliplier tubes (PMT) and wavelength-shifting fibers connected to silicon multipliers (SiPM) has been installed in Gerda. In this talk the low background design of the LAr veto and its performance during the comissioning runs will be reported.

This work was partly funded by BMBF 05A14W03.

HK 70.5 Fri 15:45 M/HS2

Measuring the attenuation length in liquid scintillators — •Dominikus Hellgartner[1], Lothar Oberauer[1], Sabrina Prummer[1], Julia Sawatzki[1], Andreas Ulrich[2], and Vincenz Zimmer[1] — [1]Technische Universität München, Physik Departement E15, James Franck Straße, 85748 Garching — [2]Technische Universität München, Physik Departement E12, James Franck Straße, 85748 Garching

The next generation of liquid scintillator detectors like the proposed LENA detector or the planned JUNO detector will feature diameters of order 30 m. Due to this vast size, the optical quality of the scintillator is of crucial importance.

To determine the attenuation length of liquid scintillators, an experiment with a 5 m long measurement section was set-up in the underground laboratory in Garching. The current set-up of the experiment will be presented along with a discussion of the results of the first measurements. Additionally, there will be an outlook towards possible upgrades of the experiment in the future.

HK 70.6 Fri 16:00 M/HS2

Measurement of proton-quenching and PSD performance of organic liquid scintillators — •Vincenz Zimmer, Dominikus Hellgartner, Julia Sawatzki, and Lothar Oberauer — Physik-Department, Technische Universität München

Understanding quenching effects in organic liquid scintillators is vital for various present and future neutrino experiments, like Double Chooz, Borexino, LENA and JUNO.

The understanding of proton-quenching is important for both signal and background detection in neutrino experiments. This effect defines the energy scale of ν-p-scattering, which is a major detection channel for supernova-νs. Furthermore, recoil protons from cosmogenic neutrons pose a severe background for the detection of the diffuse supernova neutrino background (DSNB) and reactor neutrinos. Pulse shape discrimination (PSD) is a powerful tool to identify the type of particle by its typical scintillation light emission and, therefore, to distinguish between background and signal events.

A time of flight based experiment has been established at the MLL (Garching). Using a pulsed ^{11}B-beam and a fixed H_2-target neutrons with about 6 − 11 MeV are produced to investigate the quenching effect and γ-n-discrimination performance by the resulting proton recoils in different liquid scintillator samples.

This research was supported by the DFG cluster of excellence 'Origin and structure of the Universe' and the Maier-Leibnitz-Laboratorium (MLL), Garching.

HK 70.7 Fri 16:15 M/HS2

(Alpha-) Quenching temperature dependence in liquid scintillator — •Arnd Sörensen, Valentina Lozza, Belina von Krosigk, and Kai Zuber — Institut für Kern- und Teilchenphysik, TU Dresden

Liquid scintillator (LS) is an effective and promising detector material, which is and will be used by many small and large scale experiments. In order to perform correct signal identification and background sup-

pression, a very good knowledge of LS properties is crucial.

One of those is the light yield from alpha particles in liquid scintillator. This light output strongly quenched, approx. 10 times compared to that of electrons, and has been precisely studied at room temperature for various LS. Big scintillator experiments, such as SNO+ and maybe future large scale detectors, will operate at different temperatures.

While a strong temperature dependence is well known for solid state scintillators, due to the different scintillation process, a quenching temperature dependence in LS is usually assumed negligible. On the other hand, inconsistencies in between measurements are often explained by potential temperature effects.

This study investigates LAB based liquid scintillator with an intrinsic, dissolved alpha emitter and its behaviour with temperature change. In a small, cooled and heated setup, a stabilized read-out with two PMTs is realised. First results will be presented. This work is supported by the German Research Foundation (DFG).

HK 71: Astroparticle Physics 5

Time: Friday 14:30–16:15 Location: M/HS4

Group Report HK 71.1 Fri 14:30 M/HS4

Das XENON1T-Experiment — •Hardy Simgen fuer die XENON1T-Kollaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

Die Serie der XENON-Experimente gehört zu den erfolgreichsten Projekten zur direkten Suche nach dunkler Materie in Form von WIMPs (Weakly Interacting Massive Particles). Nachdem XENON100 lange Zeit die weltbesten Limits für den WIMP-Nukleon-Wirkungsquerschnitt geliefert hat, steht nun das XENON1T-Experiment kurz vor seiner Fertigstellung. Wie der Name suggeriert wird XENON1T das erste Dunkle Materie-Experiment mit einer aktiven Masse von circa einer Tonne sein. Sein Herzstück ist eine 2-Phasen TPC (Time Projection Chamber), die mit flüssigem Xenon gefüllt ist. Ein Ereignis ist charakterisiert durch ein promptes Szintillationssignal und ein verzögertes Ionisationssignal, das in der Gasphase über dem flüssigen Xenon verstärkt und ebenfalls mittels Szintillationslicht ausgelesen wird.

In dem Vortrag werden die Herausforderungen beleuchtet, die in der Entwicklungsphase von XENON1T bewältigt werden mussten, sowie der Stand des Aufbaus des Experiments aufgezeigt. Ein besonderes Augenmerk wird auf die enorme intrinsische Reinheit gelegt, die das verwendete Xenon erfüllen muss. Nach einem Blick auf das physikalische Potential von XENON1T wird abschließend noch das geplante Upgrade XENONnT vorgestellt. Die meisten Hardwarekomponenten von XENON1T sind bereits so ausgelegt, dass ein späterer Übergang auf XENONnT mit minimaler Verzögerung stattfinden kann.

Group Report HK 71.2 Fri 15:00 M/HS4

EURECA: towards high sensitivity in the low-mass WIMP region — •Valentin Kozlov for the EURECA-Collaboration — Karlsruher Institut für Technologie, Institut für Kernphysik, Postfach 3640, 76021 Karlsruhe

The EURECA project is aimed at direct search for dark matter particles using cryogenic bolometers. It is primarily based on the expertise of the EDELWEISS and CRESST experiments, but also a close collaboration with the U.S.-led experiment SuperCDMS is foreseen. Thus in the first instance EURECA will host germanium and $CaWO_4$ crystals with the goal to significantly improve sensitivity on the WIMP-nucleon elastic scattering cross-section, especially in the low-mass WIMP region to go down to the neutrino floor. This requires to overcome many challenges. Ongoing R&D work concerning detectors, electronics readout, material screening, and technical developments towards common detector infrastructure will be presented.

HK 71.3 Fri 15:30 M/HS4

Optimization of a ^{83m}Kr tracer method for the characterization of xenon gas dynamics — •Sergej Schneider, Gianmarco Bruno, Alexander Fieguth, Michael Murra, Stephan Rosendahl, and Christian Weinheimer — Institut für Kernphysik, WWU Münster

In order to achieve the aimed sensitivity of $2*10^{-47}$cm^2 for the dark matter search with the XENON1T detector, it is crucial to remove the radioactive isotope ^{85}Kr from the detector material xenon to a sub ppt level. For this a cryogenic distillation column was constructed at the University of Münster.

To allow a quick live characterization of the column performance a doping method was developed using the relatively short living ^{83m}Kr isotope. Its decay characteristics are beneficial both for its detection in xenon with a photomultiplier tube as well as the prevention of contamination since due to its half life of 1.83 h it does not contaminate the respective system on a relevant time scale. Furthermore a custom made detector was developed for the detection of the scintillation created by a ^{83m}Kr decay in gaseous xenon. Due to the very high separation factor of the cryogenic distillation column, the detectors had to be optimized in their signal to background ratio to provide a profile characterization of the column. Studies for coincidence measurements as well as for reflectivity properties of Teflon were considered.

This work for XENON1T was funded by BMBF and by HAP.

HK 71.4 Fri 15:45 M/HS4

Entfernung von Radon aus Xenon fuer das XENON1T-Experiment — •Stefan Brünner für die XENON-Kollaboration — Max-Planck-Institut für Kernphysik Heidelberg

In Detektoren mit niedriger Ereignisrate wie XENON1T, einem Experiment zum Nachweis Dunkler Materie, stellen Radon und dessen Tochterisotope eine wichtige Untergrundquelle dar. Durch kontinuierliche Emanation aus sämtlichen Materialien gelangt Radon bis in das Innerste des XENON1T Detektors unbeeindruckt durch jegliche äußere Abschirmung. In XENON1T wird die Radon-Problematik auf zweierlei Arten angegangen: Erstens werden die Materialien, die zum Bau des Experiments verwendet werden sorgfältig auf ihre niedrige Radon-Emanationsrate hin überprüft und ausgewählt. Trotz dieser Qualitätskontrolle werden sich nicht alle Radonquellen gänzlich ausschließen lassen. Darum ist zweitens ein System geplant, in dem Radon während des Betriebs von XENON1T permanent aus Xenon entfernt wird. In diesem Vortrag werden Arbeiten zur Realisierung einer solchen Radonreinigungsanlage vorgestellt. Derzeit beruht der vielversprechendste Ansatz auf der Reinigungswirkung, die duch verdampfendes Xenon erzielt wird. Dabei ist ein mehrstufiger Destillationsprozess ebenso denkbar wie eine Reinigung durch einfaches Xenon-Verdampfen (Boil-Off Reinigung).

HK 71.5 Fri 16:00 M/HS4

Radon Screening for XENON1T — •Sebastian Lindemann — Max-Planck-Institut für Kernphysik, Heidelberg, Deutschland

Radon with its isotope ^{222}Rn is one of the dominant sources of internal background in liquid xenon detectors searching for low energetic rare events like WIMP-nucleon scattering. In my talk I will briefly review the problem posed by ^{222}Rn and motivate the screening strategy followed by XENON1T. I will introduce the radon emanation technique making use of ultra low background proportional counters and present selected results obtained during the design and construction phases of XENON1T. Finally, I will sketch advances in radon emanation assay techniques and give a short outlook on upcoming measurements.

HK 72: Precision Tests of the Standard Model 2

Time: Friday 14:30–16:30 Location: P/H1

Group Report HK 72.1 Fri 14:30 P/H1

Testing Lorentz Invariance in Weak Decays — •Auke Sytema, Elwin Dijck, Steven Hoekstra, Klaus Jungmann, Stefan Müller, Jacob Noordmans, Gerco Onderwater, Coen Pijpker, Rob Timmermans, Keri Vos, Lorenz Willmann, and Hans Wilschut — Van Swinderen Institute, University of Groningen, The Netherlands

Lorentz invariance is the invariance of physical laws under orientations and boosts. It is a key assumption in Special Relativity and the Standard Model of Particle Physics. Several theories unifying General Relativity and Quantum Mechanics allow breaking of Lorentz invariance.

At the Van Swinderen Institute in Groningen a theoretical and experimental research program was started to study Lorentz invariance violation (LIV) in weak interactions. The theoretical work allowed a systematic approach to LIV in weak decays. Limits could be set on parameters that quantify LIV.

A novel beta decay experiment was designed which tests rotational invariance with respect to the orientation of nuclear spin. In particular, using the isotope ^{20}Na, the decay rate dependence on the nuclear polarization direction was measured. Searching for sidereal variations, systematic errors can be suppressed. The result of the experiment will be presented.

HK 72.2 Fri 15:00 P/H1

Systematic Error Investigation of the Spin Tune Analysis for an EDM Measurement at COSY — •Fabian Trinkel for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich, Wilhelm-Johnen-Straße 52428 Jülich

So far there have been no direct Electric Dipole Moment (EDM) measurements for charged hadrons. The goal of the JEDI collaboration (Jülich Electric Dipole moment Investigations) is to measure the EDM of charged particles (p, d and ^3He). A first step on the way for an EDM measurement is the investigation of systematic errors at the storage ring COSY (COoler SYnchrotron). One part for these studies examines the spin tune ν_s of a horizontally polarized deuteron beam. The spin tune is defined as the number of spin rotations in the horizontal plane relative to the particle turns. To first approximation it is given by $|\nu_s| \approx \gamma G$, where γ is the Lorentz factor and G is the anomalous magnetic moment of the particle. The spin precession is observed using elastic deuteron carbon scattering.A measurement of the spin tune is performed for a polarized deuteron beam with a precision of 10^{-10} at COSY. The measurement and possible systematic errors due to acceptance and polarization variation will be discussed.

HK 72.3 Fri 15:15 P/H1

Polarimetry concepts for the EDM precursor experiment at COSY — •Paul Maanen for the JEDI-Collaboration — III. Physikalisches Institut B, RWTH Aachen

The CP violation in the Standard Model is not sufficient to explain the dominance of matter over antimatter in the universe. New CP violating sources could manifest as permanent electric dipole moments (EDM). So far, no direct measurement of a charged particle'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, 3He). In the chosen method, an EDM manifests as a small buildup of the vertical polarization of a stored hadron beam. Because the effect is very small, great care has to be taken designing the polarimeter. This talk gives an overview of the planned detector concept and discusses first results of simulations and experiments.

HK 72.4 Fri 15:30 P/H1

Bestimmung der Spintuneänderung durch Solenoiden und Steerer am COSY Speicherring — •Dennis Eversmann für die JEDI-Kollaboration — 3. Physikalisches Institut RWTH, Aachen, NRW

Eine notwendige Bedingung für die Entstehung der Baryonenasymmetrie im Universum während der Baryongenese ist die CP Verletzung, wobei bis heute experimentell keine Erklärung für unser Materie dominiertes Universum gefunden werden konnte. Ziel der JEDI Kollaboration (Jülich Electric Dipole moment Investigations) ist es, das permanente elektrische Dipolmoment (EDM) von Proton, Deuteron und Helium-3 in einem Speicherring zu vermessen, was entscheidend zur Beantwortung der oben dargelegten Frage beitragen kann, da EDMs durch P und T (CP) verletzende Prozesse enstehen können. Am Cosy Speicherring werden dazu Machbarkeitsstudien durchgeführt, die zum einen eine möglichst lange Erhaltung der Polarisation anvisieren und zum anderen untersuchen mit welcher Präzision der Spintune der Teilchen bestimmt werden kann. Der Spintune ν_s ist definiert als die Anzahl der Spinumdrehungen während eines Teilchenumlaufs durch den Speicherring und ist in erster Ordnung durch den Lorentzfaktor γ und das anomale magnetische Moment G gegeben: $\nu_s \approx \gamma G$. Ein mögliches EDM würde diese Relation geringfügig modifizieren, womit eine präzise Spintunemessung eine Möglichkeit darstellt das EDM eines Teilchen zu bestimmen. Im Vortrag zur DPG wird gezeigt, dass kleine Spintuneänderungen durch Manipulation mittels eines Solenoiden und eines Steerers im Beschleuniger gemessen werden konnten.

HK 72.5 Fri 15:45 P/H1

Resultate des A4-Compton-Rückstreu-Polarimeters — •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

Um die Strahlpolarisation für das A4-Experiment am MAMI-Elektronenbeschleuniger der Universität Mainz zu bestimmen, wurde erstmals ein Compton-Rückstreu-Polarimeter in internal-cavity-Bauweise aufgebaut. Die Verwendung des internen Laserresonators erlaubt es, die Luminosität des Systems bei geringen Teilchenströmen zu erhöhen. Nach einer erfolgreichen Erprobungsphase wurde das Polarimeter seit 2009 regulär für den Experimentierbetrieb eingesetzt. Dieser Beitrag soll das Designkonzept und die Herausforderungen beim Aufbau und Betrieb dieses Systems beleuchten und Meßergebnisse präsentieren.

HK 72.6 Fri 16:00 P/H1

Status of the TRIGA User Facility at Mainz — Klaus Eberhardt[2], Christopher Geppert[2], Werner Heil[1], Jan Peter Karch[1], •Fabian Kories[1], Tobias Reich[2], Yury Sobolev[1], and Norbert Trautmann[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Institut für Kernchemie, Johannes Gutenberg-Universität Mainz

Ultra-cold neutrons (UCN) offer unique opportunities for investigating the properties of the free neutron with exceptionally high precision such as the measurement of its lifetime.

At the pulsed TRIGA reactor in Mainz, a superthermal UCN source using solid deuterium as converter is operational and delivers up to 10 UCN/cm^3 in typical storage volumes of 10 l. [Karch, et al., Eur. Phys. J. A (2014) 50: 78]

Within PRISMA Cluster of excellence, this source will be upgraded to a targeted strength of 50 UCN/cm^3 in order to transform TRIGA Mainz into a world-leading user facility for UCN research. Besides the installation of a He liquefier to sustain long-term experiments, the existing neutron guides have to be replaced by high-quality guides with low surface roughness which are internally coated with ^{58}Ni to increase the phase space for UCN transport.

The talk gives a status report on the activities at the UCN source at TRIGA Mainz and describes the application process and experimental options for future users.

HK 72.7 Fri 16:15 P/H1

Status report of the neutron lifetime experiment tau-SPECT — •Jan Peter Karch[1], Marcus Beck[1], Simo Dragisic[1], Christopher Geppert[2], Jan Haak[1], Werner Heil[1], Sergei Karpuk[2], Fabian Kories[1], Simon Kunz[1], Yury Sobolev[1,2], and Dietmar Stepanow[1] — [1]Institut für Physik, University of Mainz, Germany — [2]Institut für Kernchemie, University of Mainz, Germany

The decay of the free neutron into a proton, electron and antineutrino

is the prototype of the semi-leptonic weak decay and plays a key role in particle physics and astrophysics. Nowadays, the accuracy achieved is limited by systematic errors, mainly caused by anomalous losses during storage of neutrons (ultracold neutrons) in material vessels. The magnetic storage of neutrons aims to avoid these systematic limitations and is expected to reach an accuracy of 0.1-0.3 s in the lifetime of the neutron. In this talk, the magnetic spectrometer tau-SPECT is presented, which uses a combination of magnetic multipole fields for radial storage and the field configuration of the superconducting aSPECT magnet [1] for longitudinal storage of ultracold neutrons. This storage experiment benefits greatly from the new ultracold neutron source at the pulsable TRIGA reactor Mainz [2]. The talk will give an overview of the experimental status: Proton detection system and adiabatic fast passages device. [1] S. Baeßler et al., Eur. Phys. J. A 38, 17-26 (2008) [2] J. Karch et al., Eur. Phys. J. A 50, 78-88 (2014)

HK 73: Heavy Ion Collisions and QCD Phases 10

Time: Friday 14:30–16:30 Location: T/HS2

Group Report HK 73.1 Fri 14:30 T/HS2

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

Low-mass dielectrons are an important experimental tool to investigate the properties of strongly interacting matter, in particular the quark-gluon plasma (QGP), which is created in ultrarelativistic heavy-ion collisions. Electrons do not interact strongly, therefore they provide information from all stages of the collision. Especially, possible modifications of the electromagnetic emission spectrum in the QGP can be probed with dielectrons, where pp collisions are used as medium-free reference and p–A collisions allow to probe cold from hot nuclear matter effects.
In this contribution, dielectron measurements in ALICE are presented, where electrons at mid-rapidity are identified by their specific energy loss in the Inner Tracking System (ITS) and the Time Projection Chamber, combined with time-of-flight information from the TOF detector. The invariant mass distributions in pp collisions at $\sqrt{s} = 7$ TeV and in p–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV are compared to the expected hadronic sources. Moreover, the cross section of virtual direct photons measured in pp collisions is compared to predictions from NLO calculations as a function of the transverse momentum. Also the status of the analysis of Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV is presented.

Group Report HK 73.2 Fri 15:00 T/HS2

Modification of hadron properties at normal nuclear matter density invested in π-induced reactions: Recent results from FOPI+GEM-TPC. — •Victoria Zinyuk[1], Felix Valentin Böhmer[3], Sverre Dørheim[2], Laura Fabbietti[2], Norbert Herrmann[1], and Bernhard Ketzer[3] for the FOPI-Collaboration — [1]Universität Heidelberg — [2]Technische Universität München — [3]HISKP Universität Bonn

In compressed baryonic matter the properties of hadrons are believed to alter as a consequence of various non-trivial in-medium effects such as the partial restoration of the spontaneously broken chiral symmetry, the modified baryon-meson couplings and the nuclear potential. In pion-induced reactions the in-medium modifications can be studied at normal nuclear matter density. At ρ=ρ_0 the chiral symmetry is expected to be partially restored to $\sim$ 30%.
The FOPI collaboration has performed fixed target experiments looking at π^- + C-, Cu- and Pb-reactions with p_π=1.7 GeV/c. For these experiments the FOPI apparatus was upgraded with a GEM-based Time Projection Chamber(TPC) leading to significant improvement of the vertex resolution and therefore improving the PID capability.
In this presentation we summarize the most recent results on possible modification of the momentum distribution for strange particles such as K^+, K^-, K^0_S, Λ^0 and ϕ-mesons.
This work was supported by BMBF 05P12VHFC7 and BMBF 05P12WOCAA.

HK 73.3 Fri 15:30 T/HS2

First results of dilepton reconstruction in pion-induced reactions — •Federico Scozzi for the HADES-Collaboration — TU Darmstadt

Precise understanding of the elementary reactions is important for the interpretation of di-electron emission in heavy-ion collisions. The coupling of virtual photons to baryonic resonances can be experimentally probed by means of the πN $\rightarrow$ R $\rightarrow e^+e^-N$ process for which neither experimental data nor reliable theoretical predictions exist. In view of these, it is necessary that the exclusive cross section or dilepton production on the nucleon be measured. In summer 2014 the High Acceptance Di-Electron Spectrometer (HADES) experiment at GSI took data from pion-induced reactions using three targets: tungsten, carbon and polyethylene, at several pion beam momenta. A large part of the data, using a polyethylene target, 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 these data with carbon data it is possible to extract pion-proton interactions. In this contribution the first results for dilepton production in pion-induced reactions will be discussed.
This work has been supported by VH-NG-823, Helmholtz Alliance HA216/EMMI and GSI.

HK 73.4 Fri 15:45 T/HS2

Angular distributions in $\pi N \rightarrow Ne^+e^-$ — •Enrico Speranza[1,2], Bengt Friman[1], György Wolf[3], and Miklós Zétényi[3] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany — [2]Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany — [3]Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics, Hungarian Academy of Sciences, H-1525 Budapest, Hungary

A calculation of angular dependencies of the cross section for the process $\pi N \rightarrow Ne^+e^-$ is presented. Three effective Lagrangians are used for the interaction vertex between a baryon resonance, a nucleon and a vector meson. The resulting angular dependencies are presented for different baryon spin states for the three interaction models. The goal of this investigation is twofold. First, to explore the possibility to identify the spin of a baryon resonance formed in the reaction, using the angular distributions. Second, to improve models for dilepton production in hadronic and nuclear collisions by confronting the results with the recent data of the HADES collaboration on this reaction.

HK 73.5 Fri 16:00 T/HS2

Dilepton and pion production at SIS energies — •Janus Weil — Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt, Germany

We discuss dilepton and pion production at SIS energies in a transport approach, both of which are tightly connected to the dynamics of baryonic resonances. In heavy-ion collisions, resonance contributions are very hard to pin down, and it has been shown that a good baseline from elementary (pp) reactions is essential for a better understanding of the resonance cocktail and the involved electromagnetic couplings and for distinguishing pure vacuum effects from actual in-medium modifications. Recent pion-beam measurements at GSI will provide further constraints for many of the assumptions and parameters that enter transport simulations, in particular resonance properties and transition form factors. We try to to get a consistent picture of dilepton and pion production at SIS energies by considering leptonic and hadronic observables from both elementary and heavy-ion collisions.

HK 73.6 Fri 16:15 T/HS2

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

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 and positrons from γ-conversions and Dalitz decays of π^0 are the main contributors to a large combinatorial

background obscuring the information carried by the rare dileptons.

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.

*This work has been supported by BMBF (05P12RFFC7), HIC for FAIR, HGS-HIRe, H-QM, and GSI.

HK 74: Heavy Ion Collisions and QCD Phases 11

Time: Friday 14:30–16:15 Location: T/SR14

Group Report HK 74.1 Fri 14:30 T/SR14

Transport study on gluon Bose-Einstein condensation in Heavy-Ion Collisions — •Kai Zhou — Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany

We investigate with transport approach the thermalization process of gluons with possible Bose-Einstein condensate under CGC(Color Glass condensate) inspired initial condition. We consider here a static gluonic matter with only homegeneous elastic collisions. By developing a new stochastic scheme for the boson*s transport treatment,the Boltzmann equation is solved numerically in cascade simulation. We see that under a over-populated initial condition, the gluon Bose-Einstein condensation indeed would occur to accommodate the gluons and balance the whole distribution to approach thermal equilibrium.

HK 74.2 Fri 15:00 T/SR14

The quark-gluon plasma within a partonic transport approach — •Florian Senzel[1], Oliver Fochler[1], Jan Uphoff[1], Zhe Xu[2], and Carsten Greiner[1] — [1]Goethe-Universität, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany — [2]Tsinghua University, Beijing 100084, China

Aiming for the simultaneous description of the hard and the soft regime of ultra-relativistic heavy-ion collisions, the partonic transport approach BAMPS (Boltzmann Approach to Multi-Parton Scatterings) simulates microscopically the quark-gluon plasma by perturbative quantum chromodynamics. To this end, it numerically solves the 3+1D Boltzmann equation by allowing interactions among all parton species: both elastic $2 \to 2$ and inelastic $2 \leftrightarrow 3$ processes for gluons as well as quarks. For the inelastic collisions, we employ the improved Gunion-Bertsch matrix element, which cures problems of the original Gunion-Bertsch result in characteristic regions of the phase space. Based on extensive numerical calculations, the improved matrix element agrees well with the exact pQCD calculation. By employing the improved GB matrix element together with a running coupling evaluated at the microscopic scale, we present results for the suppression of high p_t particles as well as the collectivity of the bulk medium and compare them to LHC data of the nuclear modification factor R_{AA} and the elliptic flow v_2. Furthermore, we present studies of R_{AA} for different hadron species, the elliptic flow v_2 at high transverse momentum and the momentum loss of reconstructed jets.

HK 74.3 Fri 15:15 T/SR14

Photons in a partonic transport approach — •Moritz Greif, Florian Senzel, and Carsten Greiner — Goethe Universität Frankfurt, Max-von-Laue-Str. 1 60438 Frankfurt am Main, Germany

Partonic transport approaches have proved to be valuable tools in describing the quark-gluon plasma, created in heavy-ion collisions. In this work, first steps towards a dynamical understanding of photonproduction in expanding heavy-ion collisions are presented. 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. Subsequently, photon spectra can be investigated, and in particular, the influence of the quark-gluon plasma phase for the elliptic flow of photons will be studied.

HK 74.4 Fri 15:30 T/SR14

Measurement of electrons from charm and beauty-hadron decays in p-Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE at the LHC — •Jan Wagner for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute EMMI, Planckstraße 1, 64291 Darmstadt

Electrons from inclusive semileptonic heavy-flavor hadron decays are used to measure charm and beauty production. Because of their large masses, heavy quarks are mostly produced in initial hard partonic interactions and thus can be used to probe the Quark-Gluon Plasma (QGP), a deconfined state of strongly-interacting matter created in heavy-ion collisions. In addition to the QGP, the presence of cold nuclear matter in the initial state may affect the production of heavy-flavour hadrons through shadowing/saturation effects. A contribution to the suppression observed in Pb-Pb collisions is investigated by analyzing p-Pb collisions.

The $p_{\rm T}$-differential production cross section of electrons from heavy-flavour hadron decays and beauty-hadron decays in the rapidity range $-1.06 < y_{\rm cms} < 0.14$ in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV has been measured with ALICE. The cross section of electrons from beauty-hadron decays, isolated based on their larger average displacement from the interaction vertex, are presented as well as the nuclear modification factor $R_{\rm pPb}$ of inclusive heavy-flavour and beauty-hadron decay electrons. Theoretical predictions including the effects due to the nuclear modification of the parton distribution functions will be discussed with the results.

HK 74.5 Fri 15:45 T/SR14

Study of the Applicability of Markov Chain Monte Carlo Methods to the Statistical Separation of Electron Sources via the Impact Parameter for ALICE — •Manuel Wittner for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg, Heidelberg

One particularly interesting measurement detected by the ALICE setup at the LHC are electrons from charm and beauty hadron decays. Heavy quarks originate from initial hard scattering processes and thus experience the whole history of a heavy ion collision. Therefore, they are valuable probes to study the mechanisms of energy loss and hadronization in the hot and dense state of matter, that is expected to be formed in a heavy-ion collision at LHC. One important task is the distinction of the different electron sources, for which a method was developed. Hereby, the impact parameter distribution of the measurement data is compared with impact parameter distributions for the individual sources, which are created through Monte Carlo simulations. Afterwards, a maximum likelihood fit is applied. However, creating a posterior distribution of the likelihood according to Bayes' theorem and sampling it with Markov Chain Monte Carlo algorithms provides several advantages, e.g. a mathematically correct estimation of the uncertainties or the usage of prior knowledge. Hence for the first time in this particular problem, a Markov Chain Monte Carlo algorithm, namely the Metropolis algorithm, was implemented and investigated for its applicability in heavy flavor physics. First studies indicate its great usefulness in this field of physics.

HK 74.6 Fri 16:00 T/SR14

Performance of the upgraded ALICE inner tracker in full kinematic reconstruction of B^+ mesons — •Johannes Stiller for the ALICE-Collaboration — PI Heidelberg

A new high-granularity silicon pixel inner tracker will be installed in the central barrel of the ALICE experiment during the second long shutdown of the LHC in 2018. New and unique measurements in the heavy-quark sector will be possible through the detectors single-hit resolution of 4 μm close to the interaction point and a readout rate capability of 50 kHz in Pb-Pb collisions. Within the scope of this upgrade, we studied the performance of full kinematic reconstruction down to lowest p_T in the channel $B^+ \to \overline{D}^0\pi^+$ and $\overline{D}^0 \to K^+\pi^-$ with branching ratios of 0.5 % and 3.9 % respectively, using detailed Monte Carlo simulations of high-multiplicity Pb–Pb collisions. Topologic and kinematic criteria are used to select the rare signal against the large combinatorial background. Furthermore, the track rotation method is used to improve the residual background statistics estimate in order to give a first outlook on the expected signal-to-background ratio and statistical significance. In order to improve this estimate on the residual

combinatorial background a dedicated fast simulation tool is being developed. Further, the effect of correlated background sources, i.e. from other beauty meson decays, is evaluated in the upgrade environment.

HK 75: Heavy Ion Collisions and QCD Phases 12

Time: Friday 14:30–16:30 Location: T/SR25

Group Report HK 75.1 Fri 14:30 T/SR25

Experimental tests of the QCD symmetries with heavy-ion collisions — •Jacobus Onderwaater for the ALICE-Collaboration — Research Division and ExtreMe Matter Institute, GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgrabenstr. 9, 64289 Darmstadt

Not long after the discovery of parity violation in weak interactions it was realized that parity violation is not prohibited in strong interactions. Although experimental results put a very small upper limit on the amount of global parity violation, no such strong restrictions exist on spontaneous occurance of local parity symmetry breaking interactions in the QCD vacuum. It was suggested that local parity violating interactions in combination with the strong magnetic field in a heavy-ion collision may result in novel phenomena like the Chiral Magnetic Effect and the Chiral Separation Effect that survive during the evolution of the hot and dense medium and can be observed via charge-dependent correlations. Charge-dependent effects are observed at RHIC and LHC but may contain contributions from different sources, such as local charge conservation.
In this report an overview of recent charge-dependent measurements with the ALICE detector is presented. Two particle correlations with respect to the event plane with one identified hadron, and two- and three-particles correlations with unidentified hadrons from Pb-Pb at $\sqrt{s_{\rm NN}} = 2.76$ TeV are discussed.

HK 75.2 Fri 15:00 T/SR25

Transverse Momentum Spectra of Inclusive Charged Particles in pp, p–Pb and Pb–Pb Collisions with ALICE — •Philipp Lüttig for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

To study the properties of matter created in p–Pb and Pb–Pb collisions, a common observable is the nuclear modification factor (R_{AA}) as function of the transverse momentum (p_T). The ALICE detector at the CERN-LHC has accumulated a wealth of data in pp, p–Pb and Pb–Pb collisions in the past years. Using a combined tracking approach based on information in the Inner Tracking System (ITS) and the Time Projection Chamber (TPC) ALICE is capable to measure the transverse momentum in a broad range.
Transverse momentum spectra of charged particles in minimum-bias pp, p–Pb and Pb–Pb (LHC-Run-2010) collisions have been measured up to $p_T = 50$ GeV/c.
For pp and p–Pb collisions, a feasibility study to extend the p_T range of the charged particle spectra using data triggered by the ALICE Electromagnetic Calorimeter or the ALICE Transition Radiation Detector is presented in this talk. For Pb–Pb collisions, the extension of these spectra for $p_T > 50$ GeV/c by including LHC-Run-2011 data is discussed. Furthermore, we present a study of R_{AA} measured in Pb–Pb collisions as a function of p_T and angle with respect to the reaction plane. Supported by BMBF and the Helmholtz Association.

HK 75.3 Fri 15:15 T/SR25

Correlation between mean transverse momentum and charged particle multiplicity based on geometrical superposition of p–Pb collisions — •Jerome Jung for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The mean transverse momentum $\langle p_T \rangle$ as a function of the charged-particle multiplicity N_{ch} in pp, p–Pb and Pb–Pb collisions was recently published by ALICE. While in pp and in p–Pb collisions a strong increase of $\langle p_T \rangle$ with N_{ch} is observed, Pb–Pb collisions show a saturation at a much lower $\langle p_T \rangle$.
Efforts of reproducing this behaviour in Pb–Pb with a superpositon of nucleon-nucleon interactions do not succeed. A superposition of p–Pb collisions seems to be more promising, since the p–Pb data shows characteristics of both pp and Pb–Pb collisions.
The geometric distribution of the p–Pb impact parameters is based on the Woods-Saxon density distribution. Using the correlation of the impact parameter and the multiplicity N_{ch} in p-Pb collisions a multiplicity-spectrum was generated. Combining this spectrum with experimental p–Pb data we present $\langle p_T \rangle$ as a function of N_{ch} in simulated Pb–Pb collisions and compare it to the correlation measured in Pb–Pb by ALICE.

HK 75.4 Fri 15:30 T/SR25

The relevance of multi-parton interactions for event-by-event mean $p_{\rm T}$ fluctuations in pp collisions — •Stefan Heckel for the ALICE-Collaboration — Goethe-Universität Frankfurt, Institut für Kernphysik, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

Event-by-event mean transverse momentum fluctuations in pp collisions have recently been measured by ALICE at the LHC [1]. High collision energies as reached at the LHC enable the occurence of multiple hard scatterings in a single pp collision, due to the large number of partons within the ultra-relativistically moving particles. High-multiplicity events in pp collisions at LHC energies are believed to be driven by such multi-parton interactions (MPIs).

We present an analysis of the influence of MPIs on event-by-event mean transverse momentum fluctuations in pp collisions at $\sqrt{s} = 7$ TeV, which has been performed with Monte Carlo simulations using PYTHIA8. The results for those fluctuations are presented as a function of the charged-particle multiplicity density and dependent on the number of multi-parton interactions. In addition, the simulations have been performed with and without the color reconnection mechanism. The inclusive results taking into account all numbers of MPIs are very similar in both cases, but for discrete numbers of MPIs they show significant and interesting differences. Finally, the results are compared to the measurements by ALICE.

[1] ALICE Collaboration, B. Abelev et al., Eur. Phys. J. C **74** (2014) 3077. arXiv:1407.5530 [nucl-ex]

HK 75.5 Fri 15:45 T/SR25

Identified charged hadron $p_{\rm T}$ spectra as a function of multiplicity in pp collisions at $\sqrt{s} = 7$ TeV with ALICE — •Benjamin Hess for the ALICE-Collaboration — Universität Tübingen, Phyiskalisches Institut I, Auf der Morgenstelle 14, 72076 Tübingen

The intriguing observation of hadron correlations in high-multiplicity pp collisions at the LHC [1] suggests possible collective effects occurring in "central" pp collisions. The multiplicity dependence of particle ratios is very sensitivity to various final-state effects like hadronisation, colour reconnection, and collective flow that are implemented in hadronic Monte Carlo models.

The ALICE detector provides excellent tracking and particle identification. Charged pions, kaons and (anti-)protons are identified using the TPC specific energy loss (dE/dx) in the momentum range up to about 20 GeV/c. In this talk, the measurements of identified charged hadron spectra (π/K/p) as a function of multiplicity in pp collisions at $\sqrt{s} = 7$ TeV are presented. The multiplicity dependence of the yield ratios is compared to p-Pb and Pb-Pb collisions. In this context, different multiplicity estimators are discussed.

[1] CMS Collaboration, "Observation of Long-Range Near-Side Angular Correlations in Proton-Proton Collisions at the LHC", *JHEP* **1009** (2010) 091, arXiv:1009.4122.

HK 75.6 Fri 16:00 T/SR25

Constraining the Jet-Energy Loss using a Parton Cascade — •Barbara Betz — Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Frankfurt am Main

We have developed a generic jet-energy loss model that has been shown to describe the experimentally measured nuclear modification factor and the high-pT elliptic flow at RHIC and LHC energies when being coupled to state-of-the-art hydrodynamic precriptions. Now we extend this study by using the parton cascade BAMPS to provide the bulk background. We discuss both pQCD-based and AdS/CFT-inspired jet-energy loss prescriptions, the impact of a temperature-dependent

jet-medium coupling, transverse flow, viscosity, as well as the difference between reconstructed and pion jets.

HK 75.7 Fri 16:15 T/SR25

Baryonic Matter Onset in Two-Color QCD with Heavy Quarks — •Philipp Scior[1] and Lorenz von Smekal[1,2] — [1]TU Darmstadt — [2]Justus-Liebig-Universität Gießen

We study the heavy quark limit of two-color QCD by using a three-dimensional Polyakov theory [1]. This theory can be derived from two-color QCD 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 [2,3]. We find evidence for the Silverblaze property and a superfluid phase when the quark chemical potential μ reaches half the diquark mass. For even higher μ we find the deconfinement transition indicated by an increase of the Polyakov loop as well as the quark number density.

[1] M. Fromm et al. , JHEP 2012, 24 (2012) [2] T. Boz et al. , EPJ A 49, 11 (2013) [3] N. Strodthoff and L. von Smekal Phys.Lett. B 731, 350 (2014)