Fachverband Physik der Hadronen und Kerne (HK)

Achim Schwenk
Institut für Kernphysik
Technische Universität Darmstadt
Schlossgartenstr. 2
64289 Darmstadt
schwenk@physik.tu-darmstadt.de

Übersicht der Hauptvorträge und Fachsitzungen

(Plenarsaal, HS 11, 12, 13, 14, 15, 16 und 18; Poster Foyer Nordbau)

Plenar- und Preisträgervorträge

PV I	Mo	9:15–10:00	Plenarsaal	**Status of the FAIR Project** — •Paolo Giubellino
PV II	Mo	10:00–10:45	Plenarsaal	**The dual role of the plasma edge in tokamaks** — •Elisabeth Wolfrum
PV IV	Di	9:00– 9:45	Plenarsaal	**Testing General Relativity with Cosmological Observations** — •Ruth Durrer
PV V	Di	9:45–10:30	Plenarsaal	**On the tension between mathematics and physics** — •Miklos Redei
PV VII	Mi	8:30– 9:15	Plenarsaal	**Reconciling the past and the present: The shared history of physicists and museums** — •Marta C Lourenco
PV VIII	Mi	9:15–10:00	Plenarsaal	**Particle-hole symmetries in condensed matter** — •Martin Zirnbauer
PV IX	Mi	10:00–10:30	Plenarsaal	**Decoding the QCD phase structure with relativistic nuclear collisions** — •Peter Braun-Munzinger
PV X	Mi	10:30–11:00	Plenarsaal	**Charmonia as Probe of Deconfinement - Recent Results and Perspectives** — •Johanna Stachel
PV XIII	Do	9:00– 9:45	Plenarsaal	**Climate change and gravity waves in the middle atmosphere** — •Franz-Josef Lübken
PV XIV	Do	9:45–10:30	Plenarsaal	**Tailoring ultrafast light pulses in waveguides** — •Carsten Fallnich
PV XVIII	Fr	9:00– 9:45	Plenarsaal	**Neutron Star Mass and Radius Measurements and Implications for the Dense Matter Equation of State** — •James Lattimer
PV XIX	Fr	9:45–10:30	Plenarsaal	**Kinetic turbulence simulations for space and laboratory plasmas** — •Daniel Told

Hauptvorträge

HK 2.1	Mo	11:15–11:50	Plenarsaal	**Search for dark matter and other rare/exotic processes with XENON1T/nT** — •Christian Weinheimer
HK 2.2	Mo	11:50–12:25	Plenarsaal	**Dark Sector searches at MESA** — •Luca Doria
HK 2.3	Mo	12:25–13:00	Plenarsaal	**Recent results on direct mass measurements of the heaviest elements with SHIPTRAP** — •Francesca Giacoppo
HK 17.1	Di	11:00–11:35	Plenarsaal	**Laboratories of the Strong Interaction: Exotic Hadrons** — •Sebastian Neubert
HK 17.2	Di	11:35–12:10	Plenarsaal	**Nuclear thermodynamics from chiral effective field theory** — •Corbinian Wellenhofer
HK 17.3	Di	12:10–12:45	Plenarsaal	**Strange hadrons in cold and hot nuclear matter*** — •Joana Wirth
HK 32.1	Mi	11:30–12:05	Plenarsaal	**Where nuclear physics meets quantum optics** — •Adriana Pálffy
HK 32.2	Mi	12:05–12:40	Plenarsaal	**COLLAPS: revealing nuclear structures of short lived isotopes by collinear laser spectroscopy at CERN-ISOLDE** — •Simon Kaufmann
HK 46.1	Do	11:00–11:35	Plenarsaal	**Non-equilibrium dynamics in high-energy Heavy-Ion collisions** — •Soeren Schlichting
HK 46.2	Do	11:35–12:10	Plenarsaal	**Probing the Quark-Gluon Plasma with low-mass dileptons in heavy-ion collisions** — •Raphaelle Bailhache

HK 46.3	Do	12:10–12:45	Plenarsaal	**QCD correlation functions from lattice QCD and the bound-state approach to hadron physics** — •Andre Sternbeck
HK 56.1	Fr	11:30–12:05	Plenarsaal	**Exotic, heavy element abundances in metal-poor dwarf galaxy stars** — •Camilla Juul Hansen
HK 56.2	Fr	12:05–12:40	Plenarsaal	**Nuclear astrophysics with gas targets** — •Konrad Schmidt

Hauptvorträge des fachübergreifenden Symposiums SYMD

Das vollständige Programm dieses Symposiums ist unter SYMD aufgeführt.

SYMD 1.1	Mo	14:00–14:30	Plenarsaal	**Analysis of historical solar Ca II K and sunspot data for irradiance studies** — •Theodosios Chatzistergos
SYMD 1.2	Mo	14:30–15:00	Plenarsaal	**MUSiC: A Model Unspecific Search for New Physics** — •Deborah Duchardt
SYMD 1.3	Mo	15:00–15:30	Plenarsaal	**Search for solar chameleons with an InGrid based X-ray detector at the CAST experiment** — •Christoph Krieger
SYMD 1.4	Mo	15:30–16:00	Plenarsaal	**Positron Annihilation Spectroscopy throughout the Milky Way** — •Thomas Siegert

Hauptvorträge des fachübergreifenden Symposiums SYPA

Das vollständige Programm dieses Symposiums ist unter SYPA aufgeführt.

SYPA 1.1	Mi	14:00–14:30	Plenarsaal	**Laser-driven ion acceleration in plasmas** — •Jörg Schreiber
SYPA 1.2	Mi	14:30–15:00	Plenarsaal	**Laser-driven electron acceleration in plasmas** — •Jeroen van Tilborg
SYPA 1.3	Mi	15:00–15:30	Plenarsaal	**Beam-driven electron acceleration in plasmas** — •Richard D'Arcy
SYPA 1.4	Mi	15:30–16:00	Plenarsaal	**Solar energetic electron events: Trying to understand the role of the shock** — •Nina Dresing
SYPA 2.1	Mi	16:30–17:00	Plenarsaal	**Plasma Wakefield Acceleration: Instabilities and Stabilization** — •Alexander Pukhov
SYPA 2.2	Mi	17:00–17:30	Plenarsaal	**LUX - A Laser-Plasma Driven Undulator Beamline** — •Andreas R. Maier
SYPA 2.3	Mi	17:30–18:00	Plenarsaal	**Magnetic reconnection as a particle accelerator** — •Michael Hesse
SYPA 2.4	Mi	18:00–18:30	Plenarsaal	**Experimental demonstration of proton bunch self-modulation and of electron acceleration in a 10m-long plasma** — •Patric Muggli

Hauptvorträge des fachübergreifenden Symposiums SYPS

Das vollständige Programm dieses Symposiums ist unter SYPS aufgeführt.

SYPS 1.1	Mi	15:00–15:40	HS 5	**Black-hole superradiance: Probing ultralight bosons with compact objects and gravitational waves** — •Paolo Pani
SYPS 1.2	Mi	15:40–16:10	HS 5	**Modelling and analyzing a binary neutron-star merger: Interpreting a multi-messenger picture** — •Tim Dietrich
SYPS 1.3	Mi	16:10–16:40	HS 5	**What can neutron-star mergers reveal about the equation of state of dense matter?** — •Ingo Tews

Fachsitzungen

HK 1.1–1.2	So	16:00–18:00	HS 1	**Tutorial Physics of Neutron Stars (joint session AKjDPG/HK)**
HK 2.1–2.3	Mo	11:15–13:00	Plenarsaal	**Hauptvorträge I**
HK 3.1–3.6	Mo	14:00–16:00	HS 13	**Hadron Structure and Spectroscopy I**
HK 4.1–4.7	Mo	14:00–16:00	HS 15	**Heavy-Ion Collisions and QCD Phases I**
HK 5.1–5.7	Mo	14:00–16:00	HS 14	**Structure and Dynamics of Nuclei I**
HK 6.1–6.6	Mo	14:00–16:00	HS 16	**Nuclear Astrophysics I**
HK 7.1–7.7	Mo	14:00–16:00	HS 11	**Instrumentation I**
HK 8.1–8.8	Mo	14:00–16:00	HS 12	**Instrumentation II**
HK 9.1–9.6	Mo	14:00–15:45	HS 18	**Outreach I**

HK 10.1–10.7	Mo	16:30–18:30	HS 13	**Hadron Structure and Spectroscopy II**
HK 11.1–11.7	Mo	16:30–18:30	HS 15	**Heavy-Ion Collisions and QCD Phases II**
HK 12.1–12.8	Mo	16:30–18:30	HS 14	**Structure and Dynamics of Nuclei II**
HK 13.1–13.5	Mo	16:30–18:30	HS 16	**Fundamental Symmetries I**
HK 14.1–14.6	Mo	16:30–18:15	HS 11	**Instrumentation III**
HK 15.1–15.6	Mo	16:30–18:15	HS 12	**Instrumentation IV**
HK 16.1–16.3	Mo	16:30–17:30	HS 18	**Outreach II**
HK 17.1–17.3	Di	11:00–12:45	Plenarsaal	**Hauptvorträge II**
HK 18.1–18.7	Di	14:00–16:00	HS 13	**Hadron Structure and Spectroscopy III**
HK 19.1–19.6	Di	14:00–15:45	HS 15	**Heavy-Ion Collisions and QCD Phases III**
HK 20.1–20.5	Di	14:00–15:15	HS 12	**Heavy-Ion Collisions and QCD Phases IV**
HK 21.1–21.7	Di	14:00–16:00	HS 14	**Structure and Dynamics of Nuclei III**
HK 22.1–22.6	Di	14:00–15:45	HS 16	**Structure and Dynamics of Nuclei IV**
HK 23.1–23.6	Di	14:00–16:00	HS 18	**Astroparticle Physics I**
HK 24.1–24.8	Di	14:00–16:00	HS 11	**Instrumentation V**
HK 25.1–25.7	Di	16:30–18:30	HS 13	**Hadron Structure and Spectroscopy IV**
HK 26.1–26.6	Di	16:30–18:15	HS 15	**Heavy-Ion Collisions and QCD Phases V**
HK 27.1–27.7	Di	16:30–18:30	HS 14	**Structure and Dynamics of Nuclei V**
HK 28.1–28.5	Di	16:30–18:00	HS 16	**Nuclear Astrophysics II**
HK 29.1–29.7	Di	16:30–18:30	HS 18	**Astroparticle Physics II**
HK 30.1–30.6	Di	16:30–18:30	HS 11	**Instrumentation VI**
HK 31.1–31.7	Di	16:30–18:30	HS 12	**Instrumentation VII and Applications**
HK 32.1–32.2	Mi	11:30–12:40	Plenarsaal	**Hauptvorträge III**
HK 33.1–33.6	Mi	14:00–16:00	HS 13	**Hadron Structure and Spectroscopy V**
HK 34.1–34.7	Mi	14:00–16:00	HS 15	**Heavy-Ion Collisions and QCD Phases VI**
HK 35.1–35.6	Mi	14:00–15:45	HS 12	**Heavy-Ion Collisions and QCD Phases VII**
HK 36.1–36.7	Mi	14:00–16:00	HS 14	**Structure and Dynamics of Nuclei VI**
HK 37.1–37.7	Mi	14:00–16:00	HS 16	**Structure and Dynamics of Nuclei VII**
HK 38.1–38.6	Mi	14:00–15:45	HS 18	**Nuclear Astrophysics III**
HK 39.1–39.6	Mi	14:00–15:45	HS 11	**Instrumentation VIII**
HK 40.1–40.7	Mi	16:30–18:30	HS 13	**Hadron Structure and Spectroscopy VI**
HK 41.1–41.7	Mi	16:30–18:30	HS 15	**Heavy-Ion Collisions and QCD Phases VIII**
HK 42.1–42.7	Mi	16:30–18:30	HS 14	**Structure and Dynamics of Nuclei VIII**
HK 43.1–43.7	Mi	16:30–18:30	HS 16	**Astroparticle Physics III**
HK 44.1–44.7	Mi	16:30–18:30	HS 11	**Instrumentation IX**
HK 45.1–45.7	Mi	16:30–18:30	HS 12	**Instrumentation X and Applications**
HK 46.1–46.3	Do	11:00–12:45	Plenarsaal	**Hauptvorträge IV**
HK 47.1–47.7	Do	14:00–16:00	HS 13	**Hadron Structure and Spectroscopy VII**
HK 48.1–48.7	Do	14:00–16:00	HS 15	**Heavy-Ion Collisions and QCD Phases IX**
HK 49.1–49.7	Do	14:00–16:00	HS 14	**Structure and Dynamics of Nuclei IX**
HK 50.1–50.6	Do	14:00–15:45	HS 16	**Structure and Dynamics of Nuclei X**
HK 51.1–51.4	Do	14:00–15:15	HS 18	**Nuclear Astrophysics IV**
HK 52.1–52.7	Do	14:00–16:00	HS 11	**Instrumentation XI, Accelerators and Applications**
HK 53.1–53.7	Do	14:00–16:00	HS 12	**Instrumentation XII**
HK 54.1–54.76	Do	16:30–19:00	Foyer Nordbau	**Poster**
HK 55	Do	19:00–21:00	HS 15	**Mitgliederversammlung**
HK 56.1–56.2	Fr	11:30–12:40	Plenarsaal	**Hauptvorträge V**
HK 57.1–57.6	Fr	14:00–15:45	HS 13	**Hadron Structure and Spectroscopy VIII**
HK 58.1–58.7	Fr	14:00–16:00	HS 15	**Heavy-Ion Collisions and QCD Phases X**
HK 59.1–59.7	Fr	14:00–16:00	HS 14	**Structure and Dynamics of Nuclei XI**
HK 60.1–60.5	Fr	14:00–15:30	HS 16	**Nuclear Astrophysics V**
HK 61.1–61.5	Fr	14:00–15:45	HS 18	**Fundamental Symmetries and Astroparticle Physics**
HK 62.1–62.6	Fr	14:00–15:45	HS 11	**Instrumentation XIII**
HK 63.1–63.6	Fr	14:00–15:45	HS 12	**Instrumentation XIV**

Abendvortrag

PV XII	Mi	19:30–21:30	Plenarsaal	**Urknall, Sternenstaub und Frage nach der Entstehung des Lebens** — •Andreas Burkert

Mittagsvorträge

PV III	Mo	13:00–13:45	HS 12	**Umgang mit Geld als Physikerin und Mutter** — •Friederike Lichtenegger
PV VI	Di	13:00–13:45	HS 12	**Highway to Intellectual Property – ein persönlicher Werdegang** — •Carmen Tesch-Biedermann
PV XI	Mi	13:00–13:45	HS 12	**Wieso? Weshalb? Warum? Ein theoretischer Physiker in der Supply Chain** — •Markus Pfannmüller
PV XV	Do	13:00–13:45	HS 12	**Vom Doktorhut zum Vorstandshemd: Physiker können auch Unternehmer** — •Wilhelm Kaenders
PV XVI	Do	13:00–13:30	HS 4	**Forschungsförderung durch die DFG – ein Überblick** — •Wolfgang Müssel
PV XVII	Do	13:30–14:00	HS 4	**ErUM-Pro: Projektförderung im BMBF-Rahmenprogramm „Erforschung von Universum und Materie“** — •Hanna Mahlke

Mitgliederversammlung Fachverband Physik der Hadronen und Kerne

Donnerstag 19:00–21:00 HS 15

HK 1: Tutorial Physics of Neutron Stars (joint session AKjDPG/HK)

Zeit: Sonntag 16:00–18:00 Raum: HS 1

Tutorium HK 1.1 So 16:00 HS 1

Birth and Death of Neutron Stars — •Hans-Thomas Janka — Max Planck Institute for Astrophysics, Garching, Germany

Neutron stars are born in catastrophic explosions of massive stars as supernovae, and they can get destroyed during the violent collision with a companion star in a close binary system. Such events belong to the most energetic phenomena in the universe, and they are among the brightest cosmic sources of electromagnetic radiation, neutrinos, and gravitational waves. Therefore they are prime targets in the new era of multi-messenger astronomy, which has received an enormous boost by the recent first measurement of gravitational waves from the late inspiral phase of two neutron stars, followed moments afterwards by the detection of a short gamma-ray burst and the discovery of the kilonova emission from a radioactively heated cloud of ejecta. Such events offer unique possibilities to probe regimes of extreme gravitational, particle, nuclear, and plasma physics that are hardly accessible by laboratory experiments. Our understanding of the complex processes taking place in the astrophysical sources and of their interplay on microscopic and macroscopic scales heavily relies on numerical simulations, which are indispensable to make quantitative predictions of observables and to interpret the measured signals. The tutorial will discuss recent progress of three-dimensional computational modeling in this fast-advancing field.

Tutorium HK 1.2 So 17:00 HS 1

Introduction to nuclear physics of neutron stars — •Ingo Tews — Theoretical Division (T-2), Los Alamos National Laboratory, Los Alamos, NM 87545

Neutron stars are fascinating stellar objects born in core-collapse supernovae. Their masses reach up to two solar masses but their radii are of the order of only 10 km. Due to these extremely high densities, up to 10^{15} g/cm^3 in their cores, neutron stars represent ideal laboratories for fundamental physics. In particular, neutron stars probe nuclear physics at densities far beyond the regime accessible in terrestrial experiments.

In this presentation, I will give an introduction to the nuclear physics relevant for the structure of neutron stars. I will present current state-of-the-art results for the equation of state of neutron-star matter and neutron-star properties, and discuss current observational limits.

HK 2: Hauptvorträge I

Zeit: Montag 11:15–13:00 Raum: Plenarsaal

Hauptvortrag HK 2.1 Mo 11:15 Plenarsaal

Search for dark matter and other rare/exotic processes with XENON1T/nT — •Christian Weinheimer — Institut für Kernphysik, University of Münster, Münster, Germany

Cosmological observations at very different scales provide evidence for dark matter, which neither can consist of baryonic matter nor can be normal neutrinos. Several candidates for this dark matter are proposed: Weakly interacting Massive Particles (WIMPs) arise naturally in many models beyond the Standard Model and solve at the same time the hierarchy problem. Other candidates are axions solving additionally the CP-problem of QCD or sterile neutrinos with keV masses.

The XENON experiments searching directly for WIMPs at the Italian underground laboratory LNGS use dual-phase xenon TPCs with ultralow background and very low threshold. XENON1T has just been finished after collecting an exposure of 1 t yr. It is giving the most stringent limits on the spin-independent WIMP-nucleon and WIMP-pion cross sections. The WIMP search will go on with XENONnT possessing a xenon mass of 8 t at an even lower background.

After an introduction, the current results of XENON1T and the status of XENONnT will be presented in this talk. Special emphasis will be given on different possible interactions of WIMPs with the nucleus and how they can be distinguished in the case of a WIMP discovery. The XENON detectors with their large mass and their low background rates can also look for other exotic or rare processes. The current status of the search for double electron capture of Xe-124 and for neutrinoless double beta decay of Xe-136 will be given.

Hauptvortrag HK 2.2 Mo 11:50 Plenarsaal

Dark Sector searches at MESA — •Luca Doria[1,2], Patrick Achenbach[1,2,3], Mirco Christmann[1,2,3], and Achim Denig[1,2,3] — [1]Institut fuer Kernphysik, Johannes Gutenberg-Universitaet Mainz, Johann-Joachim-Becher-Weg 45 D 55128 Mainz — [2]PRISMA Cluster of Excellence — [3]Helmholtz Institute Mainz, Germany

The Mainz Energy Recovery Superconducting Accelerator (MESA) at the Institute for Nuclear Physics of the Johannes-Gutenberg University in Mainz will provide intense electron beams for a wide subatomic physics program. The MESA 155 MeV energy, 100% duty cycle beam will be delivered to three different experiments. One experiment is called MAGIX: a flexible two-spectrometer setup taking advantage of the high beam current available together with an internal gas-jet target. The second is a beam-dump experiment explicitly designed for dark matter searches. The third experiment P2 is devoted to the high-precision measurement of the electroweak mixing angle. In this talk I will focus in particular on the dark matter program at MESA, describing the experiments involved and their expected performance.

Hauptvortrag HK 2.3 Mo 12:25 Plenarsaal

Recent results on direct mass measurements of the heaviest elements with SHIPTRAP — •Francesca Giacoppo for the SHIPTRAP-Collaboration — GSI Darmstadt — HIM Mainz

During summer 2018 direct mass measurements of transfermium isotopes such as ^{251}No (Z=102), ^{254}Lr (Z=103) as well as the first superheavy element ^{257}Rf (Z=104) have been successfully achieved, for the first time, with the SHIPTRAP mass spectrometer. Moreover, exploiting the enhanced resolving power of the Phase-Imaging Ion-Cyclotron-Resonance technique, it was also possible to directly resolve, for the first time, the low-lying isomeric states ^{251m}No and ^{254m,255m}Lr and the K^{π}=8$^-$ isomer ^{254m}No with a Penning-trap system. These results will shed light on the nuclear shell effects that determine regions of enhanced shell stabilization as for instance nearby the deformed neutron shell at N=152 and are closely linked to the existence of such heavy nuclei as bound systems. Furthermore, such investigations will enable a better understanding of the nature of the underlying strong interaction at the upper limit of the nuclear chart and will help to constrain predictions for the next spherical shell closures, expected by different models around Z=114, N=184, the so-called island of stability.

Such challenging experiments face the problem of very low production rates, down to few ions per hour(s) which demand a very efficient ion preparation and manipulation, coupled with a high-detection sensitivity and resolving power. In this talk an overview of the latest optimization and enhanced performances of the SHIPTRAP setup will be presented together with the recent experimental results.

HK 3: Hadron Structure and Spectroscopy I

Zeit: Montag 14:00–16:00 Raum: HS 13

Gruppenbericht HK 3.1 Mo 14:00 HS 13

Meson transition form factor measurements with A2 — •Lena Heijkenskjöld for the A2-Collaboration — Johannes Gutenberg-Universität, Mainz, Germany

A meson transition form factor (TFF) describes the dynamics of the transition between photons and mesons and hence provide an important probe of the intrinsic structure of mesons. High statistics measurements of pseudoscalar TFFs also play a role for the precision frontier of the Standard Model (SM) as they are needed to describe the hadronic Light-by-Light scattering contribution to the SM calculation of the anomalous magnetic moment of the muon. Within the time-like region, the pseudoscalar TFFs can be accessed in decays of π^0, η, ω or η' mesons.

The A2 experiment at the Mainz Microtron provides a high yield of light mesons produced by photo-induced reactions on protons, which makes the experiment ideal for precision measurements of meson TFFs. Both completed and upcoming contributions to such measurements by the A2 collaboration will be presented.

Gruppenbericht HK 3.2 Mo 14:30 HS 13

Measurement of the space-like transition form factor and study of direct production of χ_{c1} at BESIII — Achim Denig, Tong Liu, •Yuping Guo, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Mainz, Germany

The transition form factors (TFF) of mesons are important experimental inputs to the calculation of the hadronic light-by-light (HLbL) contribution of muon anomaly, a_μ. The HLbL contribution is one of the two limitations of the accuracy of the theoretical calculation. The TFFs can be measured in space-like regime through two-photon process at e^+e^- collision machine, such as BESIII. The advantage of the measurement at BESIII is that the working center-of-mass (CM) energy allows measurement of the TFF in relative low Q^2 region, which is the relevant kinematic region for the calculation. The measurements of the TFF of π^0 as a function of Q^2 from 0.3 to 3.0 GeV^2 and the amplitude of $\pi^+\pi^-$ with Q^2 from 0.1 to 4.0 GeV^2 will be presented.

In gamma-gamma interactions, a direct production of non-vector resonances becomes possible at e^+e^- accelerators. Currently, only the direct production of vector meson with $J^{PC} = 1^{--}$ has been observed, mesons with other quantum numbers are produced through the decays of the vector mesons. With a dedicated set of four data samples collected at CM energies around the χ_{c1} mass, the direct production of χ_{c1} in e^+e^- machine has been studied. The status of the analysis will be presented.

HK 3.3 Mo 15:00 HS 13

Measurement of the Hadronic R Value at BESIII — •Thomas Lenz, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

The running QED coupling constant at the Z pole $\alpha_{\mathrm{QED}}(M_Z^2)$ provides, alongside the anomalous magnetic moment of the muon $a_\mu = (g_\mu - 2)/2$, an important precision test of the Standard Model. Their theorectical uncertainties are dominated by the hadronic vacuum polarization. Precise experimental measurements of the hadronic R value $R_{\mathrm{had}} = \sigma(e^+ e^- \to \mathrm{Hadrons})/\sigma(e^+ e^- \to \mu^+ \mu^-)$ are used to reduce these uncertainties.

The BESIII experiment at the $e^+ e^-$ collider BEPCII in Beijing has collected data at 130 different energies between 2.0 GeV and 4.6 GeV for measuring the hadronic R value with at least 10^5 hadronic events at each data point. This presentation gives an overview about the current status of that analysis and also discusses the feasability of using the initial state radiation technique to measure the R value in a continous spectrum.

Supported by DFG (SFB 1044).

HK 3.4 Mo 15:15 HS 13

Measurement of the π^0 transition form factor at MAMI — •Luigi Capozza[1,2,3], Alaa Dbeyssi[1], Frank Maas[1,2,3], Oliver Noll[1,2], David Rodríguez Piñeiro[1], Sahra Wolff[1,2], and Manuel Zambrana[1,2] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

An important uncertainty on the hadronic corrections to the anomalous magnetic moment of the muon comes from the so-called "light-by-light scattering" contributions. To estimate such contributions, data on the π^0 transition form factor, parametrising the effective coupling of the neutral pion with the electromagnetic field, are useful. One way to access this form factor is measuring the π^0 electroproduction cross section in the Primakoff kinematical regime. Feasibility studies for this measurement by upgrading the A1 facility at MAMI with the PANDA backward calorimeter within the framework of the phase 0 of the FAIR project will be reported.

HK 3.5 Mo 15:30 HS 13

Electromagnetic Transition Form Factors of the η and ω Mesons — •Susan Schadmand — Forschungszentrum Jülich

Electromagnetic transition form factors are determined via meson decays into final states with dileptons. Form factors are evaluated as a function of the momentum transfer which is identical to the invariant mass of the dileptons. The results provide basic knowledge of the structure of hadrons and address the validity of vector meson dominance. The transition form factors are of special interest on account of the impact on the interpretation of the g-2 measurements. Here, light-by-light scattering is an important factor. The talk will include experimental results from the experiments WASA at COSY and CLAS at Jefferson Lab.

HK 3.6 Mo 15:45 HS 13

Measurement of the η space-like transition form factor at BESIII — •Theodoros Manoussos, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

Transition form factors (TFF) of light pseudoscalar mesons play an essential role in the calculation of the hadronic light-by-light contributions of the anomalous magnetic moment of the muon, a_μ. To increase the accuracy of its Standard Model prediction to the level of the expected accuracy of the new direct measurements of a_μ, especially the contribution due to the TFF of the η meson must be well understood. Based on data collected by the BESIII experiment at the Beijing Electron Positron Collider II (BEPCII), at center of mass energies at 4.178 GeV, the η meson production in photon photon collisions is studied. The analysis aims at the determination of the space-like η transition form factor in the region of momentum transfer below 3 GeV^2. In this presentation an overview of the current status of the analysis will be reported.

Supported by DFG(SFB1044)

HK 4: Heavy-Ion Collisions and QCD Phases I

Zeit: Montag 14:00–16:00 Raum: HS 15

Gruppenbericht HK 4.1 Mo 14:00 HS 15

Energy and system size dependent charged-particle production measured with ALICE — •Patrick Huhn — IKF, Goethe Universität Frankfurt am Main, Deutschland

The ALICE experiment at the LHC is designed to investigate the properties of the so-called Quark-Gluon Plasma (QGP) by studying high-energy pp, p-Pb, Pb–Pb and recently for the first time Xe–Xe collisions. Such a hot and dense deconfined QCD medium (the QGP) is created in collisions of Pb- or Xe-ions at high center-of-mass energies. High energetic quarks and gluons created in the early phase of the collision traveling through the plasma loose energy (parton energy loss). Such medium effects can be examined by comparing the produc-

tion of charged particles in heavy-ion collisions with the production in pp collisions where no medium is created. This comparison is usually expressed by means of the nuclear modification factor R_{AA}, the ratio of the yield in A–A collisions and the yield in pp collisions scaled by the number of binary collisions.
In this talk, we present the analysis of transverse-momentum distributions for primary charged particles as well as the nuclear modification factors in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV and 5.02 TeV and in Xe-Xe collisions at $\sqrt{s_{\mathrm{NN}}} = 5.44$ TeV measured with ALICE. In particular, we focus on a comparison of the nuclear modification factors in Pb-Pb and Xe-Xe collisions to investigate a possible system size and energy dependence of R_{AA}.

HK 4.2 Mo 14:30 HS 15

Study of the path length dependence of jet quenching in relativistic heavy-ion collisions with JEWEL — •Luisa Bergmann for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

In relativistic heavy-ion collisions, a deconfined medium with high energy density is created, the quark-gluon plasma. Amongst other observables, jets – originating from primordial hard scatterings – act as useful probes for the properties of this medium. As the initial partons traverse the quark-gluon plasma, they lose energy by interacting with the constituents of the medium. The study of this so called "jet quenching" yields insight into the interaction properties of the medium.

This talk focuses on the study of correlation functions. By analyzing the angular dependence of the distribution of charged hadrons in two particle and multi-hadron correlations, one obtains information about the path-length dependent energy loss of jets in the medium. To provide a well formed basis for future data analyses, the study of correlations is first performed with models, in particular by employing JEWEL. The usage of Monte-Carlo event generators offers the possibility to gain knowledge about the interaction processes in a controlled environment, which can then be used to understand structures in real data. This information ultimately helps to constrain the models on energy loss and on interactions of colored probes and media.

HK 4.3 Mo 14:45 HS 15

Influence of modified (non-)strange hadron spectra on statistical hadronization model calculations — Anton Andronic[1], Peter Braun-Munzinger[2], •Yannick Kirchhoff[3], Markus Köhler[3], and Johanna Stachel[3] — [1]Westfälische Wilhelms-Universität Münster, Institut für Kernphysik, Münster, Germany — [2]Research Division and ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany

A major interest in heavy-ion collisions is the investigation of the QCD phase transition from a Quark-Gluon Plasma to hadronic matter. One tool to study this phase transition is the statistical hadronization model. It describes the produced hadron densities in the fireball using a (thermal) fit to hadron yields with only a few parameters and has shown to be successful over a broad range of collision energies up to lead-lead collisions at the LHC. The results of the thermal fits depend on the included hadron spectrum. In this contribution, the impact is studied considering additional (non-)strange hadron states predicted by LQCD or the constituent quark model, particularly regarding deviations in the proton yields seen in earlier fits to LHC data. It will be shown that this problem cannot be solved by adding further hadron states but that, in fact, these states lead to a massive deterioration of the fit. This will be interpreted by applying a correction, making use of the description of statistical mechanics in terms of the S-matrix.

HK 4.4 Mo 15:00 HS 15

Multi-differential measurement of correlated pion-proton pairs in Au+Au collisions at $\sqrt{s_{NN}} = 2.42\ GeV$ with HADES.* — •Georgy Kornakov for the HADES-Collaboration — TU Darmstadt

The study of hadron formation and their properties in hot and dense QCD matter is one of the main topics in sub-nuclear physics. The short-lived states (∼1 fm/c), produced and decayed within the QCD matter contain fundamental information about the surrounding medium created in collisions of heavy-ions at relativistic energies. HADES measures rare and penetrating probes in the regime of 1-2 GeV kinetic energy per nucleon. Excitation of baryonic resonances is a key mechanism for meson, dilepton and strangeness production. The measured multi-differential spectra of mass, rapidity and transverse momentum of π^+p and π^-p correlated pairs from Au+Au collisions are going to be presented in this contribution as well as the developed methods for their reconstruction and comparison to previous measurements.

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

HK 4.5 Mo 15:15 HS 15

Multiplicity dependent charged particle p_{T} spectra with ALICE at the LHC — •Mario Krüger — Institut für Kernphysik, Goethe-Universität Frankfurt

The study of the Quark-Gluon Plasma created in ultrarelativistic heavy-ion collisions at the CERN-LHC is complemented by reference measurements in proton-lead (p–Pb) and proton-proton (pp) collisions, where the effects of multiple-parton interactions and hadronization beyond independent string fragmentation can be investigated.

In this talk, we present an unfolding procedure based on the iterative D'Agostini method to reconstruct the correlation between transverse momentum (p_{T}) spectra of charged particles and the corresponding charged-particle multiplicities N_{ch}. The unfolded spectra are presented in single multiplicity ($\Delta N_{\mathrm{ch}} = 1$) bins and are used to derive moments of the p_{T} distributions for a variety of energies and system sizes.

Supported by BMBF and the Helmholtz Association.

HK 4.6 Mo 15:30 HS 15

R_{AA} studies in Xe-Xe and Pb-Pb collisions with ALICE — •Richard Kaiser for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

Transverse momentum (p_T) spectra of charged particles at mid-pseudorapidity in Xe-Xe collisions at $\sqrt{s_{NN}} = 5.44$ TeV measured with the ALICE apparatus at the Large Hadron Collider (LHC) are reported. The kinematic range $0.15 < p_T < 50$ GeV/c and $|\eta| < 0.8$ is covered. Results are presented in nine classes of collision centrality in the 0-80% range. The charged-particle multiplicity $\frac{dN_{ch}}{d\eta}|_{\eta|<0.8}$ in Pb-Pb collisions is matched to those in Xe-Xe collisions. The nuclear modification factor (R_{AA}) in central Xe-Xe collisions and Pb-Pb collisions shows a remarkable similarity at $p_T < 1$ GeV/c. These results from the two colliding systems with significantly different size provide insight on the path length dependence of medium-induced parton energy loss.

HK 4.7 Mo 15:45 HS 15

Understanding soft hadron production at RHIC and LHC energies — •Damir Devetak for the ALICE Collaboration — PI, Heidelberg

The Quark-Gluon Plasma (QGP), created in ultra-relativistic heavy-ion collisions, is a system of strongly interacting partons. Experimental evidence from RHIC and LHC points towards a fluid-like behaviour of the formed QGP during its expansion. Here we concentrate on transverse momentum spectra of identified particles for central collisions as a function of collision energy in the ranges of RHIC and LHC. We investigate in detail how well experimental data are described by a fluid model based on causal relativistic fluid dynamics, including a Cooper-Frye type kinetic freeze-out and subsequent strong resonance decays. Also the dependence on model parameters such as the initial energy density, freeze-out temperature and viscosities will be discussed.

HK 5: Structure and Dynamics of Nuclei I

Zeit: Montag 14:00–16:00 Raum: HS 14

Gruppenbericht HK 5.1 Mo 14:00 HS 14

The FRS Ion Catcher: Status, Results and Outlook — •Daler Amanbayev for the The FRS Ion Catcher-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

In the Fragment Separator (FRS) at GSI, exotic nuclei are produced by projectile fragmentation and fission at relativistic energies, separated in-flight and range-bunched. In the FRS Ion Catcher experiment (FRS-IC), nuclides are thermalized and stopped in a Cryogenic Stopping Cell (CSC), transported via versatile RFQ beamline to a Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) for high precision mass measurements or isobar and isomer separation.

Masses of more than 30 short-lived isotopes were measured with accuracies down to 6×10^{-8}, as well as 6 isomers with excitation energies down to 300 keV were observed.

A novel technique for measuring half-lives and decay branching ratios was developed. Feasibility measurements were carried out with ^{216}Po alpha decay and ^{119n}Sb isomer-to-ground transition. These results, recent technical upgrades and approved experiments for FAIR Phase-0 will be presented.

The FRS-IC also serves as a prototype for the future Ion Catcher at the Low-Energy-Branch (LEB) of the Super-FRS at FAIR. Latest results of the next-generation CSC for the LEB with higher rate capability (10^7 ions per second), shorter extraction time (5 ms) and higher areal density (30 mg/cm^2) will be discussed.

HK 5.2 Mo 14:30 HS 14

Statue report of PUMA project — •Noritsugu Nakatsuka[1], Alexandre Obertelli[1], Jaume Carbonell[4,7], Anna Corsi[7], Freddy Flavigny[4], Herbert De Gersem[1], Guillaume Hupin[4], Yuki Kubota[1], Rimantas Lazauskas[3], Stephan Malbrunot[2], Nicolas Marsic[1], Wolfgang Müller[1], Sarah Naimi[5], Nancy Paul[5], Patrice Pérez[2,7], Emmanuel Pollacco[7], Marco Rosenbusch[5], Ryoichi Seki[6], Tomohiro Uesaka[5], Frank Wienholtz[2], Jonas Fischer[1], and Alexander Schmidt[1] — [1]Technische Universität Darmstadt, Germany — [2]CERN, Geneva, Switzerland — [3]Institut Hubert Curien, CNRS, France — [4]Institut de Physique Nucléaire, Orsay, CNRS, France — [5]RIKEN Nishina Center, Wakoshi, Japan — [6]RCNP, Osaka, Japan — [7]CEA, IRFU, Université Paris-Saclay, France

PUMA: antiProton Unstable Matter Annihilation is a starting project aimed at measuring annihilation of antiprotons with short-lived nuclei. The objective of PUMA is to determine the surface neutron/proton density profile of short-lived nuclei using the annihilation with antiprotons. The experiments will be carried out at CERN. We are developing a transportable device that can store, transport, and annihilate antiprotons with the short-lived nuclei, so that we can bring antiprotons from ELENA to short-lived nuclei produced at ISOLDE. The PUMA will consists of superconducting solenoid, ion traps for the storage and annihilation, and a detection system for the annihilation products. The development status of the PUMA ion trap will be presented.

HK 5.3 Mo 14:45 HS 14

Invariant-Mass Spectroscopy at the low-Z Shore of the Island of Inversion — •Julian Kahlbow[1], Thomas Aumann[1,2], Yosuke Kondo[3], and Heiko Scheit[1] for the NeuLAND-SAMURAI-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Department of Physics, Tokyo Institute of Technology, Japan

The so-called “island of inversion” is a region in the nuclear landscape where shell-structure changes are observed and in particular the magic neutron number at $N = 20$ vanishes. For those nuclei at $Z = 10 - 12$ and around $N = 20$, the shell gap at $N = 20$ quenches and pf-shell intruder configurations become important. We address the question how strong such configurations are for very neutron-rich but $Z = 9$ fluorine isotopes. Such exotic nuclei are produced at the radioactive-ion beam factory (Japan) at beam energies around 250 MeV/u. ^{29}F* & ^{30}F are studied in inverse kinematics at the SAMURAI experimental setup by $(p, 2p)$ reactions on neon isotopes. The two and one neutron-unbound states, respectively, are investigated in terms of invariant-mass spectroscopy where the decay neutrons are measured explicitly. The resulting excitation-energy spectra are compared to different shell-model based calculations. Moreover, ^{29}F* shows a strong two-neutron sequential decay that is also analyzed by means of Jacobi coordinates.

This work is supported by the DFG through grant no. SFB 1245, the BMBF under contract no. 05P15RDFN1, and the GSI-TU Darmstadt cooperation agreement.

HK 5.4 Mo 15:00 HS 14

Enhanced quadrupole and octupole strength in doubly-magic ^{132}Sn — D. Rosiak, •M. Seidlitz, and P. Reiter for the IS551 Miniball and HIE-ISOLDE-Collaboration — Institut für Kernphysik, Universität zu Köln

The first 2^+ and 3^- states of the doubly-magic nucleus ^{132}Sn were populated via safe Coulomb excitation at HIE-ISOLDE, CERN, employing the highly-efficient MINIBALL array. ^{132}Sn ions with a beam energy of 5.49 MeV/nucleon were impinged on a ^{206}Pb target. De-exciting γ rays from the low-lying excited states of the target and the projectile were recorded in coincidence with scattered particles. Reduced $E1$, $E2$, and $E3$ transition strengths were determined. A locally enhanced $B(E2; 0^+_{\text{g.s.}} \rightarrow 2^+_1)$ strength at doubly-magic ^{132}Sn is found and confronted with the microscopic description of the structure of the respective states within different theoretical approaches. The results provide crucial information on cross-shell configurations which were determined for the first time within state-of-the-art shell-model (LSSM, MCSM) and mean-field calculations (RPA). The presented results of experiment and theory can be considered to be the first direct verification of the sphericity and double-magicity of ^{132}Sn.

Supported by the German BMBF (Contract No. 05P15PKCIA, 05P18PKCIA, and Verbundprojekt No. 05P2015) and by European Union’s Horizon 2020 programm (Grant Agreement No. 654002).

HK 5.5 Mo 15:15 HS 14

Coulex of ^{142}Xe — •Corinna Henrich for the IS548-MINIBALL-Collaboration — TU Darmstadt, Darmstadt, Germany

Coulomb excitation is a perfect tool to investigate the structure of ^{142}Xe as it gives access to quadrupole as well as octupole collectivity. The isotope is of particular interest as it is located in a region through which the r-process is expected to pass and also as it is in the proximity of ^{144}Ba, which shows the largest octupole collectivity in the region. The experimental campaign was carried out at HIE-ISOLDE (CERN) in 2016. After undergoing "safe" Coulomb excitation, beam and target nuclei were detected with C-REX, an array of segmented Si detectors, which covers forward and backward angles. The MINIBALL spectrometer was used to detect the emitted gamma rays in coincidence.

This work is supported by BMBF under contract 05P15RDCIA and 05P18RDCIA, by the EU under contract ENSAR 262010 and by ISOLDE.

HK 5.6 Mo 15:30 HS 14

Phase-0 Experiments using the R3B CALIFA Demonstrator — •Lukas Ponnath for the R3B-Collaboration — TU München, Deutschland

Studies on the rapid neutron capture process (r-process) nucleosynthesis try to clarify the origin of the heaviest elements in the universe, which was once titled as "one of the 11 greatest unanswered questions of mondern physics". A deep insight and understanding of the structure of exotic (neutron rich) nuclei is mandatory in order to model the r-process under different astrophysical conditions.

The upcoming R3B (Reactions with Relativistic Radioactive Ion Beams) experiment at the research facility FAIR, currently under construction in Darmstadt, will enable a kinematic complete measurements to gain a deep insight to the nuclear structure far from stability.

One of the key instruments of the R3B experimental setup will be the highly segmented CALIFA calorimeter surrounding the R3B reaction target. For in flight detection of gamma-rays and light charged particles this will provide unique resolution for relativistic beam energies.

We will present first results of the Phase-0 experiments of R3B scheduled for February 2019 with the CALIFA demonstrator combined R3B detectors and the GLAD magnet for the first time.

HK 5.7 Mo 15:45 HS 14

Fission cross section measurements of ^{235}U and ^{242}Pu — •Hans Hoffmann[1,2], Toni Kögler[1,2], Roland Beyer[1], Arnd R. Junghans[1], and Ralf Nolte[3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany — [3]Physikalisch-Technische Bundesanstalt, 38116 Braunschweig, Germany

At Physikalisch-Technische Bundesanstalt the neutron-induced fission cross sections of ^{235}U and ^{242}Pu have been measured using parallel plate fission ionization chambers with novel, large area actinide deposits made in the Institute of Nuclear Chemistry, Mainz (A. Vascon *et al.*, Appl. Radiat. Isotopes **95** (2015) 36). The fission cross section of ^{242}Pu has been measured at 15 MeV using quasimonoenergetic neutrons from the DT reaction, which is above the threshold for second chance fission. These data extend the measurement done at HZDR's neutron time of flight facility nELBE to higher neutron energy (T. Kögler et al., Phys. Rev. C (2019) in press)). A status report of the experiment and data analysis will be given. This work has been supported by the German Federal Ministry of Education and Research (PTKA-WTE 02NUK13A).

HK 6: Nuclear Astrophysics I

Zeit: Montag 14:00–16:00 Raum: HS 16

Gruppenbericht HK 6.1 Mo 14:00 HS 16

Recent progress at the LUNA deep underground accelerator: The ^{22}Ne$(p,\gamma)^{23}$Na, ^{22}Ne$(\alpha,\gamma)^{26}$Mg, and ^{2}H$(p,\gamma)^{3}$He reactions — •Daniel Bemmerer[1], Klaus Stöckel[1,2], and Tamás Szücs[1] for the LUNA-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]TU Dresden, Germany

New data from the LUNA 0.4 MV accelerator in Italy's Gran Sasso lab will be reviewed. After the discovery of three new ^{22}Ne$(p,\gamma)^{23}$Na resonances, very recently the study of this nuclear reaction has been completed with stringent upper limits on two hypothetical resonances at ultra-low energy (Phys. Rev. Lett. 121, 172701 (2018)). A key uncertainty has been removed from the so-called hot-bottom burning process in asymptotic giant branch stars, enabling studies of the anticorrelated Na and O abundances in globular cluster stars. – The ^{22}Ne$(\alpha,\gamma)^{26}$Mg reaction competes against one of the main neutron source reactions of the astrophysical s-process. One of several poorly known resonances is in the LUNA 0.4 MV energy range and under study there. – Measurements of the primordial ^{2}H abundance have rekindled hope to decisively improve the precision of Big Bang nucleosynthesis constraints on the primordial baryon to photon ratio. However, the interpretation of the ^{2}H abundance data is limited by the imprecise knowledge on ^{2}H destruction by the ^{2}H$(p,\gamma)^{3}$He reaction. A study of this reaction directly in the Big Bang energy window is underway at LUNA. – Finally, an update will be given on the progress of the construction of the new, 3.5 MV underground ion accelerator LUNA-MV in Gran Sasso hall B. – Supported by DFG (BE 4100/4-1).

Gruppenbericht HK 6.2 Mo 14:30 HS 16

Status of the Felsenkeller underground accelerator for nuclear astrophysics — •Daniel Bemmerer[1], Thomas E. Cowan[1,2], Marcel Grieger[1,2], Sebastian Hammer[1,2], Thomas Hensel[1,2], Arnd R. Junghans[1], Felix Ludwig[1,2], Conrad Möckel[1,2], Bernd Rimarzig[1], Stefan Reinicke[1,2], Simon Rümmler[1,2], Franziska Schoger[1,2], Ronald Schwengner[1], Julia Steckling[1,2], Klaus Stöckel[1,2], Tamás Szücs[1], Steffen Turkat[2,1], Andreas Wagner[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]TU Dresden, Germany

At the Felsenkeller underground site in Dresden, shielded from cosmic rays by 45 m rock overburden, a 5 MV Pelletron accelerator has been installed. This machine has an internal ion source providing intensive $^{1}H^{+}$ and $^{4}He^{+}$ beams and an external sputter ion source for high-current $^{12}C^{+}$ beams. Both ion sources have already been successfully tested underground, and the commissioning of the accelerator is underway. A survey of the muon, neutron, and γ-ray background of the new lab has recently been completed. The scientific program will start with studies of solar fusion and stellar helium burning. In addition to in-house research by HZDR and TU Dresden, the new accelerator will be open for outside users, both from Germany and worldwide.

HK 6.3 Mo 15:00 HS 16

Study of the ^{2}H(p,γ)^{3}He cross section at $E_p = 400$ - 800 keV — •Sebastian Hammer[1,2], Eliana Mascha[3], S. Akhmadaliev[1], D. Bemmerer[1], F. Cavanna[4], P. Corvisiero[4], R. Depalo[5], F. Ferraro[4], M. Grieger[1,2], A. Guglielmetti[3], C. Gustavino[6], T. Hensel[1,2], M. Koppitz[1,2], F. Ludwig[1,2], V. Mossa[7], R. Schwengner[1], K. Stöckel[1,2], T. Szücs[1], S. Turkat[2], L. Wagner[1], and K. Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]Technische Universität Dresden — [3]INFN Sezione di Milano and Università degli Studi di Milano — [4]INFN Sezione di Genova and Università degli Studi di Genova — [5]Sezione di Padova and Università degli Studi di Padova — [6]INFN Sezione di Roma — [7]INFN Sezione di Bari and Università degli Studi di Bari

The production of deuterium during Big Bang Nucleosynthesis (BBN) marks a crucial step for the nucleosynthesis of light elements. Presently, the precision of the Big Bang abundance prediction of ^{2}H is limited by the uncertainty of ^{2}H destruction by the ^{2}H(p,γ)^{3}He reaction. The poor knowledge of the ^{2}H(p,γ)^{3}He cross-section in the BBN energy window is limiting further cosmological conclusions from highly accurate deuterium abundance. The present contribution reports on an experimental study of the ^{2}H(p,γ)^{3}He cross-section at energies of $E_p = 400$ - 800 keV, complementary to an ongoing study of the same reaction deep underground at LUNA at lower energy, $E_p = 50$ - 400 keV. The data have been taken at the 3 MV Tandetron accelerator of HZDR with deuterated titanium targets. Supported by DFG (BE 4100/4-1 and ZU 123/21-1)

HK 6.4 Mo 15:15 HS 16

Measurement of the ^{3}He$(\alpha,\gamma)^{7}$Be γ-ray angular distribution — •Steffen Turkat[1], Shavkat Akhmadaliev[2], Daniel Bemmerer[2], Antonio Caciolli[3], Marcel Grieger[1,2], Sebastian Hammer[1,2], Thomas Hensel[1,2], Lisa Hübinger[1,2], Felix Ludwig[1,2], Stefan Reinicke[1,2], Konrad Schmidt[1], Klaus Stöckel[1,2], Tamás Szücs[2], Louis Wagner[1,2], and Kai Zuber[1] — [1]Institut für Kern- und Teilchenphysik, TU Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf — [3]University of Padova, Italy

The improved precision regarding abundance determinations of Big Bang nuclides as well as an increased sensitivity for measuring solar neutrinos call for more precise nuclear data to improve the models. Therefore the ^{3}He$(\alpha,\gamma)^{7}$Be reaction is being studied at the 3MV Tandetron accelerator at Helmholtz-Zentrum Dresden-Rossendorf, with a focus on the measurement of the γ-ray angular distribution at E $\approx$ 1 MeV.
This reaction affects the nucleosynthesis of ^{7}Li as well as the predicted solar ^{7}Be and ^{8}B neutrino fluxes. A measurement of the angular distribution of the prompt γ-rays may enable a better comparison between precise experimental data sets at E = 0.7 - 1.3 MeV and a unique data set from the LUNA collaboration at E = 0.09 MeV - 0.13 MeV.
The activated ^{7}Be samples are counted at the new Felsenkeller underground facility in Dresden, where a HPGe detector with a relative detection efficiency of 150% was recently installed. The results of the first campaign will be summarized. — Supported by DFG (ZU 123/21-1 and BE 4100/4-1) and the Konrad-Adenauer-Stiftung.

HK 6.5 Mo 15:30 HS 16

Muon flux measurement in the shallow-underground laboratory Felsenkeller — •Felix Ludwig[1,2], Louis Wagner[1,2], Tariq Al-Abdullah[1,3], Gergely Gábor Barnaföldi[4], Daniel Bemmerer[1], Detlev Degering[5], Gergely Surányi[6], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden — [2]Technische Universität Dresden — [3]Physics Department, Hashemite University, Zarqa, Jordan — [4]Wigner Research Centre for Physics of the Hungarian Academy of Sciences (MTA Wigner), H-1525 Budapest, Hungary — [5]VKTA – Strahlenschutz, Analytik & Entsorgung Rossendorf e.V., 01328 Dresden, Germany — [6]Eötvös Loránd University, H-1117 Budapest, Hungary

Muons, which are produced by cosmic rays in the atmosphere, are highly penetrating and are mitigated by the 45 m of rock above the

shallow underground laboratory Felsenkeller in Dresden, Germany. In order to determine the precise flux and angular distribution of muons reaching the tunnels of Felsenkeller, a portable muon detector, developed and built by the REGARD group in Hungary, was employed. Data has been taken at four positions in the Felsenkeller tunnels VIII and IX, where the new 5 MV accelerator will be placed. At each position, seven different orientations of the detector were used to compile a map of the upper hemisphere. The measured muon flux data are matched by a calculation and a simulation using the known shape and density of the local rock cover.

HK 6.6 Mo 15:45 HS 16

Pulse shape discrimination with ^{3}He proportional counters for neutron flux measurements in low background environments — •Thomas Hensel[1,2], Daniel Bemmerer[1], Marcel Grieger[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

Pulse shape discrimination methods to discriminate neutrons from background events, offer a new possibility for analyzing neutron flux measurements with a low signal to noise ratio. Neutron flux measurements with moderated ^{3}He proportional counters have been performed at the site of the new Felsenkeller underground accelerator in Dresden and analyzed with different pulse shape discrimination techniques. This method is then applied for the determination of the neutron flux and spectrum in the new laboratory in Felsenkeller. The data show an ambient neutron flux that is approximately 170 times lower than at the surface of the earth.

HK 7: Instrumentation I

Zeit: Montag 14:00–16:00 Raum: HS 11

Gruppenbericht HK 7.1 Mo 14:00 HS 11

MAGIX at MESA — •Sören Schlimme for the MAGIX-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany

MAGIX will be the multi-purpose flagship experiment at the future MESA energy-recovering superconducting electron accelerator in Mainz. High precision scattering experiments at the low-energy frontier will be performed using a high-resolution magnetic spectrometer setup, covering a wide experimental program including nuclear structure investigations, determination of observables with astrophysical relevance, and the search for exotic particles. Delicate requirements exist for the experimental setup, mainly related to the low energies of the involved particles. In this presentation, the physics program at MAGIX will be outlined and an overview of the apparatus will be given, ranging from the internal cryogenic supersonic jet target to the sophisticated spectrometer magnet design, and from GEM-based Time Projection Chambers to Silicon Strip Detectors.

HK 7.2 Mo 14:30 HS 11

Discharge studies in a double-GEM detector — •Bogdan-Mihail Blidaru for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Large Hadron Collider will provide Pb-Pb collisions at an interaction rate of 50 kHz after 2021, following its Long Shutdown 2.

The ALICE TPC Upgrade project developed a continuous readout based on Gas Electron Multiplier (GEM) technology. The final design will feature a stack of four GEMs at the amplification stage. After installation in the ALICE cavern, the GEM chambers will be inaccessible. Thus, long-term stability and reliable readout over a time span of about 10 years is mandatory.

This talk is focused on one of the major challenges the GEMs must overcome, i.e. discharges: primary discharges that lead to a breakdown of the potential between both sides of a GEM foil and secondary discharges where the potential breaks down in the gap region between two foils. These events can short-circuit a GEM segment and render it inactive.

A small 10×10 cm^2 detector model with two GEM foils is used to study the evolution of the GEM potentials during and after discharges. Particular emphasis is put on mitigating the appearance of secondary discharges by using decoupling resistors that substantially reduce the propagation probability.

HK 7.3 Mo 14:45 HS 11

Study on two-track separation power of triple GEM detectors at the NA64 Experiment — •Michael Hösgen, Markus Ball, Nabeel Ahmed, and Bernhard Ketzer for the NA64-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik

The NA64 experiment uses an active target beam dump setup to conduct missing energy searches. It utilizes a high-intensity energy beam of 100 GeV energy at the SPS of CERN.

Between 2016 and 2018 a dedicated search for a new short-lived neutral boson X was performed. The X could be produced in Bremsstrahlung interactions $e^-Z \to e^-ZX$ in the active target tungsten electromagnetic calorimeter and decay into standard-model leptons ($X \to e^+e^-$). In order to record the two resulting tracks, which are emitted with a very small opening angle, four GEM detectors, each delivering two proections, were installed behind the active target.

The two-track separation power of the GEM detectors is evaluated by superimposing single-track events as well as by studying one of the well known background channels, which is the production of a $\mu^+\mu^-$-pair in the electromagnetic shower.

The talk will present the setup and discuss the results of these studies.

HK 7.4 Mo 15:00 HS 11

Ageing of GEMs in CH_4-based gas mixtures compared to ageing processes in MWPCs — •Michael Jung for the ALICE-Collaboration — Institut für Kernphysik Frankfurt

The Time Projection Chamber (TPC) of ALICE was operated with Multi-Wire Proportional Chambers (MWPCs) until 2018. During these data taking periods, N_2 and CO_2 were used as quenching gas, even if Ar-CH_4 can be considered as classical gas mixture for large-scale TPCs. Especially in high rate experiments like ALICE, it is well known that CH_4 produces hydrocarbons in the plasma of the avalanche, which will cover the electrodes and lead to insulating depositions.

From 2021 on, the TPC will run with a quadruple stack of Gas Electron Multipliers (GEMs) to allow continuous data taking at 50 kHz in Pb-Pb collisions. Since GEMs are considered to have better ageing properties than MWPCs, the possibility to use CH_4-based gas mixtures was evaluated with a GEM ageing test setup. Even if the degradation of the performance of the GEM detector was found to be less than in MWPCs, the usage of CH_4 also leads to insulating deposits on the electrodes of the GEMs. Like in MWPCs, a gain drop as well as a degradation of the energy resolution was measured.

In this presentation the results of long-term irradiation tests with GEMs, operated in Ar-CH_4 (95-5) will be presented together with a microscopic analysis of the irradiated GEMs and a comparison with ageing phenomena in MWPCs.

Supported by BMBF and the Helmholtz Association.

HK 7.5 Mo 15:15 HS 11

Gain uniformity measurements of a single GEM — •Mario Engel, Philip Hauer, Michael Hösgen, Markus Ball, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The Gas Electron Multiplier (GEM) is a type of micro-pattern gaseous detector. Optimal performance of detectors based on gas amplification in GEMs requires the gain to be uniform across the active area. Non-uniformities may arise from the production process for GEM foils, e.g. due to varying hole diameters and shapes. The holes of the GEM are etched with a photolithographic process into copper (5 μm)- polyimide (50 μm)- copper (5 μm) layers (standard GEM). Measurements of the uniformity of the gain of a single GEM foil are performed by using a setup consisting of a patterned readout electrode with an integrated bulk Micromegas, above which the GEM foil to be tested is mounted. With these two amplification stages, the effective gain of the GEM can be measured directly. As a radiation source, an ^{55}Fe X-ray emitter is used. The gain is measured at different spots over the 10 cm × 10 cm GEM. The talk will present the setup and measurements with different types of GEM foils.

Supported by BMBF

HK 7.6 Mo 15:30 HS 11

Characterization of chromium GEM foils for MAGIX — •Maximilian Littich for the MAGIX-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

The MAGIX experiment will be located at the MESA accelerator which is currently being built at the Institut für Kernphysik in Mainz. It will utilize the powerful electron beam with energies of up to 105 MeV and beam currents of up to 1 mA to perform high precision experiments. To identify scattered particles the MAGIX spectrometers will use GEM detectors as their focal plane detectors.
To build a GEM detector with a minimal material budget we characterized ultra-thin chromium GEM foils. This talk will give an overview over the characterization and performance measurements.

HK 7.7 Mo 15:45 HS 11

Measurements of the charge-up effect in Gas Electron Multipliers — Philip Hauer, •Karl Flöthner, Markus Ball, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik

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

This effect was investigated through simulations and measurements. In this talk, the results of dedicated measurements with a test-detector will be presented and compared to the outcome of the simulations. The influence of the rate of incoming radiation on the time constant of the charge-up process will be discussed. A special focus lies on the investigation of the charge-up effect in GEM foils with different hole shapes (e.g. single-conical GEM).

Supported by BMBF.

HK 8: Instrumentation II

Zeit: Montag 14:00–16:00 Raum: HS 12

HK 8.1 Mo 14:00 HS 12

New trigger concepts for future measurements at the M2 beam line at CERN — •Benjamin Moritz Veit — CERN and Institut für Kernphysik der Johannes Gutenberg-Universität, Mainz, Deutschland

Currently proposals are being prepared for future measurements with muon and hadron beams at the M2 beam line of the CERN SPS. It is mandatory for these experiments to have a new digital trigger system, which can handle the high rates at the M2 beam line and is flexible in design to adapt for the different planed physics programs. One of the planed experiments is the measurement of the proton radius by elastic muon proton scattering. For this measurement the trigger system has to be sensitive to very small scattering angles for low Q^2 events resulting in very high rates. The new trigger system has to be integrated in the main DAQ and is based on an continuous readout of fast detectors like hodoscopes and scintillating fibre stations. The handling of the triggerless data stream is done by a network of FPGAs performing the multi level trigger decision.

This talk will summarize the plans and the current status of the development of such a trigger-system.

HK 8.2 Mo 14:15 HS 12

Calibration of the Energy-Sum Trigger for the Crystal Barrel Calorimeter at ELSA — •Sebastian Ciupka, Christian Honisch, Michael Lang, Johannes Müllers, Martin Urban, and Reinhard Beck for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

The Crystal Barrel Calorimeter at the electron accelerator ELSA in Bonn, is used to detect photons from meson decays. The number of clusters produced by the photons is used in the trigger. This talk presents an upcoming upgrade which will include a fast analogous energy-sum in the trigger, allowing the suppression of specific signatures. The summation over 1320 CsI(Tl) detectors is realised in two steps, in a first step the signal of one sector, consisting of up to 23 channels, will be summed up, resulting in 60 individual signals, which will be added together in a second step.

Crucial for setting a precise energy threshold is the calibration of the individual channels of the electronics, performing the summation. This talk will present the current status of the prototype development for the first summation step, show its performance and discuss different calibration methods, as well as the achieved precision.

HK 8.3 Mo 14:30 HS 12

Functionality tests of the SerialAdapter ASIC for the PANDA Calorimeter front-end bus system* — •Christopher Hahn for the PANDA-Collaboration — II. Physikalisches Institut, Justus Liebig Universität, Gießen, Deutschland

The control of the high voltage adjustment for the Large Avalanche Photodiodes of the Electromagnetic Calorimeter (EMC) for the upcoming PANDA experiment at the future FAIR complex in Darmstadt demands innovative and specialised electronics in order to meet the design goals with respect to resolution, timing and spacial constraints. Dedicated hardware chips, the so called SerialAdapter ASICs, were developed at the Gesellschaft für Schwerionenforschung in Darmstadt (GSI Darmstadt). They unite different bus systems and therefore reduce the amount of slow-control cables within the detector volume. These chips are also utilized for the communication and control of the APFEL preamplifier ASICs, which read out the APD photodetectors. To confirm that the different features of the SerialAdapter ASIC work as expected, tests were undertaken. The results of these functionality tests of the ASIC will be presented in this talk.

*gefördert durch das BMBF und HIC for FAIR.

HK 8.4 Mo 14:45 HS 12

High-density interconnection technologies for the CBM Silicon Tracking System — •Patrick Pfistner[1], Thomas Blank[1], Michele Caselle[1], Marc Weber[1], Johann Heuser[2], Christian J. Schmidt[2], Carmen Simons[2], and Robert Visinka[2] for the CBM-Collaboration — [1]KIT, 76344 Eggenstein-Leopoldshafen, Deutschland — [2]GSI, 64291 Darmstadt, Deutschland

The double-sided silicon microstrip sensors of the Silicon Tracking System (STS) of the Compressed Baryonic Matter (CBM) experiment at FAIR, GSI are connected to the read-out electronics by low mass flexible microcables due to tight material budget restrictions. The cable length of up to 50 cm and its flexible nature make detector module assembly one of the most critical parts in STS. The established interconnection technology for the modules is aluminum - aluminum TAB bonding. While the TAB bonding technology provides a reliable interconnection between cable and die, the module production will be a highly manual and thus time-consuming procedure. Therefore, an additional interconnection technology is being developed based on a double-layered copper microcable. This microcable allows for a novel flip-chip detector production method based on high-density gold-stud bumping on the silicon die and fine-grain solder paste printing on the microcable. We present both the TAB bonding and the novel flip-chip production method together with the design and characterization of the developed copper microcable.

HK 8.5 Mo 15:00 HS 12

A new Fault Tolerant Local Monitoring Control Board with SEU mitigation and execution redundancy commercial micro-controller — •Jose Antonio Lucio Martinez and Udo Kebschull for the CBM-Collaboration — IRI Goethe Universität Frankfurt, Frankfurt am Main, Germany

Since reliable program execution is necessary for the experiment integrity, new Fault Tolerant Local Monitoring Control (FTLMC) board for high energy particle detectors was developed to operate in harsh environments, taking into account the challenges that high energy physics experiments represent, a Commercial Off the Shelf (COTS) Micro Con-

troller (MC), previously tested in accelerated particle beam, was populated in such board. The MC is the TMS570 conceived for safety and critical applications. The FTLMC provide the necessary interfaces such as SPI, I2C, CAN bus and others for detector parameter surveillance in experimental physics applications. Experimental Physics and Industrial Control System (EPICS), a commonly used SCADA for physics experiments, is ported to the MC where pre-built specific mechanisms are used to apply redundancy to programs executing with insignificant amount of CPU overhead.

HK 8.6 Mo 15:15 HS 12

High-Level Synthesis in Algorithm Implementation and Data Preprocessing on FPGAs — •Thomas Janson and Udo Kebschull — IRI, Goethe-Universität Frankfurt am Main, Senckenberganlage 31, 60325 Frankfurt am Main, Germany

In this talk, we discuss the high-level synthesis methodology from Xilinx to implement algorithms on FPGAs. The idea is to use a C++ high-level language to program an algorithm for an implementation in a massive parallel fashion, where we start from a data dependency analysis and define a data dependency graph with the goal to get a deeply pipelined implementation. In this approach, the challenge is the distribution of local on-chip memory close to the implemented arithmetic blocks in such a pipelined fashion. We compare this with an implementation using a data-flow programming approach like MaxJ from Maxeler, where an algorithm is described as a synchronous data-flow graph and implemented as a deep pipeline. In addition, we discuss the local memory distribution using the Maxeler data-flow approach compared to the Xilinx HLS approach.

HK 8.7 Mo 15:30 HS 12

Evaluation of High-Level Synthesis Approaches for FPGA-based Data Processing Algorithms — •Heiko Engel and Udo Kebschull for the ALICE-Collaboration — IRI, Goethe-Universität Frankfurt a. M.

The ALICE experiment uses an FPGA-based cluster finding algorithm implemented in the readout board to pre-process experimental data on the fly. This cluster finding algorithm, as used for the processing of raw TPC data during Run1 and Run2, saved significant amounts of CPU power in the HLT cluster and was a central part of the HLT data compression and reconstruction scheme. A similar concept is prepared for the ALICE readout for Run3. FPGA-based data processing steps are typically described in low-level hardware description languages like VHDL or Verilog, which come with considerable costs to develop, verify and maintain the hardware implementation. High-level synthesis approaches promise to ease the development of data processing steps in hardware. This contribution shows approaches and results of implementing the algorithmic hardware processing steps with high-level synthesis tools on the example of the Run2 hardware cluster finder and evaluates HLS use cases for future applications.

HK 8.8 Mo 15:45 HS 12

Ladder assembly procedure for the Silicon Tracking System of the CBM Experiment — •Shaifali Mehta for the CBM-Collaboration — Universität Tübingen, Tübingen, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment is one of the major scientific pillars of the future Facility for Anti-proton and Ion Research (FAIR), which is presently under construction adjacent to GSI, Darmstadt. In the CBM experiment, the main task of the Silicon Tracking System is to reconstruct the tracks and measure the momentum of charged particles. The detector comprises of 896 detector modules, based on double-sided silicon microstrip sensors distributed on 8 tracking stations. The stations are made from mechanical half units onto which carbon fibre detector ladders are mounted holding the modules. A tool has been designed to study the feasibility of the ladder assembly. One half of the longest ladder variant has been assembled with 5 non-functional modules. The same assembly technique was used to build a ladder with two functional modules for the mini-STS detector demonstrator which is currently in the mini-CBM set-up at SIS18.
This work focuses on integrating modules onto ladders which are then optically surveyed with a precision of ± 10 μm. The ladder assembly concept of mounting the modules on the ladder with a mechanical precision better than 100 μm will be presented in this talk.

HK 9: Outreach I

Zeit: Montag 14:00–15:45 Raum: HS 18

Gruppenbericht HK 9.1 Mo 14:00 HS 18

KONTAKT-Outreach für Teilchenphysik, Astroteilchenphysik, Hadronen- und Kernphysik unter einem Dach — Uta Bilow, Michael Kobel und •Anne Rockstroh für die Netzwerk Teilchenwelt-Kollaboration — TU Dresden, IKTP

Am 1.1.2019 startet das bundesweite Projekt KONTAKT, das Jugendlichen und der interessierten Allgemeinheit die Physik der kleinsten Teilchen näherbringt. Das Vorhaben bündelt die Outreach-Aktivitäten in der Teilchen-, Astroteilchen-, Hadronen- und Kernphysik und baut auf dem Programm von Netzwerk Teilchenwelt (www.teilchenwelt.de) auf. Bei mobilen Projekttagen können Jugendliche und Lehrkräfte die faszinierende Forschung mit Beschleunigern und Teilchendetektoren kennenlernen und eigene Messungen durchführen. Bei Vorträgen, Ausstellungen, etc. stellen Wissenschaftler/innen ihre Forschung einer breiten Öffentlichkeit vor. KONTAKT unterstützt die Outreach-Aktivitäten der Institute, stellt den direkten Zugang zur Öffentlichkeit her und fördert so Dialog zwischen Wissenschaft und Gesellschaft. Nachwuchsgewinung und -förderung für die Forschung ist durch das Fellow-Programm integriert. Im Projekt kooperieren Wissenschaftler/innen von 30 Instituten der Teilchen-, Astroteilchen- und neu auch der Hadronen- und Kernphysik. Außerdem wird bei KONTAKT ein mobiles Ausstellungsmodul zur Teilchenphysik entwickelt, das durch Deutschland touren wird.

Der Vortrag stellt die Angebote des Projekts für Institute sowie Beteiligungs- und Weiterbildungsmöglichkeiten für interessierte Wissenschaftler/ innen vor.

HK 9.2 Mo 14:30 HS 18

Café & Kosmos: Das Universum in der Kneipe — •Barbara Wankerl[1], Hannelore Hämmerle[4], Petra Riedel[2] und Waldenmaier Stefan[3] — [1]Max Planck-Institut für Physik, München — [2]Physik Department, Technische Universität München — [3]Exzellenzcluster Universe, Garching — [4]Max Planck-Institut für Extraterrestrische Physik, Garching

Über den Exzellenzcluster Universe haben sich verschiedene Münchener Forschungseinrichtungen für Public-Outreach-Aktivitäten vernetzt. Eines der gemeinsamen Projekte ist das Café & Kosmos, das 2010 aus der Taufe gehoben wurde. Die monatliche Veranstaltung geht bewusst weg von traditionellen Orten der Wissensvermittlung wie Schulen oder Hörsälen: Wissenschaftler*innen treffen das Physikinteressierte Publikum in einem Café oder einer Kneipe, um über aktuelle Forschungsfragen zu diskutieren. Die Veranstaltungsreihe ist bei den Vortragenden und den Besucher*innen sehr beliebt, die Resonanz auch nach acht Jahren ungebrochen gut, die Teilnehmerzahlen steigen weiter. Wir berichten, wie Café & Kosmos entstand, was es ausmacht und wie es zu einer Erfolgsgeschichte wurde.

HK 9.3 Mo 14:45 HS 18

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

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

Das Unterrichtskonzept beinhaltet eine einheitliche, konsistente sowie anschlussfähige Begriffsbildung und ist daher die ideale Grundla-

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

HK 9.4 Mo 15:00 HS 18

Von der Schule an die Uni - Netzwerk Teilchenwelt Aktivitäten am Standort Mainz — •Saskia Plura — Johannes-Gutenberg Universität Mainz

Der Standort Mainz bietet im Rahmen der Outreach-Aktivitäten des Netzwerk Teilchenwelts ein großes Spektrum verschiedener Aktivitäten an. Neben der regulären Teilchenphysik-Masterclasses werden nun auch damit verbundene Führungen am Teilchenbeschleuniger MaMi durchgeführt sowie die Mainzer Teilchenphysik-Akademie veranstaltet, die Schülern die Forschung am MaMi-Beschleuniger ermöglicht und damit einen Einblick in das wissenschaftliche Arbeiten gewährt. Seit Juli 2017 engagieren sich auch Studierende und Frühstudierende der JGU Mainz im Rahmen des bundesweiten Netzwerk-Teilchenwelt-Fellow-Projekts mit dem Ziel, der Öffentlichkeit, insbesondere Schülern, die Kern- und Teilchenphysik näherzubringen und den Kontakt zwischen Arbeitsgruppen und Studierenden zu fördern. Dadurch sind in den vergangenen eineinhalb Jahren viele verschiedene Projekte entstanden, die von Outreach-Aktivitäten über Mentoring-Projekte bis hin zu Kooperationen mit den verschiedenen Arbeitsgruppen reichen; zudem sollen in Zukunft Exkursionen zu Kern- und Teilchenphysikexperimenten stattfinden. Das Projekt trägt Früchte: Viele der neuen Studierende haben über das Netzwerk Teilchenwelt schon vor Beginn des Studiums Kontakte zu den Fellows und den Dozenten der JGU Mainz geknüpft. Mithilfe der Outreach-Projekte wurden sowohl Brücken zwischen Schule und Uni als auch zwischen den Arbeitsgruppen und den Studierenden geschlagen.

HK 9.5 Mo 15:15 HS 18

Holiday and Science an der Universität zu Köln: Intensivpraktikum für Schüler von MINT-Schulen — •Philipp Scholz, Andrey Blazhev, Felix Heim, Michelle Färber, Sarah Prill und Andreas Zilges — Institut für Kernphysik, Universität zu Köln

Seit mehreren Jahren organisiert eine Kooperation zwischen dem nationalen Excellence-Schulnetzwerk MINTec, Zukunft durch Innovation.NRW (zdi), dem Leistungszentrum für Naturwissenschaften und Umweltfragen (LNU-Frechen), und den Physikalischen und Chemischen Instituten der Universität zu Köln ein Ferienprogramm für Schüler der Oberstufe - Holiday & Science.

In einem selektiven Auswahlverfahren von Bewerbungen wissenschaftsbegeisterter Schüler und Schülerinnen aus ganz Nordrhein-Westfalen werden ca. 15 - 20 Teilnehmer und Teilnehmerinnen ausgewählt für drei Tage nach Köln zu reisen und Wissenschaft unmittelbar zu erfahren sowie die Stadt in den Abendstunden auf eigene Faust zu erkunden.

Die letzte Veranstaltung wurde unter dem Thema "Kernphysik - von der Elementenentstehung bis zur Strahlentherapie in der Medizin" vom 15.- 17. Oktober 2018 vom Institut für Kernphysik der Universität Köln durchgeführt.

HK 9.6 Mo 15:30 HS 18

Entwicklung einer 3D Virtual-Reality-Lehr- und Lernumgebung zur Vermittlung von Grundlagenforschung am Beispiel des ALICE-Detektors am CERN-LHC — •Christian Klein-Boesing[1], Philipp Bhatty[2], Stefan Heusler[3] und Reinhard Schulz-Schaeffer[2] — [1]Institut für Kernphysik, WWU Münster, Germany — [2]Design Department, HAW Hamburg, Germany — [3]Institut für Didaktik der Physik, WWU Münster, Germany

Detektoren in der Elementarteilchenphysik, wie der ALICE-Detektor am LHC, können in der Regel der breiten Öffentlichkeit nur an Hand von Bildern oder Filmen präsentiert werden.

Die Darstellung in einer Echtzeit-3D-Umgebung, wie einer Virtual-Reality- und Web3D-Applikation, ermöglicht hingegen direkt die Größe des Experimentes erfahrbar zu machen, aber auch neue, virtuelle Handlungsräume und Handlungsoptionen zu erforschen und zielgruppengerecht einzusetzen. Die Entwicklung einer solchen Web3D-Lernumgebung sowie einer VR-Lernapplikation, inklusive der empirischen Bewertung verschiedener Darstellungsoptionen, der Gestaltung von Nutzerinteraktion und interaktiver Lernaufgaben, erfordert eine enge Kooperation zwischen Grundlagenforschung in der Elementarteilchenphysik, der Didaktik der Physik und der Wissenschaftsillustration.

Wir präsentieren den aktuellen Entwicklungsstatus basierend auf einer interaktiven Visualisierung des ALICE-Detektors in VR (Smartphone und Cardboard) und Web-3D (Browser).

HK 10: Hadron Structure and Spectroscopy II

Zeit: Montag 16:30–18:30 Raum: HS 13

Gruppenbericht HK 10.1 Mo 16:30 HS 13

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

Polarizabilities 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. A program performed by the A2 Collaboration at the MAMI accelerator facility in Mainz aims for the first individual extraction of the nucleon scalar and spin polarizabilities using Compton scattering on the nucleons. The Crystal Ball and TAPS 4π spectrometer setup is used for the corresponding measurements. After the upgrade of the photon tagging system, a new high-statistics data set has been obtained for the determination of both unpolarized cross-section and beam asymmetry Σ_3 below pion production threshold. This data set will allow us to extract the proton scalar polarizabilities with unprecedented precision. Moreover, for the extraction of the spin polarizabilities, the beam asymmetry Σ_3 and the beam-target asymmetries Σ_{2x} and Σ_{2z} were measured at higher energies, where the sensitivity to the spin polarizabilities increases. In this talk, the current results and the plans for the upcoming measurements with the A2 setup at MAMI will be presented.

HK 10.2 Mo 17:00 HS 13

SIDIS Pion Beam Spin Asymmetries measured with CLAS 12 at 10.6 GeV — •Stefan Diehl for the CLAS-Collaboration — University of Connecticut, Storrs, USA — Justus Liebig University Giessen, Giessen, Germany

The CLAS12 detector at Jefferson Laboratory (JLab) started data taking with a polarized 10.6 GeV electron beam in February 2018. One of the first quantities which could be extracted from the new data is the moment $A_{sin(\phi)}^{LU}$ corresponding to the polarized electron beam spin asymmetry in semi-inclusive deep inelastic scattering. $A_{sin(\phi)}^{LU}$ is a twist-3 quantity which provides information about the quark gluon correlations. The study was performed with a 10.6 GeV longitudinally polarized electron beam and an unpolarized liquid hydrogen target. The talk will present a simultaneous study of all three pion channels (π^+, π^0 and π^-) over a large kinematic range with virtualities Q^2 ranging from 1 GeV^2 up to 8 GeV^2. The measurement in a large range of z, x_B, P_T and Q^2, including up to now not measured kinematic regions, enables a comparison with different reaction models.

*The work is supported by DOE grant no: DE-FG02-04ER41309.

HK 10.3 Mo 17:15 HS 13

Analysis of COMPASS data on DVCS — •Johannes Giarra — on behalf of the COMPASS collaboration - Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Johann-Joachim-Becher-Weg 45, 55099 Mainz

In 2016 and 2017 a measurement of the Deeply Virtual Compton Scattering (DVCS) was performed at the M2 beamline of the CERN SPS using 160 GeV positive and negative charged muon beams scattering off a liquid hydrogen target. The scattered muons and the produced real photons were detected by the COMPASS spectrometer, which was supplemented by an additional electromagnetic calorimeter for the de-

tection of large angle photons. The recoil protons were detected by the CAMERA detector, which consists of two barrels of scintillators surrounding the 2.5 m long target. The time of flight (TOF) measurement performed by the detector is used to identify the protons.
The talk will summarize the steps needed to determine the DVCS cross section as well as the current status of the analysis of the COMPASS DVCS data.

HK 10.4 Mo 17:30 HS 13

Measurement of the transverse beam spin asymmetry in elastic electron proton scattering at A4 — D. Balaguer Ríos[1], S. Baunack[1,3], L. Capozza[1], J. Diefenbach[1,2], B. Gläser[1,2], •B. Gou[2], Y. Imai[1,2], E.-M. Kabuss[1], J.H. Lee[1], F. Maas[1,2,3], M. C. Mora Espí[1,2], E. Schilling[1], D. von Harrach[1], and C. Weinrich[1] for the A4-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The study of the two-photon exchange is motivated by the discrepancy between the Rosenbluth separation and polarization transfer data on the proton form factor ratio. In order to extract the hadron-structure information correctly in the high-precision electron scattering experiments, one needs to understand how the two-photon exchange may affect various observables. The transverse single spin asymmetries, which arise due to the interference between the one-photon and two-photon exchange amplitudes, provide an excellent opportunity to test our understanding of the two-photon exchange mechanism. The A4 collaboration at the MAMI accelerator has performed measurements on the transverse beam spin asymmetry at various beam energies between 300 MeV and 1.5 GeV. The latest results will be presented in this talk.

HK 10.5 Mo 17:45 HS 13

Proton Time-Like Electromagnetic Form Factor Measurement with the Scan Method at BESIII — •Christoph Rosner[1], Yadi Wang[1], Samer Ali Nasher Ahmed[1], Alaa Dbeyssi[1], Paul Larin[1], Dexu Lin[1], Frank Maas[1,2,3], and Cristina Morales[1] for the BESIII-Collaboration — [1]Helmholtz-Institut Mainz, 55128 Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

Electromagnetic form factors (FF) provide valuable insight to the internal structure and dynamics of the proton. While they are well known in the space-like region through electron scattering experiments, the time-like region, typically accessed by annihilation experiments, is known with much less precision. Specifically the separation of the electric and magnetic FF has only been possible with low accuracy due to the low luminosity of previous data.

This contribution reports on the analysis based on 688.5 pb^{-1} of data taken at 22 energy points between 2.0 and 3.08 GeV with the Beijing Spectrometer III (BESIII) at the Beijing Electron Positron Collider II (BEPCII). The born cross section of $e^+e^- \to p\bar{p}$ is measured with the energy scan technique for the first time. Additionally, the absolute value of the proton electric and magnetic FF as well as their ratio are measured with high accuracy by analysing the helicity angular distribution of the outgoing protons.

HK 10.6 Mo 18:00 HS 13

Spectral functions of electromagnetic and axial nucleon form factors: 3π-continua at low energies — •Norbert Kaiser[1] and Emilie Passemar[2] — [1]Physik Department T39, TU München — [2]Department of Physics, Indiana University, Bloomington, USA

We study the imaginary parts of the isoscalar electromagnetic and isovector axial form factors of the nucleon close to the 3π-threshold in covariant baryon chiral perturbation theory. At the two-loop level, the contributions arising from leading and next-to-leading order chiral πN-vertices, as well as pion-induced excitations of virtual $\Delta(1232)$-isobars, are calculated. It is found that the heavy baryon treatment overestimates substantially these 3π-continua. From a phenomenological analysis, that includes the narrow $\omega(783)$-resonance or the broad a_1-resonance, one can recognize small windows near threshold, where chiral 3π-dynamics prevails. However, in the case of the isoscalar electromagnetic form factors $G^s_{E,M}(t)$, the radiative correction provided by the $\pi^0\gamma$-intermediate state turns out to be more significant therein. Work supported in part by DFG and NSFC (CRC110).

HK 10.7 Mo 18:15 HS 13

Measurement of the beam-normal single-spin asymmetry for electrons scattered off ^{12}C. — •Anselm Esser, Harald Merkel, Sören Schlimme, Concettina Sfienti, and Michaela Thiel — A1 Kollaboration, Inst. f. Kernphysik, Uni Mainz

The beam-normal single-spin asymmetry A_n arises in the elastic scattering of electrons polarised perpendicular to the scattering plane off unpolarised nuclei. It not only contributes as an important background to parity violation experiments, but has recently gained interest as a probe for multi photon exchange amplitudes. At the Mainz Microtron, A_n was measured for 570 MeV electrons scattered off ^{12}C, covering the Q^2 range between 0.02 and 0.05 $\mathrm{GeV}^2/\mathrm{c}^2$. Custom-build quartz Cherenkov detectors located in the focal plane of magnetic spectrometers were used for electron detection. The readout of the attached PMTs was performed with integrating ADCs allowing for particle rates too high for counting. The resulting asymmetry shows a significant deviation from the theoretical predictions in the covered Q^2 range.

HK 11: Heavy-Ion Collisions and QCD Phases II

Zeit: Montag 16:30–18:30 Raum: HS 15

Gruppenbericht HK 11.1 Mo 16:30 HS 15

J/ψ measurements at mid-rapidity with ALICE at the LHC — •Markus K. Köhler for the ALICE-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Germany

The charmonium state J/ψ is a fruitful and intriguing probe to investigate the evolution of strongly interacting matter in heavy-ion collisions. The production of charm-quark pairs and their hadronisation are well separated in the space-time evolution of the collision and provide a wealth of information of the underlying QCD dynamics from the dense to the eventually dilute system.

The ALICE detector system can measure J/ψ production at mid- and forward rapidity down to zero p_{T}. In this contribution, recent results on J/ψ production are shown with the focus being placed on measurements at mid-rapidity in pp and PbPb collisions at a centre-of-mass energy of 5.02 TeV per nucleon pair collected in LHC run2. J/ψ production as a function of rapidity, transverse momentum and- for the case of PbPb collisions- centrality are presented and compared with available model calculations.

HK 11.2 Mo 17:00 HS 15

Measurement of Angular Correlations between Heavy-Flavour Electrons and Charged Particles in pp Collisions at $\sqrt{s} = 13$ TeV with ALICE - Process and Multiplicity Dependence — •Florian Herrmann for the ALICE-Collaboration — Institut für Kernphysik, Universität Münster

Heavy flavour quarks (charm and beauty) are of special interest for the study of the Quark-Gluon Plasma as they are predominantly produced in the initial hard-scattering processes and participate in the entire evolution of the system. Moreover, heavy flavour production is well under control of perturbative QCD. Thus, heavy flavours are an excellent probe to study pQCD in small systems as well as parton in medium energy loss and transport mechanisms in nuclear collisions by measuring, for instance, the spectra, angular correlations or the nuclear modification factor R_{AA}. Experimentally, heavy flavours are often investigated using measurements of electrons from heavy-flavour hadron decays. These electrons can be separated statistically from the background and their angular correlations with other heavy flavour electrons or with charged particles can be studied. In this talk, we will present a current approach to measure two-particle correlations of heavy flavour electrons with charged particles biased to higher p_T (> 2 GeV) or with the leading particle in pp collisions at $\sqrt{s} = 13$ TeV with the ALICE experiment. Monte Carlo calculations with POWHEG and PYTHIA 8 show the sensitivity of this observable on multiplicity and production mechanisms. – Supported by DFG GRK2149.

HK 11.3 Mo 17:15 HS 15

Study of the charm quark production mechanisms through

angular correlation of dielectrons in pp collisions at $\sqrt{s}$ = 13 TeV — •Hermann Degenhardt for the ALICE-Collaboration — Excellence Cluster Universe, TUM, Munich, Germany

The aim of relativistic heavy-ion collisions is to investigate the properties of the Quark-Gluon Plasma (QGP) that is formed at high-enough temperatures and/or densities. Heavy-quarks, i.e. charm and beauty, are very useful probes for the characterization of the QGP since they are produced at the early stages of the collisions via initial hard scatterings. To quantify the QGP effects, it is important to understand the heavy-quark production in pp collisions first. In particular, the production mechanisms of charm quarks can be studied through their angular correlations which is inherited by their decay products, such as electrons.

In the leading order the heavy-flavour pair is created back to back through flavour creation. On the other hand, higher order processes like flavour excitation and gluon splitting create pairs with different angular correlation functions. While gluon splitting produces pairs with small angles, flavour excitation processes produce pairs without preferred angular correlation. In this talk we present the current analysis of angular distribution functions between correlated heavy-flavour electron-positron pairs in proton-proton collisions at a centre of mass energy $\sqrt{s}$ = 13 TeV and the comparison with simulated mechanisms processes obtained by PYTHIA.

HK 11.4 Mo 17:30 HS 15

Reconstruction of Beauty Jets in Proton-Proton Collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Katharina Garner for the ALICE-Collaboration — Westfälische Wilhelms-Universität Münster, Germany

When traversing the Quark-Gluon Plasma (QGP), partons lose energy via collisional and radiative processes. For both types of processes, the amount of lost energy depends on the particle mass and manifests in a reduced jet multiplicity in heavy-ion collisions with respect to proton-proton collisions, for which no QGP is expected to form. A detailed knowledge about not only the light-flavour but also the charm and bottom jet production in proton-proton collisions is thus inevitable for further investigations on particle energy losses. Since B mesons have much larger life-times compared to other hadrons, signed impact parameter spectra, as a measure for the distance between particle tracks and the primary vertex, offer a great opportunity to investigate the bottom jet production. First steps of an analysis on signed impact parameter distributions for tracks from within light-flavour, charm- and bottom jets in 13 TeV proton-proton collisions are presented.

HK 11.5 Mo 17:45 HS 15

Measurements of non-prompt J/Ψ production in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE — •Xiaozhi Bai for the ALICE-Collaboration — GSI Helmholtzzentrum für Schweri- onenforschung, Planckstr. 1, 64291 Darmstadt,Germany

Heavy quarks are an excellent probe to study the strongly interacting Quark-Gluon Plasma (QGP) created in high-energy heavy-ion collisions. Due to their large masses, charm and beauty quarks are mainly produced via initial hard partonic scattering processes, and thus experience the entire evolution of the QGP medium. Measurements of heavy-flavor production have advanced our understanding on the properties of the QGP. At LHC energies, the inclusive J/Ψ yield contains a significant non-prompt contribution from beauty-hadron decays. Due to the longer lifetime of beauty hadrons compared to the QGP lifetime, non-prompt J/Ψ do not suffer from color screening in the QGP medium. Instead, the non-prompt J/Ψ are affected the beauty quark energy loss in the hot and dense QCD medium.

In this talk, the analysis status of the non-prompt J/Ψ production measured via dielectron decay channel ($J/\Psi \rightarrow e^+e^-$) at mid-rapidity in Pb-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE will be shown. The related physics message will be discussed as well.

HK 11.6 Mo 18:00 HS 15

Multiplicity dependence of J/ψ production in proton-proton collisions at $\sqrt{s}$ = 13 TeV with ALICE at the LHC — •Steffen Georg Weber for the ALICE-Collaboration — Westfälische Wilhelms-Universität Münster

The hadronic production of charmonium in proton-proton collisions is a complex and intrinsically multi-scale process. The dependence of J/ψ production on the event multiplicity is of special interest, since it relates the hard-scale $c\bar{c}$ production with the soft-scale physics of light-flavour particle production. Insights into the influence of multiple-parton interactions (MPI) on charmonium production can be obtained.

In this talk the measurement of J/ψ production at mid-rapidity in transverse-momentum intervals as a function of the charged-particle multiplicity in pp collisions at $\sqrt{s}$ = 13 TeV perfomed with ALICE at the LHC will be presented. The influence of a rapidity gap between the J/ψ signal and the multiplicity is investigated. The results are compared to theoretical model predictions and interpreted based on simulation studies with the PYTHIA 8 event generator in terms of MPI, color reconnection and auto-correlation effects.

HK 11.7 Mo 18:15 HS 15

Measurement of J/ψ production in p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 8.16 TeV with ALICE — •Minjung Kim for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

The measurement of J/ψ production in p–Pb collisions is an essential probe to study possible cold-nuclear-matter effects as well as final state mechanisms, the J/ψ which can affect production. In ALICE (A Large Ion Collider Experiment), J/ψ production is measured at mid-rapidity via the dielectron decay channel and at forward rapidity via the dimuon decay channel. Especially, at mid-rapidity, the contribution of J/ψ from weak decays of beauty hadrons (non-prompt J/ψ), can be separately measured thanks to the excellent primary and secondary vertex resolution of the Inner Tracking System (ITS). In the recent data taking period (Run 2), using the electron trigger of the Transition Radiation Detector (TRD), an enriched data sample of high–$p_{\rm T}$ electron candidates was collected.

In this presentation, we will show the status of the inclusive and non-prompt J/ψ measurements in p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 8.16 TeV recorded with the TRD electron trigger.

HK 12: Structure and Dynamics of Nuclei II

Zeit: Montag 16:30–18:30 Raum: HS 14

HK 12.1 Mo 16:30 HS 14

Investigation of the Dineutron System via Quasi-Free ^{4}He-Knockout Reactions at ^{6}He — •Marco Knösel[1], Thomas Aumann[1,2], Christopher Lehr[1], and Vadim Wagner[1] for the NeuLAND-SAMURAI-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz-Zentrum für Schwerionenforschung

In this contribution, a status update on the analysis of a ^{6}He$(p, p\alpha)^2n$ experiment in inverse kinematics is given. In order to study the neutron-neutron interaction, a high-energy radioactive ^{6}He beam has been directed to a thick liquid hydrogen target, where the alpha particle is removed in a fast quasi-free knockout reaction. The shape of the two-neutron relative energy spectrum thereby is sensitive to the neutron-neutron scattering length. To calculate the distribution of relative energies, the invariant mass of the two-neutron system is measured. The experiment was performed at the SAMURAI setup at RIKEN using the NeuLAND demonstrator (of the R^{3}B setup at GSI/FAIR) and NEBULA as neutron detectors.

This work is supported by the DFG through grant no. SFB 1245, the BMBF under contract number 05P15RDFN1 and the GSI-TU Darmstadt cooperation agreement.

HK 12.2 Mo 16:45 HS 14

Determining the Neutron-Neutron scattering length with a high resolution relative energy measurement — •Vadim Wagner, Thomas Aumann, and Heiko Scheit — TU Darmstadt, Darmstadt, Deutschland

In this contribution a short overview about a proposed experiment at Riken (Japan) for a high precision measurement of neutron-neutron relative energies produced in ^{6}He(p,pα)^{2}n reactions to determine the neutron-neutron scattering length will be presented. Previous measurements with two different methods do not agree well, therefore this experiment was proposed with the goal to achieve a total uncertainty

of ±0.2 fm. The sensitivity of this method lies in the shape of the relative energy spectrum, therefore it is crucial that the shape of spectrum is not changed due to acceptance and cross talk rejection. This was investigated with a simulation of the response of the neutron detector HIME.

This work is supported by the BMBF under contract number 05P15RDFN1 and the SFB grand no. 1245.

HK 12.3 Mo 17:00 HS 14

Structure of ^{6}He in Halo EFT — •Matthias Göbel[1], Daniel R. Phillips[2,3], and Hans-Werner Hammer[1,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Institute of Nuclear and Particle Physics and Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701, USA — [3]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

The Borromean two-neutron halo ^{6}He with its scale separations is well suited to a treatment in Halo EFT with the neutrons (n) and the α core as degrees of freedom. The s-wave nn interaction and the $^2P_{3/2}$ αn interaction as well as a three-body force are employed in our leading order analysis.

Using the Faddeev equations, the leading order results of Ji, Elster and Phillips (see Phys. Rev. C **90** (2014) 044004) for the Faddeev amplitudes are reproduced. Based on these amplitudes, we study the structure of ^{6}He by calculating the momentum space probability density as seen with different spectator particles. Moreover, the results for the nn relative energy distribution will be presented.

HK 12.4 Mo 17:15 HS 14

Resonances and virtual states in few-body systems — •Sebastian Dietz[1], Hans-Werner Hammer[1,2], Sebastian König[1,2], and Joel E. Lynn[1,2] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Darmstadt

We present an investigation of the analytic structure of the S-matrix for three-body systems using the framework of pionless effective field theory. The three-body Faddeev equation in momentum space is rewritten using the dimer formalism and analytically continued onto the unphysical sheet below the positive real energy axis. This formalism is applied to the three-boson system with large scattering length. The investigation is performed as a function of the two-body scattering length and the range of validity is examined. As a further application, the position of the triton virtual state is calculated.

HK 12.5 Mo 17:30 HS 14

Elastic NN-Scattering with Coupled NΔ-Channels in Chiral Effective Field Theory — •Susanne Strohmeier and Norbert Kaiser — Technische Universität München

We study the elastic nucleon-nucleon scattering ($T_{\rm lab} \leq 300\,$MeV) by employing the dynamics of the coupled channels. The potentials arising from one- and two-pion exchange, with iterative contributions properly subtracted, are derived from chiral effective field theory at next-to-leading order. The peripheral phase shifts and mixing angles are compared with the Nijmegen partial wave analysis up to I-waves. The short-range contact interaction in the coupled (NN, NΔ, ΔN, ΔΔ)-channels is constructed up to next-to-leading order (i.e. quadratic in momenta) and the associated low energy constants are determined in fits to empirical NN-scattering phase shifts. We compare solutions of the Kadyshevsky equation with iterative treatments and identify the subset of short-distance parameters with physical significance.
Work supported in part by DFG and NSFC (CRC110).

HK 12.6 Mo 17:45 HS 14

Exploring alternative SRG generators in one dimension — •Matthias Heinz[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

The Similarity Renormalization Group (SRG) is used in nuclear theory to decouple high- and low-momentum components of nuclear interactions to improve convergence and thus reduce the computational requirements of many-body calculations. The SRG evolution is characterized by the generator, which determines toward what form the Hamiltonian is transformed. Currently, the standard choice for the generator is the kinetic energy, which evolves the Hamiltonian towards a diagonal form. However, it has been shown that significant contributions from four- and higher-body forces can be induced during the evolution, which limits the application of evolved potentials to many-body problems. Alternative generators may generate weaker many-body forces while offering the same improvements of the many-body convergence. In this talk, I will discuss the use of 1-D systems of two, three and four bosons to investigate alternative generator choices and to study the many-body convergence and the size of the induced many-body forces.

This work is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Projektnummer 279384907 – SFB 1245.

HK 12.7 Mo 18:00 HS 14

Single-particle potentials of hyperons in nuclear and neutron matter: Role of 3-baryon forces — •Dominik Gerstung, Norbert Kaiser, and Wolfram Weise — Technische Universität München

The Brueckner G-matrix formalism is employed to calculate the single-particle potentials of nucleons and hyperons in isospin-symmetric nuclear matter and pure neutron matter. The underlying two-body interactions consist of NLO chiral two-baryon potentials and effective density-dependent baryon-baryon interactions derived from the leading order chiral three-baryon forces. We compute the chemical potentials of neutrons and Λ(1116)-hyperons in order to investigate the critical density for the onset of Λ-formation in neutron-star matter.

The contact and one-pion exchange components of the NNΛ 3-body force depend on two yet undetermined short-distance parameters H_1 and H_2, whose ranges are explored by imposing empirical constraints from Λ-hypernuclei and nuclear matter.

Work supported in part by DFG and NSFC (CRC110).

HK 12.8 Mo 18:15 HS 14

Structure of three-body hypernuclei — •Fabian Hildenbrand and Hans-Werner Hammer — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

We construct a short-range effective field theory with contact interactions for three-body hypernuclei in the strangeness S=-1 sector. Renormalization is achieved with a one-parameter three-body force. We present universal correlations between observables in the Isospin $I = 1$ and $I = 0$ sector. Furthermore, predictions for the matter radii in both channels are presented. Finally, we discuss the possibility of a Λnn bound state in this effective theory.

*This work has been supported by the BMBF under grant 05P15RDFN1 and 05P18RDFN1.

HK 13: Fundamental Symmetries I

Zeit: Montag 16:30–18:30 Raum: HS 16

Gruppenbericht HK 13.1 Mo 16:30 HS 16

The Neutron Lifetime Experiment PENeLOPE — •Dominic Gaisbauer — TU München, Garching, Deutschland

The neutron lifetime $\tau_n = 880.2 \pm 1.0\ s$ is an important parameter in the Standard Model of particle physics and in Big Bang cosmology. Several systematic corrections of previously published results reduced the PDG world average by several s 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".

Gruppenbericht HK 13.2 Mo 17:00 HS 16

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

Within the standard model of particle physics semi-leptonic weak decay is described by only two free parameters, the ratio of vector and axial vector couplings, λ, and the first element of the CKM-matrix V_{ud}. Due to the absence of nuclear structure, neutron beta decay is an ideal probe to test the structure of the weak interaction.

Measuring the beta asymmetry, A, is the most precise way of measuring λ. The spectral shape of the experimental beta asymmetry furthermore contains information about hypothetical scalar- and tensor interactions via the Fierz interference term.

In this talk we present the result of the world's most precise measurement of the beta asymmetry performed with the decay spectrometer Perkeo III. This measurement has been carried out at the PF1B cold neutron beam facility at the Institut Laue-Langevin.

Gruppenbericht HK 13.3 Mo 17:30 HS 16

The P2 experiment: A high precision measurement of the weak mixing angle — Sebastian Baunack[1], Dominik Becker[1], Frank Maas[1,2,3], David Rodriguez Pineiro[2], and •Malte Wilfert[1] for the P2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The weak mixing angle $\sin^2\theta_w$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is a very precise measurement of the weak mixing angle with a precision of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}\,\mathrm{GeV}^2$. This precision is comparable to existing measurements at the Z pole. The experiment will be built at the future MESA accelerator in Mainz.

In this talk, the motivation for the measurement and the theoretical and experimental challenges will be discussed.

HK 13.4 Mo 18:00 HS 16

Neutron beta decay studies with PERC — •Bastian Märkisch for the PERC-Collaboration — Physik-Department, Technische Universität München

Neutron beta decay is an excellent system to study the charged weak interaction experimentally. The decay is precisely described by theory and unencumbered by nuclear structure effects. Observables are numerous correlation coefficients which e.g. relate the spin of the neutron and the momenta of the particles, spectra and the lifetime. Precision measurements in neutron beta decay are used to search for hypothetical scalar and tesor couplings and to derive the element V_{ud} of the Cabibbo-Kobayashi-Maskawa matrix.

The Proton Electron Radiation Channel (PERC) instrument is currently under construction at the MLZ, Garching. It designed to improve measurements of several correlation coefficients by an order of magnitude. In this talk, we will present the concept of the instrument and its current status.

HK 13.5 Mo 18:15 HS 16

Towards Sympathetic Cooling of Single Protons and Antiprotons — •Markus Wiesinger[1,2], Matthew Bohman[1,2], Georg Schneider[3], Christian Smorra[2], Andreas Mooser[1,2], Pascal Blessing[2,4], Jack Devlin[2,5], James Harrington[1,2], Elise Wursten[2,5], Klaus Blaum[1], Yasuyuki Matsuda[6], Wolfgang Quint[5], Jochen Walz[3], and Stefan Ulmer[2] — [1]Max-Planck-Institut für Kernphysik, Germany — [2]Ulmer Fundamental Symmetries Laboratory, RIKEN, Japan — [3]Johannes Gutenberg-Universität Mainz, Germany — [4]GSI, Germany — [5]CERN, Switzerland — [6]University of Tokyo, Japan

We, the BASE collaboration, perform most precise tests of the CPT symmetry in the baryon sector by measurement of the proton and antiproton magnetic moment and the proton-to-antiproton charge-to-mas ratio.

Our latest high-precision measurement of the proton magnetic moment at the proton g-factor experiment in Mainz is limited by statistics. The reason is that the current use of sub-thermal cooling of a single proton by a resistive method - an extremely time-consuming technique - leads to cycle times of hours.

To overcome this limitation sympathetic cooling by laser-cooled Be^+ ions is planned in a common-end-cap Penning trap: The method not only promises to produce protons or antiprotons with mK temperatures within tens of seconds but also achieves separation of the cooled ion and the refrigerator ion - a feature distinct from other ongoing efforts to sympathetically cool antiprotons.

We present the current setup of the proton g-factor experiment and report on the status of our laser cooling experiments.

HK 14: Instrumentation III

Zeit: Montag 16:30–18:15 Raum: HS 11

Gruppenbericht HK 14.1 Mo 16:30 HS 11

Finale Detektorkomponenten des elektromagnetischen Kalorimeters des $\overline{\mathrm{P}}$ANDA-Experimentes und ihr Aufbau. — •Claudius Schnier für die PANDA-Kollaboration — Ruhr-Universität Bochum

Das $\overline{\mathrm{P}}$ANDA-Experiment ist eines der Schlüsselexperimente an der sich im Bau befindlichen Beschleunigeranlage FAIR. Hier werden Kollisionen von Antiprotonen in einem Impulsbereich zwischen 1,5 GeV/c und 15 GeV/c mit Protonen untersucht. Der $\overline{\mathrm{P}}$ANDA-Detektor ist ein vielseitiger Detektor mit präziser Spurrekonstruktion und der Möglichkeit neutrale, sowie geladenen Teilchen zu detektieren. Das homogene elektromagnetische Kalorimeter (EMC) des Target-Spektrometers, welches in einen fassförmigen Mittelteil und zwei Endkappen aufgeteilt ist, stellt eine zentrale Detektorkomponente für die Bestimmung der Energien von Elektronen, Positronen und Photonen dar. Als Szintillator wird Bleiwolframat ($PbWO_4$) unter anderem wegen seiner hohen Strahlenhärte, kurzen Abklingzeit und der wegen des kompakten Detektordesigns benötigten kurzen Strahlungslänge eingesetzt. Das EMC wird auf $-25°$C heruntergekühlt, da mit fallender Temperatur die Lichtausbeute von $PbWO_4$ steigt.

Es wird ein Überblick über den Detektoraufbau des EMCs vorgestellt. Hierbei werden die finalen Detektorkomponenten und ihre Zusammensetzung, so wie unter anderem die Kühlung, die Submodule und das Monitorierungssystem, aber auch weitere zum Detektoraufbau nötige Komponenten, besprochen.

Gefördert durch das BMBF.

HK 14.2 Mo 17:00 HS 11

Feature extraction of the electromagnetic calorimeter preamplifier (APFEL - ASIC) for the PANDA experiment at FAIR — Luigi Capozza[1,2], Alaa Dbeyssi[1,2], Frank Maas[1,2,3], •Oliver Noll[1,2], David Rodriguez Pineiro[1], Sahra Wolff[1,2], and Manuel Zambrana[1,2] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

The PANDA experiment at the upcoming FAIR accelerator facility will study antiproton annihilation reactions at antiproton beam momenta from 1.5 GeV/c up to 15 GeV/c. With its modular multi-purpose detector system, it will be able to observe a variety of physics channels. The electromagnetic process group (EMP) at HI-Mainz is developing the backward end-cap of the electromagnetic calorimeter. Within this activity, a method for the real-time extraction of specific signal features using the APFEL ASIC preamplifier was developed for the PANDA sampling ADC. Besides different extraction routines, a high order finite impulse response filter was implemented. A test beam time at the Mainz Microtron facility using the backward end-cap prototype was performed. The setup achieved decent linearity and a relative energy resolution of less than 2.3 % at 1 GeV. Moreover, a proper hit detection at detector rates up to 350 kHz was obtained. The talk will address both the hardware implementation and the test beamtime.

HK 14.3 Mo 17:15 HS 11

Ein mobiler Teststand für die Montage des elektromagne-

tischen Kalorimeters des $\overline{\text{P}}$ANDA-Experiments sowie Optimierung der im Lichtpulsersystem verwendeten LCDs. — •Hans-Christopher Wenzel für die PANDA-Kollaboration — Ruhr-Universität Bochum, Institut für Experimentalphysik I

Das $\overline{\text{P}}$ANDA-Experiment ist eines der vier Schlüsselexperimente an der zukünftigen Beschleunigeranlage FAIR in Darmstadt, welches Fragestellungen in der Hadronenphysik untersuchen soll. Eine zentrale Detektorkomponente für die Detektion von Endzustandsteilchen aus Antiproton-Proton-Kollisionen ist das elektromagnetische Kalorimeter (EMC). Das EMC besteht aus Einheiten von Bleiwolframat ($PbWO_4$) Szintillationskristallen, den so genannten Submodulen. Mögliche Schäden der Kristalle sowie der sich anschließenden Photodetektoren und der Ausleseelektronik werden über ein Lichtpulsersystem monitoriert. Das Lichtpulsersystem erzeugt Lichtpulse äquivalent zum Szintillationssignal von Teilchen mit Energien zwischen 10 MeV und 15 GeV. Die Intensität der Pulse kann mit Hilfe von LCDs, über drei Größenordnungen, variiert werden. Bei der finalen Montage des EMCs wird weiterhin ein kompakter und mobiler Teststand benötigt, mit dem die Submodule vor deren Einbau auf ihre Funktionstüchtigkeit überprüft werden.
In diesem Vortrag werden Optimierungsansätze für die Lichtpulser-LCDs wie auch erste Konstruktionsideen für den mobilen Teststand vorgestellt.
Gefördert durch das BMBF

HK 14.4 Mo 17:30 HS 11

Software Alignment am PANDA Luminositätsdetektor — •Roman Klasen[1], A. Denig[1,3], F. Feldbauer[2], M. Fritsch[2], R. Hagdorn[2], H. Leithoff[1], S. Maldaner[1], C. Motzko[1], S. Pflüger[2], A. Pitka[2], G. Reicherz[2] und T. Weber[2] für die PANDA-Kollaboration — [1]Helmholtz-Institut Mainz — [2]Ruhr Universität Bochum — [3]Johannes Gutenberg Universität Mainz

Am Antiproton-Spreicherring des in Darmstadt entstehenden Beschleunigerkomplexes FAIR werden mit dem PANDA-Experiment elementare Fragen der Hadronenphysik beantwortet werden. Zum Beispiel werden mit der Energy-Scan-Methode die Parameter wie Breite oder Linienform bekannter oder bisher unbekannter Resonanzen präzise vermessen. Zur Normierung der einzelnen Messpunkte eines Scans ist die genaue Kenntnis der Luminosität unbedingt notwendig.

Die Luminosität wird anhand der elastischen Antiproton-Proton-Streuung bestimmt, welche als Referenzprozess dient. Hierzu wird die gemessene Winkelverteilung der vorwärts gestreuten Antiprotonen vermessen und mit der theoretischen Vorhersage verglichen. Die Präzision der Messung hängt maßgeblich von der präzisen Messung dieser Winkelgenauigkeit ab. Die exakte Kenntnis der Position der Sensoren ist dafür Voraussetzung. In diesem Votrag wird ein Überblick über die technischen Herausforderungen bei der Positionsbestimmung der einzelnen Detektorkomponenten und deren technische Lösung gegeben, sowie der Einfluss von geometrischen Ungenauigkeiten auf die Messung der Luminosität.

HK 14.5 Mo 17:45 HS 11

Towards the final setup of KOALA experiment — •Yong Zhou and Huagen Xu — Institute for Nuclear Physics (IKP), Forschungszentrum Jülich, Germany

The KOALA experiment will measure antiproton-proton elastic scattering cross-section in a wide range of four momentum transfer |t| from 0.0008 to 0.1 $(GeV/c)^2$ at the upcoming HESR ring of FAIR. It aims to provide key input parameters for PANDA's luminosity determination. The recoil detector of KOALA has already been built and tested with proton beams by measuring proton-proton elastic scattering at COSY. The recoil detector measures both the kinetic energy and the polar angle of the recoil proton. The beam test results show that a range of |t| down to 0.001 $(GeV/c)^2$ can be measured with the recoil detector alone. However, large background events from inelastic proton-proton reaction at polar angle close to 90° limit the ability of the recoil detector to reach all the way down to the lowest end of the required |t| range. To extend the lower limit, a forward scintillator detector has been built. The goal is to suppress the high background by the coincidence measurement between the recoil proton and the forward scattered beam particle. The scintillator bars are placed close to the beam axis covering the polar angle range of 0.4°-1.2°. Performance tests of the forward detector are carried out in the laboratory and the results will be reported in this talk. The commissioning of the full KOALA setup with proton beam at COSY is also described and the latest results will be presented.

HK 14.6 Mo 18:00 HS 11

Optimization of the photon reconstruction of the PANDA target calorimeter — •Áron Kripkó for the PANDA-Collaboration — II. Physikalisches Institut, JLU Gießen

PANDA is a hadron physics experiment planned to be operated at the future FAIR facility at Darmstadt, Germany. It will use cooled antiproton beams interacting with various internal targets.

The common simulation framework for feasibility studies of the PANDA experiment is PANDARoot. When reconstructing electromagnetic showers, there are some cases, when a secondary maximum is created a few crystals away from the impinging point of the primary photon. These secondaries are called split-offs. In the current version of PANDARoot many split-off events are reconstructed wrongly as individual photons in the target calorimeter.

Due to the wrong reconstruction, the combinatorial background is high. This complicates the reconstruction of events, especially those which consist of many low energy photons. To improve the reconstruction, new clustering algorithms are being developed and tested. New measures were defined, which give detailed insight to the capabilities of the algorithms. Tests showed, that the performance of the algorithms vary in energy and also depends on the number of photons in the final state. During the talk a detailed description of the algorithms will be given and the test results will be presented.

This project is supported by BMBF and HIC for FAIR.

HK 15: Instrumentation IV

Zeit: Montag 16:30–18:15 Raum: HS 12

Gruppenbericht HK 15.1 Mo 16:30 HS 12

Status of the mCBM@SIS18 experiment at GSI/FAIR — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at FAIR is consequently designed to measure nucleus-nucleus collisions at unprecedented interaction rates up to 10 MHz which will allow to study extremely rare probes with high precision. To achieve this high rate capability CBM will be equipped with fast and radiation hard detectors, readout by a free-streaming data acquisition system transporting data with up to 2 TB/s to a large scale computer farm which provides first level event selection. With *mCBM@SIS18* ("mini-CBM") we are presently commissioning a CBM full-system test-setup at GSI/FAIR comprising final prototypes and pre-series components of all CBM detector subsystems and their read-out systems. The primary aim is to develop, commission and optimize (i) the free-streaming data acquisition system including the data transport to a high performance computer farm inside the GreenITCube, (ii) the online track and event reconstruction and event selection algorithms and (iii) the offline data analysis as well as the controls software package. Furthermore, the setup offers additional high-rate tests of the final detector prototypes in nucleus-nucleus collisions under realistic experiment conditions. An overview on the *mCBM@SIS18* project incl. first results from the commissioning runs will be given.

Supported by BMBF and GSI/FAIR.

HK 15.2 Mo 17:00 HS 12

Das Optimierungsframework Geneva in der Physik — •Jannis Geuppert[1], Kilian Schwarz[1], Jan Knedlik[1], Matthias Lutz[1] und Rüdiger Berlich[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt — [2]Gemfony scientific UG, Hauptstraße 2, 76344 Eggenstein-Leopoldshafen

Das Optimierungsframework Geneva wird nach mehreren Jahren weiterhin bei GSI erfolgreich zur parametrischen Optimierung technischer und wissenschaftlicher Fragestellungen auf Clustern sowie lokalen parallelen Recheneinheiten eingesetzt. Im Vortrag werden ein Überblick über die Funktionen und Anwendungsbereiche von Geneva gegeben, bereits mit Geneva durchgeführte Projekte präsentiert sowie wichtige

vollzogene Änderungen diskutiert. Dazu gehört der Umstieg zu Beast-Websockets sowie die Implementierung der Speicherung von bereits durchgeführten Optimierungs-Iterationen in Kontrollpunkten, um diese nach Bedarf an anderer Stelle fortsetzen zu können. Ferner wurde die Kompatibilität mit neueren Compiler-Versionen erzielt und damit begonnen als zusätzlichen Optimierungalgorithmus den parallele Nelder-Mead-Simplex-Algorithmus in Geneva zu implementieren.

HK 15.3 Mo 17:15 HS 12

ALICE Tier 2 Centre and ALICE Analysis Facility prototype at GSI — •Sören Fleischer, Raffaele Grosso, Jan Knedlik, Paul-Niklas Kramp, and Kilian Schwarz for the ALICE-Collaboration — GSI, Darmstadt, Deutschland

Since 2004 GSI has been operating a Tier 2 Center for the ALICE experiment on the local shared computing cluster, currently located in the Green IT Cube. In this contribution we describe the current status of the center and important changes within the past year, including improvements in the high-level monitoring of ALICE Grid (AliEn) jobs and further virtualisation of XRootD redirectors. In parallel, a working prototype of an ALICE Analysis Facility (AF) has been set up at GSI. The effectiveness of XRootD plug-ins developed at GSI is presented. The RedirLocal plug-in allows local clients to directly access files on the local file system, bypassing the XRootD data servers and thus making local data access faster and more scalable compared to using default Grid methods. The SymLink plug-in allows local clients to access local files by their logical name as available on the AliEn File Catalogue, without accessing the latter. Performance tests using standard ALICE analysis trains running on the current test setup suggest that the target data throughput of 100 GB/s for an ALICE Analysis Facility will be achievable. Furthermore, the ALICE AF prototype has allowed to successfully test the usage within AliEn jobs of the Dynamic Deployment System (DDS), a toolset for effective deployment of distributed processes, developed at GSI.

HK 15.4 Mo 17:30 HS 12

Control system developments and machine model benchmark for the GSI fragment separator FRS — •Jan-Paul Hucka[1], Joachim Enders[1], Stephane Pietri[2], Helmut Weick[2], David Ondreka[2], Jutta Fitzek[2], and Bernd Schlei[2] — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

At the GSI facility, the LSA [1] framework from CERN is used to implement a new control system for accelerators and beam transfers.

This was already completed and tested for the SIS18 accelerator. The implementation of experimental rings such as CRYRING and ESR is currently under development. In addition, the fragment separator FRS [2] and - at a later stage - also the superconducting fragment separator Super-FRS at FAIR will be controlled within this framework.

The challenge posed by the implementation of the control system for the FRS arises from the interaction of the beam with matter in the beamline and the beam's associated energy loss. This energy loss is determined using input from ATIMA [3] and has been included into the code of the LSA framework. The developed control system solutions were tested in dry-runs and proven to control power supplies and actuators with the help of an out of framework solution.

Additionally the current production version of the software and setting generator was simulated and benchmarked by comparison to older measurements.

[1] M. Lamont et al., LHC Project Note 368 [2] H. Geissel et al., NIM B 70, 286 (1992) [3] H. Weick et al., NIM B 164/165 (2000) 168
Supported by BMBF (05P15RDFN1 and 05P19RDFN1).

HK 15.5 Mo 17:45 HS 12

Status of MRPC calibrations for the endcap-time-of-flight upgrade of STAR — •Philipp Weidenkaff for the CBM-Collaboration — Ruprecht-Karls-Universität Heidelberg

As part of the FAIR phase 0 program, CBM-ToF MRPC modules have been installed as endcap-time-of-flight detectors in STAR for the upcoming beam-energy-scan II. These detectors will provide a major improvement to the particle identification capability of the experiment in the forward region ($1.0 < \eta < 1.5$), which is especially necessary for the planned fixed target program. A parallelized calibration scheme for the MRPC detectors has been developed inside the StROOT framework. Current status of this calibration scheme and the detector performance in the 2018 test runs will be presented in this talk.

The project is partially founded by BMBF 05P15VHFC1.

HK 15.6 Mo 18:00 HS 12

Characterization of the Strip Front-End ASIC of the PANDA MVD with the JDRS — •Alessandra Lai[1], Tobias Stockmanns[1], James Ritman[1], Daniela Calvo[2], and Kai-Thomas Brinkmann[3] for the PANDA-Collaboration — [1]Forschungszentrum Jülich — [2]INFN Torino — [3]Uni Gießen

The Micro Vertex Detector (MVD), the innermost subsystem of the PANDA detector, plays an essential role in the event reconstruction. The requirements of the experiment lead to the development of custom front-end chips for the MVD pixel and strip sensors. The Jülich Digital Readout System (JDRS) is the data acquisition system designed to evaluate the performance of the prototypes of these front-end ASICs through measurements in the laboratory and under ionizing particle beams. The recent improvements on the JDRS will be presented, together with the results of the tests carried out on the first prototype of the strip front-end ASIC PASTA.

HK 16: Outreach II

Zeit: Montag 16:30–17:30 Raum: HS 18

Gruppenbericht HK 16.1 Mo 16:30 HS 18

Die Entwicklung des Universums - Eine aktiv bespielte Ausstellung im Deutschen Museum — •Hannelore Hämmerle[1], Petra Riedel[2], Stefan Waldenmaier[3] und Barbara Wankerl[4] — [1]Max-Planck-Institut für extraterrestrische Physik, Garching — [2]Ludwig-Maximilians-Universität München/Exzellenzcluster Universe — [3]Technische Universität München/SFB1258 — [4]Max-Planck-Institut für Physik, München

Unter Leitung des Exzellenzclusters Universe haben Münchner Forschungsinstitutionen im Deutschen Museum gemeinsam eine eigene Ausstellung über die Entwicklung des Universums aufgebaut. Die Ausstellung nimmt den Besucher mit auf eine Zeitreise, die vor 13,7 Milliarden Jahren beginnt und mit einem Blick auf die Zukunft des Universums endet. Auf dem Weg erfahren die Besucher, wie sich Raum, Zeit, Materie und die großen Strukturen im Weltall gebildet haben. Die Ausstellung verknüpft Erkenntnisse aus der Astronomie, Astro-, Kern-, und Teilchenphysik, um die Entwicklungsgeschichte des Kosmos aus verschiedenen Blickwinkeln darzustellen. Der aktuelle Stand der Forschung wird mit Video- und Bildmaterial anschaulich illustriert. Experimente laden zum Mitmachen ein. Die Ausstellung zieht jährlich 70000 Besucher an. Sie besteht seit dem Jahr 2009 und wurde aufgrund ihrer Attraktivität 2014 umfassend aktualisiert und erweitert. Wir berichten über die Konzeption der Ausstellung, Erfahrungen mit Führungen und über flankierende Maßnahmen wie öffentliche Vorträge, Schülertage und Lehrerfortbildungen im Deutschen Museum.

HK 16.2 Mo 17:00 HS 18

Jugendliche erforschen das Unsichtbare mit CosMO — •Steffen Turkat[1], Carolin Schwerdt[2] und Michael Walter[2] für die Netzwerk Teilchenwelt-Kollaboration — [1]Institut für Kern- und Teilchenphysik, TU Dresden — [2]Deutsches Elektronen-Synchrotron DESY, 15738 Zeuthen, Deutschland

Arbeiten wie ein/e Wissenschaftler/in – das wünschen sich viele Jugendliche. Auch für die Nachwuchsgewinnung im Bereich der Forschung ist dies ein immer wesentlicheres Element. Netzwerk Teilchenwelt schafft dafür Angebote. Jugendliche können an der Forschung zu den kleinsten Teilchen teilhaben und eigene Forschungsaufgaben bearbeiten. DESY in Zeuthen hat im Netzwerk Teilchenwelt das CosMO-Experiment und die Webplattform Cosmic@Web entwickelt. Jugendliche können damit die uns permanent durchdringende kosmische Strahlung selbstständig untersuchen. Voraussetzung sind allgemeines Wissen und Interesse am Fachgebiet. Im Vortrag werden der Detektor, Beispiele für damit durchführbare Messungen, wie z.B. die Kalibration von Detektoren oder die Bestimmung der Lebensdauer von Myonen vorgestellt. Zusammen mit rund 20 anderen Instituten im Netzwerk Teilchenwelt stellt DESY das CosMO-Experiment bundesweit für Schülerprojekte zur Verfügung, sowohl an den jeweiligen Instituten als

auch an anderen Lernorten.

HK 16.3 Mo 17:15 HS 18

Eine Einführung in Numerische Simulationen: Die Perihelbewegung des Merkurs — •Jan-Lukas Wynen[1], Christopher Körber[1,2], Inka Hammer[1], Joseline Heuer[3], Christian Müller[4] und Christoph Hanhart[1] — [1]Institut für Kernphysik (IKP-3) und Institute for Advanced Simulation (IAS-4), Forschungszentrum Jülich, D-52425 Jülich, Germany — [2]Department of Physics, University of California, Berkeley, CA 94720, USA — [3]Hochschule Hamm-Lippstadt, Marker Allee 76-78, 59063 Hamm, Germany — [4]Schülerlabor JuLab, Forschungszentrum Jülich, D-52425 Jülich, Germany

Numerische Simulationen spielen eine immer wichtiger werdende Rolle in der Wissenschaft. Es wird ein Projekt vorgestellt, das Gymnasiasten Grundprinzipien von numerischen Simulationen anhand der Perihelbewegung des Merkurs lehrt. Eintägige Kurse basierend auf diesem Projekt wurden in mehreren Jahren auf der "Schülerakademie Teilchenphysik" am Science College Overbach mit großem Erfolg abgehalten. Die Simulation wird Schritt für Schritt under Anleitung aufgebaut, ohne dass vorherige Programmierkenntnisse benötigt werden. Der Kurs hilft Schüler*innen Intuition für numerische Rechnungen zu entwickeln und regt zum Nachdenken und zu Diskussionen an. Kombiniert mit selbst erstellten Visualisationen ist dies für viele ein eindrucksvoller erster Schritt in der Welt der Numerischen Physik.

HK 17: Hauptvorträge II

Zeit: Dienstag 11:00–12:45 Raum: Plenarsaal

Hauptvortrag HK 17.1 Di 11:00 Plenarsaal

Laboratories of the Strong Interaction: Exotic Hadrons — •Sebastian Neubert — Physikalisches Institut, Heidelberg, Germany

The formation of hadrons, which escape description through the quark model, is a most fascinating effect of the strong interaction. Such exotic hadrons can be studied with a variety of experimental techniques. The discovery of mesons composed of four quarks in decays involving charmonia at the B-factories has opened an experimental window that is especially well suited to the direct observation of effects beyond the quark model. With the discovery of Pentaquark candidates in their decay to J/ψ proton, LHCb has extended this window to the baryon sector. These phenomena are unique laboratories to study multiquark and multihadron effects in the spectrum of QCD, which may hold the key to some of the oldest questions in understanding the strong interaction.

Hauptvortrag HK 17.2 Di 11:35 Plenarsaal

Nuclear thermodynamics from chiral effective field theory — •Corbinian Wellenhofer — Institut für Kernphysik, Technische Universität Darmstadt — ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH

The thermodynamics of dense nuclear matter is of fundamental importance for heavy-ion collisions and many astrophysical phenomena, in particular core-collapse supernovae and neutron star mergers. In recent years, considerable progress has been achieved in the description of low-energy nuclear interactions based on chiral effective field theory. This presentation focuses on recent advances in the application of chiral two- and three-nucleon interactions in nuclear matter calculations at zero and finite temperature. The discussed topics include the predictions for various nuclear bulk properties, the nuclear liquid-gas phase transition, and the fourth-order term in the Fermi-momentum expansion. The role of three-nucleon interactions and their impact on the theoretical uncertainties is examined, and we discuss current developments that are aimed at testing the many-body convergence and the construction of a chiral nuclear equation of state for astrophysical applications. Supported by the DFG - Projektnummer 279384907-SFB 1245.

Hauptvortrag HK 17.3 Di 12:10 Plenarsaal

Strange hadrons in cold and hot nuclear matter* — •Joana Wirth for the HADES-Collaboration — Physik Department, TUM, Garching, Germany — Excellence Cluster "Universe", Garching, Germany

The properties of hadrons immersed in a strongly interacting environment have been of great interest in recent decades. HADES explores the effects of nuclear matter in heavy ion collisions where baryon densities ρ_B exceed the normal nuclear density. However, modifications of hadron properties are already expected in cold nuclear matter (ρ_0), which is investigated in hadron-nucleus reactions with HADES where the dynamics are less complex and fundamental aspects can be addressed more directly. A nearly complete set of strange particles ($K^{\pm,0}$, Λ and ϕ) produced in the Au+Au collisions at 1.23A GeV as well as in $\pi^- + A$ ($A = C$, W) at $p_{\pi^-} = 1.7$ GeV/c has been measured.
We will present results on the (double-differential) yields and compare them with transport calculations. The KN potential is studied by means of the K^0_S and Λ kinematical distributions. Special attention will be on the investigation of the exclusive channel $\pi^- + p \to K^0 + \Lambda$ to shed light on the ΛN and $\Sigma^0 N$ potentials predicted by χ effective theory. In addition, the relative production yields of ϕ to K^- in all three collision systems will be discussed. Moreover, the K^- and ϕ absorption studied in πA collisions will be addressed in a model-independent way for the first time. ∗ supported by the DFG cluster of excellence "Origin and Structure of the Universe" and SFB 1258

HK 18: Hadron Structure and Spectroscopy III

Zeit: Dienstag 14:00–16:00 Raum: HS 13

Gruppenbericht HK 18.1 Di 14:00 HS 13

Search for four- and six-quark exotics with charm and strange quark content. — •Elisabetta Prencipe[1], Jens Soeren Lange[2], James Ritman[1], and Ashish Thampi[1] — [1]Forschungszentrum Juelich, IKP1, Leo Brandt strasse, 52428 Juelich, Germany — [2]JLU, Physikalisches Institut II, Heinrich-Buff-Ring 16, Giessen, Germany

The e^+e^- asymmetric colliders BaBar and Belle collected a huge data sets, roughly 1.5 ab^{-1}, running at the energy in the center of mass of $\Upsilon(nS)$, where n =1, 2, 3, 4, 5 (n = 5 at Belle, only). Even if they stopped data taking since almost 10 years, this represents the biggest available statistics at e^+e^- colliders, with great and unique possibilities in data analysis.

The present report summarizes the main goals of a combined BaBar+Belle data analysis project, approved since 1 years at FZJ, focused on the search of 4-quark states with $c\bar{c}s\bar{s}$ quark content, which main purpose is to analyze the invariant mass systems of $J/\psi\phi$ and $D_s^+ D_{s0}^*(2317)^-$ in different decay mechanisms. This is the first approved project in hadron spectroscopy with combined BaBar+Belle data sets. Possible search for 6-quark bound states is also possible and here introduced, with extrapolation and expectations with the full available statistics. Preliminary results on MC simulations and off-resonance data are presented, in an analysis of the $J/\psi\phi$ invariant mass system performed in continuum and through B decays. Feasibility studies are also shown for the analysis of the $D_s^+ D_{s0}^*(2317)^-$ invariant mass system.

HK 18.2 Di 14:30 HS 13

Analysis of $e^+e^- \to p\bar{p} + (\eta, \omega, \eta', f_1)$ at BESIII — •Marcel Rump, Johannes Bloms, Nils Hüsken, Johannes Kellers, Alfons Khoukaz, and Frederik Weidner — Westfälische Wilhelms-Universität Münster, Münster, Germany

Since the discovery of the $\chi_{c1}(3872)$ state by the BELLE experiment in 2003, a large number of new states were found in the mass region around 4 GeV/c^2, which apparently do not fit into the scheme of conventional charmonium states. The possibility that some of these states could be of exotic nature has raised interest on charmonium physics to a new level. Using data collected with the Beijing Spectrometer

III (BESIII) in positron-electron annihilations at the Beijing Electron-Positron Collider (BEPCII) above 4 GeV allows studying final states including a $p\bar{p}$ pair and different light mesons. Systematic searches for heavy resonances as well as their decays via nucleon resonances are performed analysing $e^+e^- \to p\bar{p} + (\eta, \omega, \eta', f_1)$. In this talk, the current status of the analysis will be discussed.

HK 18.3 Di 14:45 HS 13

Study of the invariant mass system $J/\psi\phi$ in B decays and continuum with BaBar and Belle combined data sets — •Ashish Thampi[1], Elisabetta Prencipe[1], James Ritman[1], and Jens Soeren Lange[2] — [1]IKP-1, Forschungszentrum Juelich, Leo Brandt Strasse, 52428 Juelich, Germany — [2]JLU Giessen, Physikalisches Institut II, Heinrich-Buff-Ring 16, Germany

The importance of analyzing the $J/\psi\phi$ invariant mass system is known, due to the controversial interpretation of two enhancements observed at 4140 and 4274 MeV/c^2, and two more peaks observed at 4500 and 4700 MeV/c^2 by the LHCb experiment in the same invariant mass system through B^+ decays.

The Belle experiment, located around the interaction point of the asymmetric energy e^+e^- collider at KEK (Tsukuba, Japan), collected 772 Mio. $B\bar{B}$ pairs at the center of mass energy corresponding to the $\Upsilon(4S)$ production. This report will present the preliminary results of MC simulations for the B decay using data collected at the energy in the center of mass of the $\Upsilon(4S)$, and also will show preliminary results of $e^+e^- \to J/\psi\phi$ in continuum, by analyzing all data sets collected by Belle at $\Upsilon(nS)$. The goal of this project is to analyze the invariant mass system of $J/\psi\phi$ in different production mechanisms, and combine these Belle results with the corresponding results of an equivalent BaBar analysis to gain sufficient statistics, and perform eventually angular analysis for a better understanding of the $c\bar{c}s\bar{s}$ spectrum.

HK 18.4 Di 15:00 HS 13

Shedding light on exotic charmonium: Reconstruction of a hybrid candidate with PANDARoot by means of a genetic algorithm — •Christian Will, Markus Moritz, and Kai-Thomas Brinkmann for the PANDA-Collaboration — 2nd Physics Institute, Justus-Liebig-University Giessen

One of the most interesting fields in modern high energy physics is the experimental study of quantum chromodynamics. The PANDA-experiment at FAIR aims to explore this field by probing hadrons with unprecedented precision and sensitivity. It will use proton-antiproton collisions to reach center-of-mass energies of up to 5.5 GeV. Combined with a high luminosity, this will make the detection of exotic resonances with tiny cross sections feasible. In order to support the experiment with simulations, the software framework PANDARoot was developed.

In this talk, the reconstruction of a hybrid candidate in the charmonium sector with PANDARoot will be presented. The decay channel involving the hybrid candidate ultimately decays into seven photons, which makes it an excellent candidate to evaluate the performance of the electromagnetic calorimeter. While seven photons already create immense combinatorical background within the signal channel, there exist at least four background channels with a very similar decay pattern. Hence it is important to maximize the statistical significance of the signal. For this, different optimization algorithms were evaluated, where a genetic algorithm was found to be the most suitable one. Its features and performance will be discussed. This project is supported by BMBF and HIC for Fair.

HK 18.5 Di 15:15 HS 13

Neutral pion-pair production in singly-virtual two-photon scattering at BESIII — •Max Lellmann, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany

The anomalous magnetic moment of the muon a_μ is one of the most precisely measured observables of the Standard Model, yet it shows a discrepancy of about 3.7σ between Standard Model prediction and measurement. It is still under discussion whether this discrepancy is a hint for New Physics or a proof for the poor understanding of strong interaction at low energies.

Information on the production of pion pairs in two-photon fusion processes plays an important rule in the calculation of the hadronic light-by-light scattering contribution to a_μ.

The BESIII experiment, located at the institute of high energy physics in Beijing/China, offers a perfect testbed for the investigation of two-photon processes at small momentum transfers. The process $e^+e^- \to e^+e^-\gamma\gamma^* \to e^+e^-\pi^0\pi^0$ is measured at the BESIII experiment at centre-of-mass energies between 3.77 and 4.23 GeV with a total integrated luminosity of about 7 fb^{-1}. This presentation will discuss the current status of the analysis.

Supported by DFG (SFB1044)

HK 18.6 Di 15:30 HS 13

Measurement of the Electromagnetic Transition Form Factor of the η' Meson — •Sascha Wagner for the A2-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

Electromagnetic Transition Form Factors (TFF) allow us to study the intrinsic structures of hadrons and gain knowledge of their compound particles and properties. Furthermore the TFF of the light pseudoscalar mesons are an important quantity to reduce the theoretical uncertainty of the hadronic light-by-light scattering of the anomalous magnetic moment of the muon. These TFF are accessible in accelerator experiments like the Mainzer Mikrotron (MAMI) and the Crystal Ball experiment via particle decays in the time-like region.

In the A2 collaboration at MAMI experiments with bremsstrahlung photons are conducted. In 2014 dedicated experiments for the photoproduction of η' and ω mesons took place with a special photon tagging device constructed mainly for measurements of the η', the so-called End-point Tagger, covering the high-energetic region of the bremsstrahlung spectrum.

In this contribution the measurement of the Dalitz decay $\eta' \to \gamma^*\gamma \to e^+e^-\gamma$ with the Crystal Ball and TAPS setup will be discussed. Simulation studies for the photoproduction processes as well as first results of the 2014 measured data will be presented.

HK 18.7 Di 15:45 HS 13

Measurement of the Pion Form Factor above 1 GeV using Initial State Radiation at BESIII — •Yasemin Schelhaas and Achim Denig for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

The anomalous magnetic moment of the muon $a_\mu = (g_\mu - 2)/2$ is one of the most precise measured variables in physics. However, there is a discrepancy of 3.7 standard deviations between the Standard Model (SM) prediction and the direct measurement, known as the $(g-2)$-puzzle. The accuracy of the SM prediction can be improved using experimental measurements of hadronic processes at e^+e^- colliders. One of the most important processes is $e^+e^- \to \pi^+\pi^-$. Using a data set of 3.1 fb^{-1} taken at a center of mass energy of 4.18 GeV, its cross section is measured at the BESIII experiment at the BEPCII collider in Beijing, exploiting the Initial State Radiation technique. The analysis aims at the determination of the pion form factor above 1 GeV, which is also interesting for spectroscopy. In this presentation an overview of the current status of the analysis is given.

Supported by DFG (SFB 1044).

HK 19: Heavy-Ion Collisions and QCD Phases III

Zeit: Dienstag 14:00–15:45 Raum: HS 15

Gruppenbericht HK 19.1 Di 14:00 HS 15

Central production in ALICE in proton-proton collisions at the LHC — •Rainer Schicker for the ALICE-Collaboration — Phys. Inst., Heidelberg

Central production in proton-proton collisions has been analysed from the low energy range $\sqrt{s}$ = 12.7-63 GeV of the ISR at CERN up to the presently highest energy available of $\sqrt{s}$ = 13 TeV achieved in Run II at the LHC. Central production is characterized by the hadronic state produced at or close to midrapidity, and by the two forward scattered protons, or remnants thereof. No particles are produced between the midrapidity system and the beam particles or remnants on either side of the central system, thereby resulting in a double gap topology of the event. I will give an overview of the ongoing efforts in the ALICE collaboration to analyse double gap events taken in Run II at the LHC,

and present the prospects of such data taking in Run III.

HK 19.2 Di 14:30 HS 15

Production of (anti-)t and (anti-)^{4}He in Pb–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE at the LHC — •Esther Bartsch for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The high collision energies reached at the LHC lead to significant production yields of light (anti-)nuclei in proton-proton and, in particular, Pb–Pb collisions. The excellent particle identification capabilities of the Time Projection Chamber, using the specific energy loss (dE/dx), and the time-of-flight measurement, allow for the detection of these rarely produced particles. Furthermore, the Inner Tracking System gives the possibility to separate primary nuclei from those coming from the decay of heavier systems.

New results on (anti-)triton and (anti-)^{4}He production in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV will be presented. The goal is to study production mechanisms such as coalescence and thermal models, and to compare the results to those in heavy-ion collisions at lower energies.

Supported by BMBF and the Helmholtz Association.

HK 19.3 Di 14:45 HS 15

Light Nuclei Production in Au+Au Collisions at 1.23A GeV with HADES — •Melanie Szala for the HADES-Collaboration — Goethe Universität Frankfurt

In 2012 the HADES experiment at GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt measured Au+Au collisions at $\sqrt{s_{NN}}$ = 2.4 GeV. As light hadrons have successfully been analysed, we present recent results of light nuclei in order to extend the set of identified particles towards heavier hadrons.

After particle identification, the transverse mass spectra of the particle candidates are extracted. Subsequently, they are corrected for acceptance and efficiency losses, and the obtained spectra are then compared to blast-wave-fits, in order to extract the radial expansion velocity β of the system and its kinetic freeze-out temperature T_{kin}.

The production of nuclei in heavy ion collisions is commonly discussed within two different scenarios: the thermal-statistical model and the coalescence model.

The yields and extracted kinetic freeze out temperature are confronted to the chemical freeze-out temperature T_{chem} as extracted from statistical model fits to light hadron yields.

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

HK 19.4 Di 15:00 HS 15

Anti-helium production in pp collisions mesured with ALICE — •Michael Habib for the ALICE-Collaboration — GSI, Planckstraße 1, 64291 Darmstadt

Cosmic-ray anti-helium ($\overline{\rm He}$) have been long suggested as dark matter probe, since their production from collisions of high-energetic cosmic-rays with the interstellar medium seems to be extremely rare. However, due to the lack of $\overline{\rm He}$ measurements at comparable energies and system sizes, the astrophysical background is still poorly known.

ALICE has collected ∼1.5 billion pp events at a center-of-mass energy of $\sqrt{s}$ = 13 TeV. This constitutes a sufficient sample to measure the rare processes of anti-^{3}He production and contribute to a more precise estimate of the astrophysical background.

In this talk, we present the transverse-momentum ($p_{\rm T}$) spectra of (anti-)^{3}He in pp collisions and the corresponding coalescence parameter (B_3) for different event multiplicities.

HK 19.5 Di 15:15 HS 15

Alice measurement of the elliptic flow relative to the spectator plane — •Damir Devetak for the ALICE Collaboration — PI, Heidelberg

The Quark-Gluon Plasma (QGP) is a system of strongly interacting partons, created in heavy-ion collisions, that behaves almost like a perfect liquid. Its energy density and geometry profile can be described by relativistic hydrodynamics. The initial conditions to this calculations are defined by the phase-space distribution of the participating nucleons and thus fluctuate even at a fixed beam energy and collision centrality. This results in fluctuations of the anisotropic flow coefficients of the final particles that can be seen in the experiment and in calculations.

In this talk, measurements of the reaction plane elliptic flow are presented, using the Zero Degree Calorimeter at ALICE, and compared to the elliptic flow values calculated with the cumulants of the fourth order. According to calculations, in which elliptic flow fluctuations emerge from Gaussian fluctuations of initial spatial eccentricity components, the results should exhibit the same behaviour for central and semi-central collisions and differ for peripheral. Deviation from this trend can provide new insight into the nature of flow fluctuations in heavy-ion collisions.

HK 19.6 Di 15:30 HS 15

Performance study of the TRD nuclei trigger — •Ömür Erkiner for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

At the Large Hadron Collider at CERN significant production rates of light (anti-)(hyper-)nuclei have been measured in Pb–Pb collisions. The production of such loosely bound objects has recently become a topic of high interest. For instance the measured lifetime of the lightest hypernucleus, the hypertriton (a bound state of a proton, a neutron and a Λ hyperon), is significantly below the expectation of theory calculations which expect the lifetime to be very close to the Λ lifetime. Therefore, it is important to also measure these rare nuclei in pp collisions. Due to their weak decay, only its daughter products can be measured, e.g. the charged two body decay channel ${}^3_\Lambda{\rm H} \rightarrow {}^3{\rm He} + \pi^-$. Furthermore, anti-alpha have not been measured in pp and p–Pb collisions because of rare statistics and low production yield. In order to be able to measure these rare (anti-)nuclei also in pp collisions, it is essential to increase the statistics by employing a trigger on nuclei. The transition radiation detector (TRD) was constructed for electron identification and offers trigger capabilities. Using the data on pp collisions at $\sqrt{s}$ = 13 TeV it turned out that particles with $Z > 1$ the TRD shows a good behaviour as a nuclei trigger. In this talk the properties of the nuclei trigger will be elaborated as well as the extracted efficiencies and purities for the different light nuclei, i.e. (anti-)d, (anti-)t, (anti-)^{3}He and (anti-)^{4}He.

Supported by BMBF and the Helmholtz Association.

HK 20: Heavy-Ion Collisions and QCD Phases IV

Zeit: Dienstag 14:00–15:15 Raum: HS 12

HK 20.1 Di 14:00 HS 12

Flow performance studies with CBM — •Viktor Klochkov[1,2] and Ilya Selyuzhenkov[1,3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Göthe Universität Frankfurt, Frankfurt am Main, Germany — [3]National Research Nuclear University (Moscow Engineering Physics Institute), Moscow, Russia

The Compressed Baryonic Matter experiment (CBM) at FAIR aims to study the area of the QCD phase diagram at high net baryon densities and moderate temperatures using collisions of heavy ions at center-of-mass energies of a few GeV per nucleon. Anisotropic transverse flow is among the key observables to study the properties of matter created in such collisions.

The CBM performance for anisotropic flow measurements is studied with Monte-Carlo simulations using gold ions at SIS-100 energies with lab momentum up to 12A GeV/c employing different heavy-ion event generators. Various combinations of CBM detector subsystems are used to investigate the possible systematic biases in flow measurement and to study the effects of detector azimuthal non-uniformity. The resulting performance of CBM for flow measurements is demonstrated for different harmonics of identified charged hadron anisotropic flow as a function of rapidity and transverse momentum in different centrality classes.

HK 20.2 Di 14:15 HS 12

Λ Polarization in Au+Au collisions at $\sqrt{s_{NN}}$ = 2.4 GeV measured with HADES — •Frederic Kornas for the HADES-

Collaboration — TU Darmstadt, Darmstadt, Germany

Through its self-analyzing decay the Λ hyperon allows to measure the spin orientation by measuring the outgoing proton momentum. A possible spin polarization with respect to the reaction plane could probe a global polarization of the fireball. This would be a hint for vortical effects at the very early stages of the collision.

Previous measurements by the STAR collabiration show an increasing polarization to $P_\Lambda \approx 2\,\%$ for a center-of-mass energy of $\sqrt{s_{NN}} = 7.7\,\mathrm{GeV}$. In this contribution the status of the Lambda polarization in Au+Au collisions at $\sqrt{s_{NN}} = 2.4\,\mathrm{GeV}$ measured with HADES will be reported.

HK 20.3 Di 14:30 HS 12

Reconstruction of hypernuclei in CBM — •Maksym Zyzak[1], Iouri Vassiliev[1], and Ivan Kisel[1,2,3] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Göthe-Universität Frankfurt, Frankfurt am Main, Germany — [3]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

The main goal of the CBM experiment is to study highly compressed baryonic matter produced in the collisions of heavy ions. According to modern theories a complex structure of the QCD matter is predicted in the energy region of the SIS100 accelerator. To successfully fulfil its wide and challenging physics program CBM will study all relevant observables. One of them are hypernuclei, which are believed to be sensitive probes of the newly created matter. They will allow investigation of the equation of state of the highly compressed baryonic matter, hyperon-nucleon and hyperon-hyperon interactions.

The maximum yields of hypernuclei are predicted to be at CBM energies. Thus, with its unprecedented interaction rate of 10^7 Hz CBM will be able to perform high-precision measurement of hypernuclei containing one Λ particle like ${}^{3}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{H}$, ${}^{4}_{\Lambda}\mathrm{He}$, ${}^{5}_{\Lambda}\mathrm{He}$, etc. and even double-Λ hypernuclei like ${}^{4}_{\Lambda\Lambda}\mathrm{H}$ or ${}^{6}_{\Lambda\Lambda}\mathrm{He}$. Results of the feasibility studies on the reconstruction of hypernuclei in the CBM experiment are presented and discussed.

HK 20.4 Di 14:45 HS 12

Production of (anti-)^{3}He and (anti-)^{3}H in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV measured with ALICE — •Sebastian Hornung for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Heidelberg University, Germany

The production mechanism of multi-baryon states in ultra-relativistic ion collisions is one of the open puzzles in high-energy physics. On the one hand, thermal-statistical hadronization models can describe the particle yields over a wide range of energies in AA collisions. On the other hand, the nuclei yields can also be explained by the coalescence of protons and neutrons which are close by in phase space. Studies of the light (anti-)nuclei production as a function of the charged-particle multiplicity per event provide an important insight into the system-size dependence of hadronization. Previous measurements in pp and Pb–Pb collisions by ALICE show a more coalescence-like behaviour for low multiplicities and a thermal behaviour at larger multiplicities.

The spectra of (anti-)^{3}H and (anti-)^{3}He measured in p–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV are presented. The latter were measured for different charged-particle multiplicities. Thanks to removal of the contamination from nuclei produced via spallation, the spectra could be evaluated down to a transverse momentum $p_{\mathrm{T}} = 1.5$ GeV/c for both the anti-nuclei and the nuclei. These results contribute to the current picture by providing information about intermediate multiplicities. In addition, an upper limit on the production of anti-^{4}He is provided.

HK 20.5 Di 15:00 HS 12

Strange particle reconstruction in the CBM experiment at FAIR — Ivan Kisel[1,2,3], •Pavel Kisel[1,3,4], Peter Senger[3], Iouri Vassiliev[3], and Maksym Zyzak[3] for the CBM-Collaboration — [1]Goethe-Universität Frankfurt — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Joint Institute for Nuclear Research

The main goal of the CBM experiment at FAIR is to study the behavior of nuclear matter at very high baryonic density in which the transition to a deconfined and chirally restored phase is expected to happen.

One of the promising signatures of this new states are the enhanced production of multi-strange particles. The CBM detector is designed to measure such rare diagnostic probes with unprecedented precision and statistics.

Most of these particles have all decay modes with neutral daughter, which cannot be registered directly. The results of two independent approaches, conventional and missing mass methods, for reconstruction of these key CBM observables are presented.

HK 21: Structure and Dynamics of Nuclei III

Zeit: Dienstag 14:00–16:00 Raum: HS 14

Gruppenbericht HK 21.1 Di 14:00 HS 14

Lifetime determination via the Doppler-shift attenuation method using particle-γ coincidences in Cologne — •S. Prill[1], A. Bohn[1], V. Everwyn[1], M. Färber[1], F. Kluwig[1], P. Petkov[1,2], S.G. Pickstone[1], P. Scholz[1], M. Spieker[3], M. Weinert[1], J. Wilhelmy[1], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]National Institute for Physics and Nuclear Engineering, Bucharest-Magurele — [3]NSCL, Michigan State University, MI48824, USA

The Doppler-shift attenuation method using proton-γ coincidences as performed in Cologne is a well established method to extract lifetimes of excited nuclear levels in the sub-picosecond range [1]. In the past two years, the particle spectrometer SONIC with up to 12 silicon detectors in combination with the γ-ray detection array HORUS with its 14 HPGe detectors was used for p-γ coincidence measurements on various nuclei, such as ^{96}Ru [1], ^{112,114}Sn [2], ^{128,130}Te and ^{164}Dy. Numerous extracted lifetimes were derived and used to identify mixed-symmetry states and analyse the systematics of low-spin states. In this contribution, the method as well as recent improvements and additions in combination with experimental results will be presented. Supported by DFG (ZI 510/9-1). A.B. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

[1] A. Hennig *et al.*, NIM A **794**, 171 (2015)
[2] M. Spieker *et al.*, Phys. Rev. C **97**, 054319 (2018)
[3] S.G. Pickstone *et al.*, NIM A **875**, 104 (2017)

HK 21.2 Di 14:30 HS 14

A new approach to determine nuclear-level lifetimes using the Doppler-shift attenuation method — •A. Bohn[1], V. Everwyn[1], M. Färber[1], F. Kluwig[1], M. Müscher[1], S. G. Pickstone[1], S. Prill[1], P. Scholz[1], M. Spieker[2], M. Weinert[1], J. Wilhelmy[1], and A. Zilges[1] — [1]University ofCologne, Institute for Nuclear Physics — [2]NSCL, Michigan State University, MI 48824, USA

The combination of the γ-ray detector array HORUS, consisting of 14 HPGe detectors, and the target chamber SONIC, housing 12 silicon detectors, enables the determination of nuclear-level lifetimes in the range of sub-picoseconds via the Doppler-shift attenuation method (DSAM) [1,2,3]. The measurement of p-γ-coincidences allows to determine the complete reaction kinematics. Hence, centroid-energy shifts can be extracted in proton-gated γ-ray spectra, depending on the γ-emission angle θ. In the standard analysis, the attenuation factor $\mathrm{F}(\tau)$ is determined by using its correlation with the slope of $E_\gamma(cos(\theta))$. Alternatively, the spectra measured at different angles can be corrected for their expected Doppler shifts assuming different $\mathrm{F}(\tau)$ values. Then, a FWHM minimization for the transition of interest can be performed to obtain the final value of $\mathrm{F}(\tau)$. This procedure might be more efficient to determine lifetimes of weakly excited states. First results from DSAM experiments on ^{130}Te will be presented. Supported by DFG (ZI 510/9-1). A.B. is supported by the BCGS.

[1] A. Hennig *et al.*, NIM A **794** (2015) 171.
[2] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319.
[3] S. G. Pickstone *et al.*, NIM A **875** (2017) 104.

HK 21.3 Di 14:45 HS 14

Using the Doppler-shift attenuation method to extract lifetimes in ^{20}Ne — •David Werner[1], Andrey Blazhev[1], Alfred Dewald[1], Jan Jolie[1], Claus Müller-Gatermann[1], Pavel

Petkov[1,2], and Karl Oskar Zell[1] — [1]University of Cologne, Institute for Nuclear Physics, Cologne — [2]National Institute for Physics and Nuclear Engineering, Bucharest, Romania

In the series of Ne isotopes it becomes apparent that for ^{20,22}Ne the drastic increase in B(E2; $2^+ \rightarrow 0^+$) strength, compared to the double-magic ^{16}O, is difficult to be reproduced by modern configuration-mixing models [1] or shell model calculations without changing parameters, such that they deviate drastically from those describing neighbouring nuclei. Because of this discrepancy, we remeasured lifetimes in ^{20}Ne and ^{22}Ne using the Doppler-shift attenuation method. The experiments were performed at the Cologne FN Tandem accelerator in October 2017 using the ^{9}Be(^{16}O,nα)^{20}Ne and ^{9}Be(^{18}O,nα)^{22}Ne reactions with a 0.9 $\frac{mg}{cm^2}$ Be target on a 2.7 $\frac{mg}{cm^2}$ Mg backing at multiple beam energies between 30 and 38 MeV. The stopping powers of the reaction products in target and backing were measured at the Cologne Accelerator Mass Spectrometer in March 2018. For the line shape analysis an improved version of DESASTOP [2] was used, which utilizes a Monte-Carlo simulation of the stopping process of the recoil nuclei. Detailed discussion of the used analysis method as well as results will be presented and compared to the systematics of light nuclei.

[1] J. Le Blois *et al.*, Phys. Rev. C **89** (2014) 011306(R)
[2] G.Winter, NIM **214** (1983) 537

HK 21.4 Di 15:00 HS 14

Lifetime measurements in the self-conjugate nucleus ^{44}Ti — •K. Arnswald, P. Reiter, A. Blazhev, T. Braunroth, A. Dewald, M. Droste, C. Fransen, A. Goldkuhle, R. Hetzenegger, R. Hirsch, E. Hoemann, L. Kaya, L. Lewandowski, C. Müller-Gatermann, D. Rosiak, M. Seidlitz, B. Siebeck, K. Wolf, and K.O. Zell — Institut für Kernphysik, Universität zu Köln

Reduced transition strengths are sensitive signatures to describe collective excitations of atomic nuclei and the evolution of shell structures. They provide stringent tests of present shell-model interactions in the $0f1p$ shell along the $N = Z$ line. Recently determined $B(\mathrm{E2}, 2_1^+ \rightarrow 0_{\mathrm{g.s.}}^+)$ values for ^{44}Ti showed an enhanced collective behavior which was associated with core excitations from the *sd*-shell [1]. However, there is a lack of information on precise values along the negative parity band in this nucleus. These states arise from a strong interplay between *sd*- and *pf*-shell orbitals and allow for refined tests of cross-shell contributions. In order to investigate the single-particle and collective characters of low-lying states, lifetime measurements employing the Recoil-Distance Doppler Shift (RDDS) and the Doppler-Shift Attenuation Method (DSAM) were performed at the FN tandem accelerator at the IKP, Cologne. Excited states in ^{44}Ti were populated with a ^{40}Ca(^{6}Li,pn)^{44}Ti fusion-evaporation reaction. The emitted γ rays were detected by an array of 11 HPGe detectors. First lifetime results will be presented and compared to shell-model calculations including multi particle-hole cross-shell excitations.

[1] K. Arnswald *et al.* Phys. Lett. B **772**, 599 (2017)

HK 21.5 Di 15:15 HS 14

Lifetime determination in ^{97}Sr via delayed γ-γ fast-timing spectroscopy — •Arwin Esmaylzadeh[1], Jean-Marc Régis[1], Jan Jolie[1], Ulli Köster[2], and Yung Hee Kim[2] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institut Laue-Langevin, Grenoble

Delayed γ rays from neutron rich A=97 fission fragments were measured using the Lohengrin spectrometer at the reactor of the Institut Laue-Langevin in Grenoble [1]. Several lifetimes of excited states in ^{97}Sr were measured using the fast-timing technique [2]. The rapid change in ground-state deformation between the spherical ^{96}Sr (N=58) and the deformed ^{98}Sr (N=60) is well known [3,4]. Therefore, it is of particular interest to study the shape-coexisting structures at the spherical-deformed border (N=59). With the extracted transition probabilities the type of excitation of some states could be studied and assigned.

[1] P. Armbruster et al., Nucl. Instrum. Methods 139 (1976)
[2] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. 726 (2013)
[3] J.-M. Régis et al., Phys. Rev. C 95, 054319 (2017)
[4] E. Clément et al., Phys. Rev. Lett. 116, 022701 (2016)

HK 21.6 Di 15:30 HS 14

Direct lifetime measurements in ^{104}Pd — •Maximilian Droste, Peter Reiter, Konrad Arnswald, Robert Hetzenegger, Rouven Hirsch, Levent Kaya, Lars Lewandowski, Claus Müller-Gatermann, Michael Seidlitz, Burkhard Siebeck, and Kai Wolf — Institut für Kernphysik, Universität zu Köln

Coulomb excitation is a powerful tool to determine reduced transition probabilities of exotic nuclei far off stability. Therefore, the radioactive ion beam impinges onto target nuclei with well-known transition probabilities. Typically, unknown transition probabilities of the projectiles are determined relative to the established target values and detailed knowledge of standard target nuclei like ^{104}Pd is key. The B(E2:$2^+ \rightarrow 0^+$) value of the first excited state in ^{104}Pd and the correlated quadruple moments have so far only been investigated via Coulomb excitation. A precise lifetime measurement, as a complementary approach to determine reduced transition strengths in ^{104}Pd and to minimize the systematic errors, was performed at the FN Tandem accelerator of the IKP Cologne employing the Recoil-Distance Doppler-Shift (RDDS) method. Excited states of ^{104}Pd were populated via the fusion evaporation reaction ^{96}Zr(^{12}C,4n)^{104}Pd at 55 MeV upto 18 $\hbar$. Measured lifetimes in ^{104}Pd will be presented and reduced transition probabilities will be compared to Coulomb excitation results.

HK 21.7 Di 15:45 HS 14

Lifetime measurement of excited states in ^{124}Ba via RDDS — •Marcel Beckers[1], Alfred Dewald[1], Marcel Bast[1], Thomas Braunroth[1], Christoph Fransen[1], Kalin Gladnishki[2], Alina Goldkuhle[1], Jan Jolie[1], Julia Litzinger[1], and Claus Müller-Gatermann[1] — [1]Institute for Nuclear Physics, University of Cologne, Germany — [2]Faculty of Physics, University of Sofia, Bulgaria

Yrast B(E2) values in the Ce-Ba-Xe region around A=124 show an unexpected behaviour if compared to collective model predictions in various nuclei (^{122}Ba,^{124}Xe,^{126}Ce), since they decrease with higher spins. In contrast to this, other nuclei in that region show a normal behaviour, as expected within the framework of the collective model (e.g. ^{122}Xe, ^{126}Ba). For ^{124}Ba no B(E2) values above the $2_1^+ \rightarrow 0_{gs}^+$ transition are published. It is therefore not clear if the observed behaviour is indeed systematic in this mass region. To shed light on the situation we performed a lifetime measurement on ^{124}Ba using the Recoil-Distance Doppler-shift method. The results of this measurement will be presented, together with a comparison of the $B_{4/2}$, $B_{6/2}$ values with the $X(5)$ model, which predicts the empirical $R_{4/2}$, $R_{6/2}$ values of ^{124}Ba extremely well.

HK 22: Structure and Dynamics of Nuclei IV

Zeit: Dienstag 14:00–15:45 Raum: HS 16

Gruppenbericht HK 22.1 Di 14:00 HS 16

Towards Laser Spectroscopy of Boron-8 — •Felix Sommer[1], Jason Clark[2], Phillip Imgram[1], Simon Kaufmann[1], Kristian König[1], Jörg Krämer[1], Jan Krause[1], Alessandro Lovato[2], Bernhard Maass[1], Peter Müller[2], Krzysztof Pachucki[5], Mariusz Puchalski[6], Maria Piarulli[3], Robert Roth[1], Rodolfo Sánchez[4], Guy Savard[2], Robert Wiringa[2], and Wilfried Nörtershäuser[1] — [1]TU Darmstadt, DE — [2]ANL, Lemont, IL, US — [3]Washington University, St. Louis, MO, US — [4]GSI, Darmstadt, DE — [5]University of Warsaw, PL — [6]AM University, Poznan, PL

We report on the status of the charge radius determination of the proton halo candidate ^{8}B via collinear laser spectroscopy at Argonne National Laboratory. By combining high-resolution measurements of the isotope shift in an atomic ground state transition and high-accuracy *ab initio* mass-shift calculations of the five-electron system, the difference in mean-square charge radii between the short-lived ^{8}B and the stable isotopes ^{10,11}B can be extracted and will deliver a model-independent test of the ^{8}B proton halo character. In preparation, we installed a collinear laser spectroscopy beamline at ANL and investigated the production of ^{8}B-ions, including molecule breakup through few-nm carbon foils. Furthermore, we determined the nuclear charge radii of the stable boron isotopes ^{10,11}B by resonance ionization mass spectrometry (RIMS) at TU Darmstadt.

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

HK 22.2 Di 14:30 HS 16

β-decay Q-value measurements using the phase-imaging ion-cyclotron-resonance detection with ISOLTRAP at CERN — •Jonas Karthein for the ISOLTRAP-Collaboration — CERN, Geneva, Switzerland — MPI für Kernphysik, Heidelberg, Germany

ISOLTRAP, located at the radioactive ion beam facility ISOLDE at CERN, is a high-precision Penning-trap mass spectrometer for short-lived nuclides. This gives access to the study of nuclear-structure effects and provides precision β-decay Q-values to test nuclear models and fundamental interactions. Previously, the measurement principle has been the time-of-flight ion-cyclotron-resonance (ToF-ICR) technique, which limits accessible half-lives and relative uncertainties. With the new phase-imaging ion-cyclotron-resonance (PI-ICR) technique [S. Eliseev et al., Phys. Rev. Lett. 110 082501 (2013)], experiments can be performed with fewer ions and higher resolving power, providing access to new areas of the nuclear chart and to new physics.

This contribution will report on the status of PI-ICR mass spectrometry (MS) with ISOLTRAP, including results from first on-line measurements in both the high-resolution and high-precision regimes. In particular, the Q-value of the ^{131}Cs→^{131}Xe β-decay, previously considered as a candidate for the direct neutrino-mass determination, was measured with a precision $\delta m/m = 1.4 \cdot 10^{-9}$ and a mass resolving power $m/\Delta m > 7 \cdot 10^6$ in only 100 ms measurement time allowing to preclude it as a possible candidate in the neutrino-mass search.

HK 22.3 Di 14:45 HS 16

High-Precision Collinear Laser Spectroscopy - Towards All-Optical Nuclear Charge Radius Determination — •Phillip Imgram, Kristian König, Jörg Krämer, Tim Ratajczyk, and Wilfried Nörtershäuser — Institut für Kernphysik, TU Darmstadt

In recent measurements with the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) at TU Darmstadt, the rest-frame transition frequencies of Ba^+ ions were determined with unprecedented accuracy. This precision will be used in the future to test precise atomic many-body calculations and especially for the determination of nuclear charge radii from an all-optical approach by the spectroscopy of Li-like light ions. Such ions will be produced in an Electron Beam Ion Source (EBIS) with a rather large energy spread and a widely broadened spectral linewidth is expected. A so-called pump-and-probe procedure will be used to reduce the experimentally observed linewidth. Here, only one velocity class is selected with a laser through optical pumping in a first step. Afterwards, only the selected ions are probed with a second laser and a largely reduced linewidth will be observed. This procedure has been demonstrated with In^+ ions and the results are presented in this talk.

HK 22.4 Di 15:00 HS 16

Testing the mass surface of the nuclear chart with ISOLTRAP — •Ivan Kulikov for the ISOLTRAP-Collaboration — GSI, Darmstadt, Germany

The atomic nucleus is pictured as a system of bound nucleons. The mass of each nuclide results from the sum of the masses of the nucleons minus the binding energy of the system. The mass surface of the nuclear chart is built from the masses of all stable and radioactive nuclides. On this surface nuclear structure effects are seen as sudden irregularities. Additionally, nucleosynthesis and nuclear structure models are constrained by accurately known masses of nuclei.

Precise mass measurements are routinely carried out by the online Penning-trap mass spectrometer ISOLTRAP, based at the radioactive ion-beam facility ISOLDE/CERN [S. Kreim et al., Nucl. Instrum. Meth. B 317, 492-500 (2013)]. New mass investigations of ^{69,70}As, $^{49-51}$Sc and ^{72,73}Br were performed during the latest experiment campaigns. The measurements were accomplished by using multi-reflection time-of-flight mass spectrometry and the Penning-trap based time-of-flight ion-cyclotron-resonance detection technique. The masses of ^{69,70}As and $^{49-51}$Sc were previously known only through their β decay Q-values.

The new mass data provides an important test of the nuclear models in this region of the mass surface. This contribution will present results of the aforementioned measurements and discuss the impact of the refined mass values on the neighbouring isotopes.

HK 22.5 Di 15:15 HS 16

MIRACLS: The Multi Ion Reflection Time of Flight Apparatus for Collinear Laser Spectroscopy — •Simon Lechner[1,2], Paul Fischer[3], Hanne Heylen[1], Varvara Lagaki[1,3], Franziska Maier[4], Wilfried Nörtershäuser[5], Peter Plattner[1,6], Marco Rosenbusch[3], Lutz Schweikhard[3], Simon Sels[1], Frank Wienholtz[1,3], and Stephan Malbrunot-Ettenauer[1] — [1]CERN, Switzerland — [2]TU Wien, Österreich — [3]Universität Greifswald, Deutschland — [4]Johannes Kepler Universität, Österreich — [5]TU Darmstadt, Deutschland — [6]Universität Innsbruck, Österreich

Collinear laser spectroscopy (CLS) is a powerful tool to access nuclear ground state properties of short-lived radionuclides [1]. However, in order to explore the most exotic nuclides far away from stability, more sensitive methods are needed.

For this reason, the novel MIRACLS project at ISOLDE/CERN, aims to combine the high spectral resolution of conventional CLS with high experimental sensitivity. This is achieved by trapping ion bunches in a 30 keV MR-ToF (Multi-Reflection Time of Flight) device, which greatly enhances the observation time and hence, the sensitivity, while retaining the high resolution of CLS.

This presentation will introduce the MIRACLS concept, present the first results from a proof-of-principle experiment and give an outlook to the design of a 30 keV MR-ToF apparatus including a compact, linear Paul trap for optimal beam preparation.

[1] K. Blaum, et al., Phys. Scr. T152, 014017 (2013)

HK 22.6 Di 15:30 HS 16

Recent upgrades of the multiple-reflection time-of-flight isobar separator and mass spectrometer at TITAN, TRIUMF — •Gabriella Kripkó-Koncz for the TITAN-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

Measuring the atomic mass is critical to understand nuclear structure and astrophysics. Exotic nuclei can be produced with very high rates at the ISOL facility ISAC at TRIUMF (Vancouver, Canada). TRIUMF's Ion Trap for Atomic and Nuclear Science (TITAN) is a multiple ion-trap system for high-precision mass measurements and in-trap decay spectroscopy. A multiple-reflection time-of-flight isobar separator and mass spectrometer (MR-TOF-MS) has been integrated into the TITAN experiment. It is based on an established concept tested at the FRS Ion-Catcher at GSI. The ion of interest can be temporally separated from isobaric contaminations with mass-selective dynamic re-trapping. Furthermore, the device is well suited to perform high precision mass measurements, particularly for short-lived isotopes produced at low rate.

The improved capabilities of TITAN have been used in the first experiments to investigate the sub-shell closure of neutron-rich nuclides at N=32 and the r-process nucleo-synthesis for masses at A∼85. Besides these first results, several technical upgrades of the MR-TOF-MS have been made and will be presented.

HK 23: Astroparticle Physics I

Zeit: Dienstag 14:00–16:00 Raum: HS 18

Gruppenbericht HK 23.1 Di 14:00 HS 18

Search for neutrinoless double beta decay beyond a half-life of 10^{26} yr with GERDA — •Roman Hiller for the GERDA-Collaboration — Universität Zürich

The GERDA collaboration searches for neutrinoless double beta decay ($0\nu\beta\beta$) of ^{76}Ge. A discovery of this hypothetical decay would establish neutrinos as Majorana fermions and imply a violation of lepton number conservation. In GERDA, germanium detectors enriched in ^{76}Ge are deployed in a cryostat filled with liquid argon (LAr). Instrumenting the cryostat with photosensors, scintillation light in the argon can be used to veto external background events. With this concept, GERDA reached an unprecedented low background for germanium detectors and will remain effectively background free up to its design

exposure of 100 kg yr. With the latest data release mid 2018 GERDA was the first experiment to surpass a half-life sensitivity of 10^{26} yr for $0\nu\beta\beta$ decay. Afterwards the experiment was upgraded, deploying a new type of germanium detector and improving the LAr instrumentation. A summary of the latest results and an outlook on the performance after the upgrade of the experiment will be given.

Gruppenbericht HK 23.2 Di 14:30 HS 18

Status and prospects of the COBRA experiment — •Stefan Zatschler for the COBRA-Collaboration — TU Dresden, Institut für Kern- und Teilchenphysik

The COBRA experiment at the underground facility LNGS (Italy) is dedicated to the search for the hypothesized neutrinoless double beta-decay ($0\nu\beta\beta$-decay). The observation of this lepton number violating process would prove the Majorana nature of neutrinos and shed light on physics beyond the established Standard Model. In 2018 an upgrade of the COBRA demonstrator to the extended demonstrator (XDEM) was performed by adding nine 6 cm^3 CdZnTe crystals to the existing 4×4×4 array of 1 cm^3 detectors. COBRA XDEM uses improved prototypes of CdZnTe solid state detectors with an instrumented guard-ring electrode to veto surface events as the original demonstrator's main background component. During the preparation phase of this upgrade the setup was optimized for low-threshold operation to investigate the fourfold forbidden non-unique β-decay of ^{113}Cd. The spectral shape of the electron momentum distribution of this highly forbidden decay is expected to strongly dependent on an effective value of the weak axial-vector coupling strength g_A. For the scientific discussion regarding quenching effects that might affect the half-life predictions for the $0\nu\beta\beta$-decay due to an effectively smaller value of g_A such experimental input is in high demand. This talk will present the current experimental status including first results of COBRA XDEM and summarize the spectral shape analysis of the ^{113}Cd β-decay as well as ongoing studies of exotic $\beta\beta$-decay modes. COBRA is funded by the DFG.

HK 23.3 Di 15:00 HS 18

Double beta decay transitions of ^{76}Ge into excited states of ^{76}Se — •Thomas Wester and Birgit Schneider for the GERDA-Collaboration — IKTP, TU Dresden

The search for the neutrinoless double beta decay is one of the most active fields in modern neutrino physics. An observation would imply lepton number violation and provide valuable information about the neutrino mass mechanism. The GERDA experiment searches for the neutrinoless double decay in ^{76}Ge, by operating an array of isotopically enriched germanium detectors in a liquid argon cryostat.

This contribution discusses the search for two-neutrino and neutrinoless double beta decay transitions of ^{76}Ge into the three energetically lowest excited states of ^{76}Se performed with the Phase II data of GERDA. Due to phase space suppression, the predicted half-lives of those transitions are longer than the ground state transitions. Unfortunately, the predictions additionally vary by several orders of magnitude, due to large uncertainties in the calculations of the nuclear matrix elements. An observation of even the two-neutrino modes would therefore help to constrain model parameters and decrease such uncertainties also for neutrinoless transitions into the ground state and excited states. The sensitivity of GERDA covers several of the predicted half-lives.

An event counting method is performed based on coincident events between two germanium detectors. The analysis procedure and preliminary results will be presented.

HK 23.4 Di 15:15 HS 18

The Liquid Argon Veto System for the Gerda Phase II Upgrade — •Patrick Krause — Technische Universität München, Garching, Germany

Liquid Argon (LAr) scintillates upon interaction with ionizing radiation. In this process light with a wavelength of 128 nm is emitted. With the help of so-called wavelength shifting (WLS) fibres and silicon photomultipliers (SiPMs), this property is an element of Gerda's active background suppression strategy to reject events with coincident energy deposition in the germanium detectors and the surrounding LAr. An improved version of the WLS fiber-modules and the SiPM-readout has been developed. This talk will report the changes, challenges and improvements compared to the previous design. Furthermore the first results of the new LAr veto system in Gerda Phase II+ will be presented.

This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 23.5 Di 15:30 HS 18

Probing new physics with double-beta decay in Gerda Phase II — •Elisabetta Bossio for the GERDA-Collaboration — PhyPhysik-Department , Technische Universität München, James-Franck-Straße, 85748 Garching

The main goal of the GERmanium Detector Array (Gerda) experiment at the Laboratori Nazionali del Gran Sasso of INFN (Italy) is the discovery of the neutrinoless double-beta ($0\nu\beta\beta$) decay of ^{76}Ge. In Gerda Phase II, the Liquid Argon veto system and the Pulse Shape Discrimination (PSD) allow to have marginal background in the $2\nu\beta\beta$-decay dominated region of the spectrum. This makes the search for other exotic processes attractive: models involving Majorons or Lorentz violating physics predict different shapes of the measured spectrum. Systematic uncertanties due to the background modeling are expected to be small. On the other hand different sources of systematics related to detector physics become important. A study of the dominant systematics and their impact on the sensitivity for new physics will be presented.

This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) and the German Research Foundation (DFG) via the SFB1258.

HK 23.6 Di 15:45 HS 18

Plate-out and removal of radon daughters from material surfaces — •Stefan Bruenner — Max-Planck-Institut für Kernphysik, Heidelberg

Surface contaminations with long lived Rn-222 daughters crucially contribute to the background in many rare event search experiments. In this talk we discuss different plate-out mechanisms of radon daughters on materials with a main focus on PTFE. Several cleaning procedures have been investigated by means of alpha-spectroscopy for their capability to remove Pb-210 and Po-210 from surfaces and the results will be presented. The goal of this study is to identify dedicated cleaning methods matched with the different materials and contaminations.

HK 24: Instrumentation V

Zeit: Dienstag 14:00–16:00 Raum: HS 11

HK 24.1 Di 14:00 HS 11

Development of a High Rate Neutron Polarimeter — •Rouven Spreckels — Institute for Nuclear Physics in Mainz, Germany

A high rate neutron polarimeter is being developed by the A1 collaboration at the Institute for Nuclear Physics in Mainz, Germany extending their three-spectrometer apparatus at MAMI. To meet the high rate capability and timing precision requirements, the signals of the plastic scintillators are discriminated by custom-made front-end electronics based on the ultrafast multi-channel NINO ASIC in single-ended mode, encoding the signal time-over-threshold into the output signal width. Digitization is performed by TRB3 boards with multi-hit capability covering a total of 574 channels. Their FPGA-based high precision TDCs measure leading as well as trailing edges of the NINO output signals and generate triggers on configurable veto and coincidence conditions with negligible dead time and hardware resources compared with conventional ADCs or sampling ASICs. The precise time-over-threshold information allows walk corrections and background suppression by reconstructing the signal amplitudes to deduce the related energy deposits. Initial tests of the readout electronics, using the 855 MeV electron beam of MAMI, show promising results fulfilling our expectations with a timing precision of about 240 ps being constant up to about 2.5 Mcps. A full test of the whole setup in its final stage will be performed in January 2019. Preliminary results from the commissioning experiments will be discussed in March 2019

at the DPG Spring Meeting in Munich.

HK 24.2 Di 14:15 HS 11

Evaluation of different feature extraction methods for the CBM-TRD. — •Florian Roether for the CBM-Collaboration — Institut für Kernphysik, Frankfurt, Deutschland

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) will explore the QCD phase-diagram in the region of high net-baryon densities. The Transition Radiation Detector (TRD) with its multi-layer-design will provide electron identification and contribute to particle tracking as well as the identification of light nuclei.

The detector signals will be digitized by the Self-triggered Pulse Amplification and Digitization ASIC (SPADIC), collected by the GBTx based Readout Board (ROB) and pre-processed by the Data Processing Board (DPB). This process of time ordering and feature extraction of the raw data stream is crucial for the subsequent processing and data storage.

The SPADIC allows to set a mask which defines what part of the time evolution of the signal is read out. This requires different algorithms to extract the information of interest, like e.g. position and energy deposition out of the raw data stream. In this talk the focus will be on the evaluation of different feature extraction methods based on data from simulations and a DESY test beam campaign performed in 2017.

This work is supported by BMBF-grant 05P15RFFC1.

HK 24.3 Di 14:30 HS 11

The HADES electromagnetic calorimeter upgrade: commissioning with Ag beam* — •Adrian Rost for the HADES-Collaboration — TU Darmstadt

The HADES spectrometer is located at the SIS18 accelerator at the GSI Helmholtzzentrum für Schwerionenforschung GmbH in Darmstadt. The new electromagnetic calorimeter (ECAL) detector, which is based on lead-glass modules. For February and March 2019 a physics production beam time is planed. The calorimeter enables photon measurements. Thus neutral mesons (π^0, η, ω), which are essential for interpretation of dilepton data, will be measured. Furthermore, photon measurement is of a large interest for the HADES strangeness program. The read-out system is based on the PaDiWa-AMPS2 Q2ToT (Charge-to-Time-over-Threshold) front-end board for the well established TRB3 (Trigger and Read-out Board - version 3) platform. The needed discriminators, the high precision TDCs (Time-to-Digital-Converters) and the data acquisition functionality are implemented with the help of FPGAs (Field Programmable Gate Arrays). In this contribution the performance of the detector under beam conditions will be shown. Special emphasis will be put on the read-out system and its performance.

This work has been supported by the DFG through GRK 2128 and VH-NG-823.

HK 24.4 Di 14:45 HS 11

Shadow Readout – Glowing VME Backplanes — Michael Munch[1], Jesper H. Jensen[1], •Bastian Löher[2,3], Hans T. Törnqvist[2,3], and Håkan T. Johansson[4] — [1]Department of Physics and Astronomy, Aarhus University, Denmark — [2]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]Department of Physics, Chalmers University of Technology, Sweden

The accepted trigger rate of modular electronics (e.g. VME) is limited by the per-cycle deadtime. Conventional multi-event readout employs on-module multi-event-buffers to make DMA transfers feasible and reduce the average deadtime. In this talk a generic implementation of a shadow readout scheme is presented, which continuously empties the module buffers into local RAM. This method is capable of reducing the average dead-time to the limit of the module conversion time (few μs) and allows accepted trigger rates beyond 100 kHz with conventional hardware. It has been used successfully during the last HIE-ISOLDE beam-time and is continuously running since April at the Aarhus 5MV Van de Graaff accelerator. *Supported by the GSI-TU Darmstadt cooperation agreement.

HK 24.5 Di 15:00 HS 11

The free-streaming readout chain for the Silicon Tracking System of the CBM experiment — •Adrian Rodriguez Rodriguez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter (CBM) experiment at the FAIR facility will explore the QCD phase diagram at very high baryon densities, where a first order phase transition from hadronic to partonic matter as well as a chiral phase transition is expected to occur. The Silicon Tracking System (STS) is its essential tracking component, designed to measure up to 1000 particles in A+A collision at rates up to 10 MHz and to achieve a momentum resolution better than 2% inside a 1 Tm dipole magnetic field. With its 1.8 million readout channels, the STS poses the most demanding requirements regarding bandwidth and density of all CBM detectors. The STS readout chain consists of: (1) detector frontend boards with custom ASICs (STS-XYTER), (2) readout boards (ROB) for data aggregation from many electrical links and conversion to optical data transmission, and (3) FPGA based common readout interface (CRI) for data preprocessing, time slice building and interfacing to slow and fast control. In the framework of the miniCBM campaign at SIS18 in GSI, the STS will deploy a prototype of its readout chain. This opportunity will allow to evaluate detector performance and to test integration with other subsystems under realistic experimental conditions. This presentation aims to show an overview of the development status of the readout components and the first test results of the system.

HK 24.6 Di 15:15 HS 11

A Sampling ADC-Readout for the Crystal Barrel Calorimeter - Pile-Up Detection and Recovery — •Jan Schultes for the CBELSA/TAPS-Collaboration — HISKP, Universität Bonn

The Crystal Barrel Calorimeter consists of 1320 CsI(Tl) scintillating crystals, which are, after a recent upgrade, read out by APDs. The signals are digitized using Fastbus QDCs. In preparation of replacing the QDCs by FPGA-controlled sampling ADCs, these sampling ADCs are already used in addition in the high rate forward direction. This offers possibilities to perform on-line pile-up detection and subsequent recovery, thus allowing to reach even higher rates without a loss of data quality in the main calorimeter.

Specifically developed methods and approaches to detect and recover pile-up are presented and very promising first results are discussed.

HK 24.7 Di 15:30 HS 11

Development of detector read-out electronics for the P2 experiment at MESA — •Rahima Krini[1], Sebastian Baunack[1], Dominik Becker[1], Michael Gericke[2], Frank Maas[1,3,4], and David Rodriguez Pineiro[3] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]University of Manitoba, Canada — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA Cluster of Excellence, Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. It presents the most challenging parity-violation experiment with a relative uncertainty of $\frac{\Delta A^{PV}}{A^{PV}} \approx 2.41\,\%$.

The small asymmetries $\mathcal{O}(10^{-9})$ and the high precision require very high statistics and therefore a long measurement time. The Cherenkov ring detector consists of fused silica bars equipped with photomultiplier tubes with high quantum efficiency. The challenge is to control the integrating detector signal chain and all sources of electronics noise within the whole experimental P2 set-up. The first preliminary results of the main front-end components will be presented.

HK 24.8 Di 15:45 HS 11

Beam test results of the DiRICH based readout system for H12700 MAPMTs — •Vivek Patel, Christian Pauly, Karl - Heinz Kampert, and Joerg Foertsch — University of Wuppertal

The HADES RICH detecter has been fully upgraded using H12700 Multi Anode Photomultiplier Tube (MAPMT) from Hamamatsu and a DiRICH based readout system. A total of 428 MAPMTs and 856 DiRICHs are installed in the upgraded HADES RICH. This upgraded RICH will see its first beam in March 2019. The new FPGA based DiRICH readout chain has been developed as a joint effort of the CBM-, HADES- and TRB- collaborations and might also be used by PANDA DIRC and fRICH detectors. The new readout concept has been extensively tested over the last two years before finalizing the design prior to mass production for HADES RICH. In November 2017 this readout system was tested under real beam conditions at the COSY accelerator at the Juelich research facility. The talk will focus on analysis results of the test beam data from COSY particulary focusing on de-

riving proper time over threshold (ToT) information and later using it to suppress crosstalk from neighbouring MAPMT pixel. We will also present the improvement in Cherenkov ring reconstruction by using the ToT information.

Supported by BMBF grant 05P15PXFCA, and GSI.

HK 25: Hadron Structure and Spectroscopy IV

Zeit: Dienstag 16:30–18:30 Raum: HS 13

Gruppenbericht HK 25.1 Di 16:30 HS 13

A New QCD Facility at the M2 beamline of CERN SPS — •Jan Friedrich for the COMPASS-Collaboration — Physik-Department, Technische Universität München

In view of completing the current physics programme of the COMPASS collaboration in 2021, ideas are shaped up for future measurements in the context of QCD with a refurbished and upgraded detector in the same experimental hall at the M2 beamline of the CERN SPS with 100–200¯GeV beam energies. They range from high-energy elastic muon scattering for a proton radius measurement, with rather modest changes to the COMPASS setup, to upgrading the beamline with a radiofrequency separation of the hadron beam components, allowing e.g. for a strongly enriched kaon beam. This will allow measurements of the kaon parton distributions via the Drell-Yan process, and the kaonic excitation spectrum through diffractive dissociation. Further ideas, amongst others, concern measurements of antiproton production cross-sections, as of interest for Dark Matter Search, hadron spectroscopy with annihilation processes initiated by the antiproton beam component, and hard exclusive reactions using a muon beam on a transversely polarised target. Status and timelines of the project will be discussed.

HK 25.2 Di 17:00 HS 13

News from the "proton radius puzzle" — •Randolf Pohl for the CREMA-Collaboration — JGU Mainz, Germany

For more than eight years now, the "proton radius puzzle" has let us dream about new physics: Our measurements of muonic hydrogen and muonic deuterium, performed in the CREMA Collaboration at PSI, yielded a proton radius which is more than five standard deviations smaller than the CODATA world average from measurements using electrons, namely precision spectroscopy of atomic hydrogen and deuterium, and elastic electron scattering.

A wealth of new experiments has been fueled by this exciting discrepancy, and the first results are now coming in. I will report on several new measurements in atomic hydrogen we have performed at MPQ Garching. These, together with new hydrogen measurements from LKB Paris and York U. Toronto and new elastic electron scattering data from the PRad experiment at Jefferson Lab start to paint a clearer picture on the "proton radius puzzle", albeit not without raising new questions.

HK 25.3 Di 17:15 HS 13

High-precision Measurement of the Proton Radius with TPC — •Vahe Sokhoyan for the A2-Collaboration — Universität Mainz, Institut für Kernphysik

The so-called "proton radius puzzle" originated due to a striking discrepancy between the electric charge radius of the proton, extracted from the muonic hydrogen Lamb shift, compared to the CODATA value, based on electron-proton scattering experiments as well as most of the atomic transition measurements in electronic hydrogen. To address this puzzle, a high-precision measurement of the differential *ep* scattering cross section in the region of low momentum transfer ($0.002\ \mathrm{GeV}^2 \leq Q^2 \leq 0.04\ \mathrm{GeV}^2$) will be performed at the Mainz Microtron (MAMI). The experimental setup consisting of a Hydrogen Time Projection Chamber and Forward Tracking System will allow us to measure the energy as well as the angle of the recoil proton in combination with the angle of the forward scattered electron. This is a completely new approach for the extraction of the proton radius, compared to previous low-Q^2 scattering experiments. Moreover, the construction of the Time Projection Chamber and Forward Tracking System will open avenue for various experiments using deuterium and helium targets with a detection of recoil particles in the final state. In this talk, the current status of this project and the future plans will be presented.

HK 25.4 Di 17:30 HS 13

Proton Radius in High-Energy Muon Scattering — •Christian Dreisbach[1], Jan Friedrich[1], Martin Hoffmann[2], Alexander Inglessi[3], Eva Kabuss[4], Bernhard Ketzer[2], Oleg Kiselev[6], Evgeny Maev[3], Stephan Paul[1], Sebastian Uhl[1], Benjamin Veit[5,6], and the COMPASS Collaboration[5] — [1]Technische Universität München, Physik-Department, Garching, Germany — [2]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [3]Petersburg Nuclear Physics Institute (PNPI), Gatchina, Russia — [4]Universität Mainz, Institut für Kernphysik, Mainz, Germany — [5]CERN, 1211 Geneva 23, Switzerland — [6]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The proton radius can be determined by measuring the slope of the electric form factor G_E at small squared four-momentum transfer Q^2. Numerous elastic-scattering and laser-spectroscopy measurements of the proton radius have been performed with contradicting results, the so-called proton radius puzzle. We propose to measure the proton radius in high-energy elastic muon-proton scattering at the M2 beam line of CERN*s Super Proton Synchrotron in the year 2022. A high-precision measurement at low Q^2 realized with a high-pressure hydrogen TPC can contribute to a solution of the puzzle, especially in view of the systematics of this approach compared to electron scattering. In the year 2018, a test measurement with silicon tracking detectors upstream and downstream of a prototype TPC was performed to study the feasibility employing both detector systems. We present results of the on-going analysis and discuss ideas for a possible setup in 2022.

HK 25.5 Di 17:45 HS 13

Investigations of muon-proton elastic scattering to measure the proton charge radius — •Martin Hoffmann[1], Christian Dreisbach[2], Jan Friedrich[2], Alexander Inglessi[3], Eva Kabuss[4], Bernhard Ketzer[1], Oleg Kiselev[5], Evgeny Maev[3], Stephan Paul[2], Sebastian Uhl[2], and Benjamin Veit[5] for the COMPASS-Collaboration — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Technische Universität München, Physik-Department, Garching, Germany — [3]Petersburg Nuclear Physics Institute (PNPI), Gatchina, Russia — [4]Universität Mainz, Institut für Kernphysik, Mainz, Germany — [5]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The proton radius puzzle is an exciting problem in particle physics. To help solving it, the COMPASS collaboration plans to conduct a measurement of the proton electric form factor at very small values of the squared momentum transfer using high-energy muons scattered in a high-pressure hydrogen TPC (Time Projection Chamber). In the year 2018 a first proof-of-principle experiment was performed at the COMPASS beam line using a prototype TPC and eight double-sided silicon detectors. The talk will focus on the analysis of the TPC data and of the combined data of both detector systems. Correlations between parameters measured in the TPC and in the tracking system will be discussed. The resolutions achieved with the present setup will be presented. They will be used together with ongoing Monte-Carlo studies to define the final setup for the measurement.

Supported by BMBF.

HK 25.6 Di 18:00 HS 13

Status of the analysis for the search of polarization in the antiproton production process — •Dominika Alfs, Dieter Grzonka, and James Ritman — Institut für Kernphysik, Forschungszentrum Jülich, Germany

The goal of the P-349 experiment is to measure the polarization of antiprotons produced in pA collisions. Experimentally this is done by the measurement of the left-right asymmetry of elastic antiproton scattering on a liquid hydrogen target in the Coulomb-nuclear interference region.

According to preliminary calculations, the maximum of the analyzing power A_y, equal to about -4.5%, is reached for a four-momentum transfer $|t| \simeq 0.003$ GeV/c which corresponds to a scattering angle in

the laboratory frame in the range of 10 - 20 mrad. Therefore, the required track reconstruction precision expected to be sufficient for the asymmetry determination is equal to about 1 mrad.

The experiment was performed in the PS test beam East Area at CERN in 2014, 2015 and in 2018 with an improved detector setup. The data analysis is ongoing. Currently, the main goals are reaching the desired track reconstruction precision and elimination of the dominant pionic background.

In this contribution the current status of the analysis will be presented with a focus on track identification and reconstruction and Monte Carlo supported particle identification with DIRC.

HK 25.7 Di 18:15 HS 13

Studies on deuteron-proton collisions at the magnetic spectrometer ANKE — •Christopher Fritzsch and Alfons Khoukaz for the ANKE Collaboration — Westfälische Wilhelms-Universität, Münster, Germany

Total and differential cross sections of the reaction $d+p \to {}^3\mathrm{He}+\eta$ are of special interest since they differ strongly from a pure phase space behavior near threshold. The asymmetry factor α of the differential cross sections show a distinct effect of an s- and p-wave interference, caused by a rapid variation of the relative phase. These observations are an indication for an unexpected strong final state interaction between the ^{3}He nuclei and the η mesons which could lead to a quasi bound state of the $^3\mathrm{He}\eta$ system. Current investigations using high precision data of the internal fixed target experiment ANKE of the storage ring COSY allow the extraction of total and differential cross sections for the η production up to an excess energy of $Q = 15\,\mathrm{MeV}$. Additionally, new differential cross sections of the reaction $d + p \to {}^3\mathrm{He} + \pi^0$ were determined for the forward hemisphere, covering a range where no differential cross sections are available so far. Both the η meson and π^0 production were normalized absolutely by using the dp elastic scattering. Here, also new differential cross sections of high precision were determined to enrich the existing data base. Recent results will be presented and discussed.

*This work has been supported by the COSY-FFE program of the FZJ and the DFG through the Research Training Group "GRK 2149: Strong and Weak Interactions - from Hadrons to Dark Matter".

HK 26: Heavy-Ion Collisions and QCD Phases V

Zeit: Dienstag 16:30–18:15 Raum: HS 15

Gruppenbericht HK 26.1 Di 16:30 HS 15

Results of low-mass dielectron measurements in pp, p–Pb and Pb–Pb collisions with ALICE at the LHC — •Torsten Dahms for the ALICE-Collaboration — Excellence Cluster Universe - TUM, Garching, Germany

Low-mass e^+e^- pairs (dielectrons) are a particularly useful probe to study the hot and dense medium created in ultra-relativistic heavy-ion collisions. Such pairs are produced during all stages of the collision and carry information about the whole space-time evolution of the system, unperturbed by strong final-state interactions.

The invariant-mass continuum of dielectrons is extremely rich in physics sources: on top of ordinary in-vacuum decays of light and heavy-flavour hadrons, the contributions from thermal radiation and a modified ρ meson due to the predicted restoration of chiral symmetry in heavy-ion collisions are of great interest. However, it is first necessary to understand the very large background of correlated dielectron pairs from semi-leptonic charm and beauty hadron decays. Dielectron measurements in pp and p–Pb collisions serve as crucial vacuum and cold nuclear matter references needed for the heavy-ion studies. Here, the intermediate-mass region provides insight into heavy-flavour production complementary to single heavy-flavour hadron measurements.

We present an overview of the latest results on low-mass dielectron production from the ALICE Collaboration in pp, p–Pb and central Pb–Pb collisions at various energies. The implications for heavy-flavour and (thermal) direct photon production will be discussed. Finally, perspectives for the LHC Run-3 will be shortly mentioned.

HK 26.2 Di 17:00 HS 15

Considering the Effects of Radial Flow in Decay Photon Calculations in Ultrarelativistic Nucleus-Nucleus Collisions — •Ilya Fokin — Physikalisches Institut, Heidelberg, Germany

For decay-photon calculations, it is crucial to accurately describe the spectra of particles that decay into photons. These include particle species for which there are either no measurements available or only measurements with large uncertainties such as the η, ω and η'. Since collective radial flow is expected in heavy-ion collisions, it must be taken into account when predicting particle spectra. A cocktail from transverse mass scaling, which does not include radial flow, serves as a baseline. In a two-component model, the momentum distributions are split into one component that incorporates all radial flow using a blast-wave description and one component for hard scatterings without radial flow. The parameters for extrapolating to other particles are obtained in a simultaneous fit with $\pi^\pm$ and $K^\pm$ data from ALICE. The model predicts an enhancement in the η, ω and η' to π^0 ratios at intermediate transverse momenta which results in a 5% increase in decay-photons in this range. Because the direct photon signal is already small compared to the background of decay photons, this relatively small increase can have a significant effect on the double ratio R_γ which determines the direct photon yield.

HK 26.3 Di 17:15 HS 15

Azimuthal Anisotropy of Virtual Photons — •Dominique Dittert for the HADES-Collaboration — TU Darmstadt

Virtual photons, that decay into dileptons, are penetrating probes which directly access the entire space-time-evolution of the fireball and escape from the collision zone without further interactions. Thus they provide unique information about the various stages of the collision. Collective observables like flow are used to describe the macroscopic properties of nuclear matter. Since the effective temperature extracted from the m_T spectra of dileptons results from the superposition of all fireball stages with decreasing temperature T but increasing radial flow over time, it is difficult to disentangle early and late emission sources. In comparison, the elliptic flow does not show this implicit time dependence and the combined dependence of elliptic flow of dileptons on their transverse momentum and their invariant mass provides a rich landscape of structures, which allows to set the observational window on specific stages of the fireball evolution. In this contribution the preliminary results on azimuthal anisotropy of e^+e^- excess radiation measured in Au+Au collisions at $\sqrt{s_{NN}} = 2.4\,GeV$ with HADES will be presented.

HK 26.4 Di 17:30 HS 15

Low-mass dielectron measurements in high-multiplicity pp collisions with ALICE at the LHC — •Ivan Vorobyev for the ALICE-Collaboration — Technische Universität München

Electron-positron pairs produced in ultra-relativistic heavy-ion collisions at the LHC carry important information about the system space-time evolution unperturbed by strong final-state interactions. Measurements of the dielectron continuum in inelastic proton-proton collisions serve as an important vacuum reference for the heavy-ion studies. However, proton-proton collisions with high charged-particle multiplicities recently have been found to exhibit interesting phenomena, such as the longitudinal structure in the two-dimensional angular correlation and the enhanced production of strange and heavy-flavour hadrons. Measurements of low-mass dielectrons could provide additional information regarding the underlying physics processes in high-multiplicity pp collisions.

In this talk, we present the latest results of the dielectron analysis with ALICE in pp collisions at $\sqrt{s} = 13$ TeV. A particular focus of the discussion is put on the modification of dielectron spectrum in pp collisions collected with a trigger on high charged-particle multiplicities with respect to the inelastic events. The relative increase of dielectron production in high-multiplicity events is compared to the expectations from already measured multiplicity-dependent production of light and heavy hadrons. The production of direct photons in inelastic and high-multiplicity collisions is also discussed.

HK 26.5 Di 17:45 HS 15

Performance simulation of the Transition Radiation Detector of the CBM experiment — •Etienne Bechtel for the CBM-Collaboration — IKF , Frankfurt , Germany

The Compressed Baryonic Matter (CBM) experiment will access a wide range of physics observables for heavy-ion collisions in the region of high- est net-baryon densities. One of the core physics program is the study of rare dilepton channels, which was not precisely measured before with other experiments in this energy range. For this purpose a powerful electron iden- ti*cation, respectively a good pion suppression, is absolutely crucial. In ad- dition to the RICH detector the Transition Radiation Detector (TRD), will contribute to the electron identi*cation in the complete momentum range and is supposed to deliver the main identi*cation power for momenta above 6 GeV/c. The dE/dx measurement, in combination with the mass of the Time-Of-Flight (TOF) detector, also makes possible the separation of charge states of light nuclei, which is necessary for the CBM hypernuclei program. This talk will cover the newest results in the simulation of di*erent dielectron channels, including the measurement of the thermal radiation of the *reball itself, as well as the essential improvements on the whole TRD detector sim- ulation and reconstruction procedures, which allow to obtain a much more realistic description of test beam data with simulations. This work is supported by BMBF.

HK 26.6 Di 18:00 HS 15

Electrons from semi-leptonic decays of heavy-flavour hadron at mid-rapidity in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE — •Michael Ciupek — University, Heidelberg, Germany

Hadrons containing charm or beauty quarks are a unique probe to study the properties of the Quark-Gluon Plasma (QGP) created in heavy-ion collisions. Because of their large masses they are produced via initial hard partonic scattering processes and therefore witness the full evolution of the hot and dense QGP medium.
Measurements of heavy-flavour hadrons produced in proton-proton collisions provide a reference for the measurements in heavy-ion collisions and are also an important test for perturbative Quantum Chromo Dynamics calculations.
The measurement of electrons from semi-leptonic decays of heavy-flavour hadrons require a precise knowledge of electrons coming from non heavy-flavour sources.Therefore the main contribution of the background is removed by tagging electrons from Dalitz decays of neutral mesons and from photon conversions.
In this talk the production cross section of electrons from heavy-flavour hadron decays at mid-rapidity in proton-proton collisions at $\sqrt{s} = 5.02$ TeV with ALICE at the LHC will be shown.

HK 27: Structure and Dynamics of Nuclei V

Zeit: Dienstag 16:30–18:30 Raum: HS 14

Gruppenbericht HK 27.1 Di 16:30 HS 14
Proton-Hole states in ^{52,54}Ca: First Spectroscopy of ^{51,53}K — •Yelei Sun for the SEASTAR17-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

We report on the first in-beam γ-ray spectroscopy of the very neutron-rich potassium isotopes ^{51,53}K. The low-lying states of ^{51,53}K were populated using the $(p,2p)$ reactions from doubly magic nuclei ^{52,54}Ca. The $1/2^+_1 \rightarrow 3/2^+_1$ transitions in ^{51,53}K were clearly observed. For ^{53}K, a ground-state spin $I = 3/2$ was firmly established based on the measured individual parallel momentum distribution. The vertex tracker of MINOS plays an important role to preserve the momentum resolution when using a thick target. The energy splittings between the lowest $3/2^+$ and $1/2^+$ states in K isotopes were compared to shell model calculations with phenomenologically derived effective interactions and state-of-the-art *ab initio* calculations using the newly developed chiral effective field theory interactions. The results provide important information for a complete understanding of the single-particle drift and reinversion effect of the proton $1d_{3/2}$ and $2s_{1/2}$ orbitals along the K isotopic chain.

HK 27.2 Di 17:00 HS 14
How robust is the N = 34 subshell closure? First spectroscopy of ^{52}Ar — •Hongna Liu for the SEASTAR17-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

It is now well known that magic numbers are not universal across the nuclear landscape and that new shell closures may emerge in exotic nuclei. For example, a new N=34 subshell closure was predicted for neutron-rich pf-shell nuclei. However, on the experimental side, the N=34 subshell closure has been so far reported only in ^{54}Ca. The systematics of $E(2^+_1)$ along the Ti and Cr isotopes show no local maximum at N=34. It is thus very natural to ask how the N=34 subshell evolves below Z=20 towards more neutron-rich systems, such as ^{52}Ar.

In this talk, we will report on the first γ-ray spectroscopy of ^{52}Ar measured using the ^{53}K(p,2p) reaction at ∼210 MeV/u at RIBF. The 2^+_1 excitation energy was measured to be 1656(18) keV, the highest among the Ar isotopes with N>20, providing the first experimental signature of the persistence of the N = 34 subshell closure below Z=20. Shell-model calculations with phenomenological and the chiral interaction 1.8/2.0 (EM) both reproduce the measured 2^+_1 systematics of the neutron-rich Ar isotopes, and surpport a N=34 subshell closure in ^{52}Ar. However, coupled-cluster calculations based on the same chiral interaction underestimate $E(2^+_1)$ in ^{52}Ar. The data measured in current work serves as an important benchmark to understand the uncertainties of the employed many-body methods and chiral effective-field-theory interactions.

HK 27.3 Di 17:15 HS 14

Spectroscopy of neutron-rich Sc isotopes at RIKEN-RIBF — •P. Koseoglou[1,2], V. Werner[1], P.-A. Söderström[1,2], M. Lettmann[1], N. Pietralla[1], P. Doornenbal[3], and A. Obertelli[1,3,4] for the SEASTAR17-Collaboration — [1]Institut für Kernphysik, TU-Darmstadt, Darmstadt, Germany — [2]GSI Helmoltzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]RIKEN Nishina Center, Wako, Japan — [4]IRFU, CEA, Université Paris-Saclay, Paris, France

Evidence for the existence of a new "magic number", $N = 34$, are observed in ^{54}Ca [1] but not in Ti isotopes [2,3]. The magic number $N = 34$ was recently shown to vanish already in ^{55}Sc [4]. The evolution of proton orbitals on the $^{55-61}$Sc isotopes may reveal the mechanism of the disappearance of the $N = 34$ magicity, and further elucidate the early onset of collectivity at $N = 40$, which has so far been observed in Cr and Fe isotopes. The status of the analysis of $^{55-59}$Sc data from the 3rd SEASTAR campaign at RIKEN-RIBF will be presented. In this analysis, gamma rays previously reported for ^{55}Sc [4] were confirmed. For $^{57-59}$Sc gamma rays are shown here for the first time and possible level schemes will be proposed. This work was supported by the Helmholtz Graduate School for Hadron and Ion Research (HGS-HIRe) for FAIR though the HGS-HIRe abroad program.
[1] D. Steppenbeck, *et al.*, Nature 502, 207-210 (2013).
[2] D.-C. Dinca, *et al.*, Phys. Rev. C 71, 041302(R) (2005).
[3] S. N. Liddick, *et al.*, Phys. Rev. Lett. 92, 072502 (2004).
[4] D. Steppenbeck, *et al.* Phys. Rev. C 96 , 064310 (2017).

HK 27.4 Di 17:30 HS 14
Übergangswahrscheinlichkeiten angeregter Zustände der Yrast-Bande in ^{54}Ti — •Alina Goldkuhle für die AGATA-Kollaboration — Institut für Kernphysik, Universität zu Köln, Germany

Bisherige Untersuchungen der neutronenreichen Ti-Isotope deuten auf die Entwicklung eines Unterschalenabschlusses bei $N = 32$ hin. Schalenmodellrechnungen konnten dieses Verhalten jedoch bislang nicht erklären: der Verlauf der Anregungsenergien der tiefsten Yrast-Zustände in diesen Ti-Isotopen wird zwar reproduziert, jedoch nicht der Verlauf der $B(E2; 2^+_1 \rightarrow 0^+_{gs})$ Werte in Abhängigkeit der Neutronenzahl. Zusätzlich sind wenige Informationen über E2-Übergängsstärken zwischen höheren Yrast-Zuständen bekannt. Um diese zu messen, wurden in dieser Arbeit angeregte Zustände in $^{46-54}$Ti mit Hilfe von Multinukleonentransferreaktionen bevölkert und Zustandslebensdauern bestimmt, die mittels der Recoil-Distance Doppler-Shift Methode gemessen wurden. Das Experiment wurde am GANIL mit dem Detektorsystem AGATA und dem Spektrometer VAMOS++ zur Teilchenidentifikation sowie dem Kölner Kompakt-Plunger für tiefinelastische Reaktionen durchgeführt. Lebensdauern vom 2^+_1 und 4^+_1 Zustand sowie Ober- und Untergrenzen der Lebensdauern des 6^+_1 und 8^+_1 Zustands in ^{54}Ti konnten mit der differential decay curve method (DDCM) bestimmt und die $B(E2)$-Werte für die Übergänge zwischen diesen Zuständen

ermittelt werden. Die Ergebnisse werden in diesem Vortrag vorgestellt und mit aktuellen Schalenmodellrechnungen verglichen. Teilförderung durch BMBF.

HK 27.5 Di 17:45 HS 14

Determination of exclusive (p,3p) cross sections for neutron-rich medium mass nuclei — •Axel Frotscher — TU Darmstadt, Darmstadt, Deutschland

The knockout of nucleons from nuclei is a powerful tool to investigate nuclear structure. In particular, the knockout of nucleons at energies above 200 MeV/nucleon from a hydrogen target, so called quasi free scattering, is believed to be a clean probe for nuclear structure and have led to several recent experimental programs and theoretical developments. In this work, we are interested to reactions that lead to the removal of two nucleons. Indeed, it was observed in several occurrences that a different states of a nucleus are populated when produced from one nucleon knockout (p,2p) or two nucleon knockout (p,3p). So far, there is no proper reaction theory for this second class of reactions. Understanding it might provide a new tool to investigate nuclear structure.

The analysis of two experimental campaigns conducted at the RIBF in RIKEN, Japan, is presented here. The (p,3p) cross sections from several neutron-rich medium-mass nuclei were analysed. The radioactive nuclei were impinging onto a 100-mm long liquid hydrogen target. The protons issued from the reaction were measured with the MINOS tine-projection chamber surrounding the target, giving access for the first time to angular correlations of the protons in the final state in such reactions. Inclusive and exclusive cross sections have been extracted.

This work is supported by the DFG through grant no. SFB1245.

HK 27.6 Di 18:00 HS 14

Recent studies of neutron-rich Kr isotopes with N≤60* — •Rosa-Belle Gerst, Kevin Moschner, Julia Litzinger, Andrey Blazhev, and Nigel Warr — IKP, Universität zu Köln

In the neutron-rich A = 100 region a sharp shape transition at N = 60 has been observed in the Sr and Zr isotopic chains. For Kr isotopes, a smooth onset of collectivity was established [1] and recent studies revealed further differences to the Sr and Zr isotopes [2,3]. Additionally, mean field calculations suggest the existence of a second minimum in potential energy surfaces for ^{96}Kr leading to low-lying shape-coexisting structures [1,2,4]. During the SEASTAR campaign at the RIBF at RIKEN, low lying excited states were measured in ^{94,95,96}Kr with the NaI DALI2 array. Due to the limited energy resolution of the array, further experiments were performed to investigate the level structure of the neutron rich Kr isotopes. At the MINIBALL array at HIE-ISOLDE, excited states in ^{96}Kr were populated using Coulomb-nuclear excitation. At the IPN Orsay, a pulsed beam together with the fast neutron source LICORNE and the Nu-Ball array were used to study $^{90-96}$Kr after fission of ^{238}U. Preliminary results will be shown and compared to theoretical models.

*Supported by the DFG under Grant No. BL 1513/1-1 and the BMBF under Grant No. 05P18PKCIA

[1] M. Albers *et al.*, Nucl. Phys. A 899 (2013), 1
[2] F. Flavigny *et al.*, Phys. Rev. Lett. 118 (2017), 242501
[3] J. Dudouet *et al.*, Phys. Rev. Lett. 118 (2017), 162501
[4] K. Nomura *et al.*, Phys. Rev. C 96, 034310 (2017)

HK 27.7 Di 18:15 HS 14

Population in fragmentation reaction and properties of γ-decaying isomers in the ^{100}Sn region — •Guillaume Haefner[1,2], Andrey Blazhev[1], Kevin Moschner[1], Jan Jolie[1], Plamen Boutachkov[3], Paul John Davies[4], and Robert Wadsworth[4] — [1]IKP, Universität zu Köln, Deutschland — [2]CSNSM Orsay, Frankreich — [3]GSI Darmstadt, Deutschland — [4]University of York, Großbritannien

The study of nuclei around ^{100}Sn has been of long standing interest for the nuclear structure and nuclear astrophysics (see Ref. [1] for a recent review). Lately, results on properties of γ-decaying isomers in that region studied in a fragmentation reaction of a ^{124}Xe beam at 345 MeV/A at the RIBF of the RIKEN Nishina Center have been reported by Park *et al* [2]. This contribution presents results obtained in a similar experiment at the RIBF. Half-lives of isomeric states have been remeasured and are consistent with literature values while improving the uncertainty in some cases. Reduced transition probabilities are deduced and compared to shell-model calculations in various model spaces. The previously reported low-energy transitions in ^{92}Rh and ^{96}Ag were remeasured and their energies are given with better precision. Additionally, isomeric ratios have been remeasured and are compared to the previous study and the sharp cut-off model of fragmentation reaction.

[1] T. Faestermann, M. Górska and H. Grawe, Prog. Part. Nucl. Phys. 69, 85 (2013)
[2] J. Park et al., Phys. Rev. C 96, 044311 (2017)

HK 28: Nuclear Astrophysics II

Zeit: Dienstag 16:30–18:00 Raum: HS 16

Gruppenbericht HK 28.1 Di 16:30 HS 16

Core-collapse supernovae and equation of state effects — •Hannah Yasin[1], Sabrina Schäfer[1,2], Almudena Arcones[1,3], and Achim Schwenk[1,2,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Max-Planck-Institut für Kernphysik, Heidelberg

Core-collapse supernovae (CCSN) are cosmic laboratories for physics at the extremes and numerical simulations are essential to help us understand the underlying mechanisms in these events. A key ingredient in simulations is the equation of state (EOS), which determines the contraction behavior of the proto-neutron star (PNS) and thus impacts neutrino energies and explosion dynamics. However, the EOS for hot and dense matter is still not fully understood and CCSN simulations rely on EOS models that differ in their underlying theory and nuclear matter properties.

We present the first systematic study on the impact of different nuclear matter properties of the EOS in CCSN simulations. This allows us to examine possible reasons for differences in commonly used EOS in simulations. We find that the contraction behavior of the PNS is mainly governed by the effective mass, which impacts the shock propagation.

* Supported by the Deutsche Forschungsgemeinschaft through SFB 1245 (Projektnummer 279384907) and the European Research Council Grant No. 677912 EUROPIUM.

HK 28.2 Di 17:00 HS 16

Impact of the equation of state in core-collapse supernovae — •Sabrina Schäfer[1,2], Hannah Yasin[1], Almudena Arcones[1,3], and Achim Schwenk[1,2,4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Max-Planck-Institut für Kernphysik, Heidelberg

Neutron stars originate in core-collapse supernovae, which are one of the most energetic events in the universe. In core-collapse supernova simulations, the equation of state is a key ingredient. However, matter at high densities is only poorly constrained and the nuclear equation of state is still not fully understood. Equations of state that are available for supernova simulations differ considerably in their underlying theory as well as nuclear physics input. We investigate the impact of different nuclear matter properties on the equation of state in core-collapse supernovae. To this end, we introduce a range of equations of state based on the Lattimer and Swesty equation of state that vary the nucleon effective mass, incompressibility, symmetry energy, and nuclear saturation point. Larger effective masses lead to lower pressures at nuclear densities and a lower thermal index. This has an important impact on the proto-neutron star contraction and shock evolution.

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HK 28.3 Di 17:15 HS 16

Astrophysical implications of the forbidden transition be-

tween ^{20}Ne and ^{20}F — •Dag Fahlin Strömberg[1,2] and Gabriel Martínez-Pinedo[1,2] — [1]Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]Gesellschaft für Schwerionenforschung Darmstadt, Planckstr. 1, D-64259 Darmstadt, Germany

Following carbon burning, intermediate-mass stars (initial mass ∼7–11 solar masses) form degenerate cores composed primarily of ^{16}O and ^{20}Ne. When such cores grow massive and dense enough various electron capture reactions occur due to the high chemical potential of the electron gas. In addition to absorbing electrons these reactions also affect the temperature of the core. Most notably, the double electron capture $^{20}\text{Ne} \rightarrow {}^{20}\text{F} \rightarrow {}^{20}\text{O}$ releases enough heat to ignite runaway oxygen burning resulting in either a collapse to a neutron star or a thermonuclear explosion.

In this talk we will discuss the implications of the newly measured forbidden transition ($0^+ \rightarrow 2^+$) between the ground states of ^{20}Ne and ^{20}F. Its effects are twofold: the ignition occurs at lower central densities and the point of ignition is shifted away from the centre. We will discuss how this happens, the role played by the composition and growth rate of the core, and what this means for the final outcome.

This work is supported by the Deutsche Forschungsgemeinschaft through contract SFB 1245 and the EU COST Action CA16117 (ChETEC).

HK 28.4 Di 17:30 HS 16

Influence of astrophysical and nuclear physics uncertainties on the nucleosynthesis in the νp-process* — •Maximilian Jacobi[1], Julia Bliss[1], and Almudena Arcones[1,2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The spectra of very old stars often show a robust abundance pattern for the elements beyond barium which is associated with the r-process, but exhibit a star-to-star scatter in the abundances of the elements between strontium up to (possibly) silver (the so-called lighter heavy elements). This scatter can be explained by an additional primary process which might occur in the neutrino-driven wind following a successful core-collapse supernova. Motivated by recent supernova simulations, we investigate proton-rich neutrino-driven ejecta where the νp-process can contribute to the production of lighter heavy elements. We use steady-state neutrino-driven wind trajectories to systematically study the influence of astrophysical uncertainties on the nucleosynthesis evolution in proton-rich conditions and present possible abundance patterns. In the νp-process the nucleosynthesis evolves mainly by (p,γ) and (n,p) reactions and variations in the reaction rates of the latter have a critical influence on the final abundance patterns. We perform a sensitivity study based on a Monte Carlo approach and present a list with key (n,p) reactions for representative astrophysical conditions.

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HK 28.5 Di 17:45 HS 16

Parametrized Core-Collapse Supernova Simulations in Spherical Symmetry — •Kevin Ebinger[1], Sanjana Curtis[2], Carla Fröhlich[2], Matthias Hempel[3], Albino Perego[4], Matthias Liebendörfer[3], and Friedrich-Karl Thielemann[1,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany — [2]Department of Physics, North Carolina State University, Raleigh NC 27695 — [3]Department für Physik, Universität Basel, CH-4056 Basel, Switzerland — [4]Istituto Nazionale di Fisica Nucleare, Sezione Milano Bicocca, Gruppo Collegato di Parma, I-43124 Parma, Italy

Core-collapse supernovae (CCSNe) are explosions of stars that have reached their lives' end. These extreme events lead to the formation of a neutron star or a black hole and allow for the synthesis of elements heavier than iron that can be ejected and contribute to the galactic chemical evolution. To investigate the complex explosion mechanism of CCSNe, computationally expensive multi-dimensional simulations are required. If one wants to investigate the outcome, global trends and the dependency on the progenitor star for large samples of CCSNe, such multi-dimensional simulations become prohibitively resource consuming. We use a parametrized framework, the PUSH method, to investigate CCSNe for a large sample of progenitor models with solar and lower metallicities. This method allows us to identify trends of CCSNe with progenitor properties, compute nucleosynthesis yields that can be used in galactic chemical evolution models and predict remnant properties that can be compared with observations.

HK 29: Astroparticle Physics II

Zeit: Dienstag 16:30–18:30 Raum: HS 18

Gruppenbericht HK 29.1 Di 16:30 HS 18

The Large Enriched Germanium Experiment for Neutrinoless double beta Decay - LEGEND — •Yoann Kermaidic for the LEGEND-Collaboration — Max Planck Institute für Kernphysik 1 Saupferchekweg 69117 Heidelberg

The search for neutrinoless double beta ($0\nu\beta\beta$) decay is a very sensitive probe of whether neutrinos are Dirac or Majorana particles. Its discovery could have far reaching consequences for particle physics and cosmology (leptogenesis). Current ^{76}Ge-based experiments, Gerda and Majorana Demonstrator, benefit from the best energy resolution and the lowest background in the signal region in the field if normalized by the resolution. These superior characteristics allow the ^{76}Ge program to reach a half-life sensitivity over 10^{26} yr in 2018, and demonstrates the feasibility of deploying a large-scale next-generation ^{76}Ge-based experiment. The Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) collaboration has been founded with the goal to build a ton-scale experiment and boost the $0\nu\beta\beta$ decay half-life sensitivity by two orders of magnitude. The collaboration pursues a phased approach, based on the Gerda and Majorana Demonstrator experience, starting in 2021 with 200 kg of ^{76}Ge. I will present the general aspect of Legend and focus on the ongoing developments for Legend-200, which will make use of the Gerda cryostat at the underground Laboratori Nazionali del Gran Sasso in Italy.

HK 29.2 Di 17:00 HS 18

Time correlated backgrounds in GERDA and LEGEND — •Mario Schwarz[1], Luciano Pandola[2], Stefan Schönert[1], and Christoph Wiesinger[1] for the LEGEND-Collaboration — [1]Physik-Department, Technische Universität München, Garching, Germany — [2]INFN Laboratori Nazionali del Sud, Catania, Italy

The Gerda (GERmanium Detector Array) experiment, located in the Laboratori Nazionali del Gran Sasso (LNGS), uses ^{76}Ge-enriched germanium detectors to search for the lepton number violating neutrinoless double beta ($0\nu\beta\beta$) decay. The detectors are operated in liquid argon (LAr) serving both as cooling medium and as active shield against radiation. Time correlated background events can lead to signals in the Ge-, LAr- and water Cherenkov detector systems, which in turn opens new ways for their identification and suppression. The in-situ production of $^{77(m)}$Ge by cosmic muon interactions is an example for a delayed coincidence, which will have an increasing influence on the next generation of experiments searching for the $0\nu\beta\beta$ decay of ^{76}Ge. This might define a minimum depth requirement for next generation rare event searches with Legend (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay). Therefore, mechanisms for identifying the cosmogenic $^{77(m)}$Ge production are proposed for the first stage of Legend at LNGS. The expected event topologies are presented as well as plans for an acquisition of the coincidences. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 29.3 Di 17:15 HS 18

Signal modeling in inverted coaxial HPGe detectors for Legend — •Tommaso Comellato, Matteo Agostini, and Stefan Schönert — Physik-Department, Technische Universität München, Garching, Germany

The Legend collaboration plans to operate in its first stage up to 200 kg of enriched High Purity Germanium (HPGe) detectors in the upgraded Gerda infrastructure at LNGS, Italy. The science goal is to search for the neutrinoless double beta decay of ^{76}Ge. In the current Gerda and Majorana Demonstrator experiments, enriched HPGe

detectors with excellent pulse shape discrimination (PSD) properties are operated. Their masses are however typically below one kilogram. To reduce backgrounds from close-by parts as cables and holders, larger mass detectors without compromising the PSD performance are required. A novel detector geometry, referred to as inverted coaxial, is the baseline design of LEGEND HPGe detectors. A custom designed inverted coaxial detector with 1.6 kg mass was produced in collaboration with Baltic Scientific Instruments and the Helmholtz Research Center Rossendorf, and has been comprehensively characterized at TUM. In this talk I will present the latest results about the performance of this detector including the charge collection, signal shape properties and pulse shape discrimination performance. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02 and the German Research Foundation (DFG) via the SFB1258.

HK 29.4 Di 17:30 HS 18

Characterization and Optimization of the Front-End Electronics for LEGEND — •Oskar Moras[1], Paul Barton[2], Konstantin Gusev[1,3], Patrick Krause[1], Antonio Lucchini[4], Alan Poon[2], Stefano Riboldi[4], Stefan Schönert[1], and Michael Willers[2] for the LEGEND-Collaboration — [1]Physik Department, Technische Universität München, Germany — [2]INPA and NSD, Lawrence Berkeley National Laboratory, Berkeley, California — [3]Joint Institute for Nuclear Research, Dubna, Russia — [4]Dipartimento di Fisica, Università degli Studi di Milano and INFN Milano, Italy

The LEGEND collaboration aims to use High-Purity Germanium (HPGe) detectors to search for neutrinoless double beta decay of ^{76}Ge. In order to achieve the projected sensitivity, an excellent spectroscopic performance is crucial, which is obtained by minimizing the electronic noise. Therefore, it is necessary to operate the first stage of the charge amplifier, a JFET and a feedback circuit, close to the detectors, which requires these components to be extremely radiopure. We report results from first integration tests carried out at TUM. This talk will cover optimization for noise and resolution performance in the test bench, as well as first results from measurements performed in a liquid argon cryostat with a HPGe detector. So far, a test pulser resolution of 0.5 keV @ 1 MeV (FWHM) was achieved. This work has been supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundsforschung and the German Research Foundation (DFG) via the SFB1258.

HK 29.5 Di 17:45 HS 18

Development of Low-mass Signal Readout Electronics for LEGEND-1000 — •Frank Edzards[1,2], Susanne Mertens[1,2], and Michael Willers[3] for the LEGEND-Collaboration — [1]Max-Planck-Institut für Physik — [2]Technische Universität München — [3]Lawrence Berkeley National Laboratory

LEGEND is a future ton-scale experiment to search for neutrinoless double beta decay ($0\nu\beta\beta$) in the isotope ^{76}Ge using high purity germanium detectors. Its observation would establish lepton number violation, provide information on the neutrino mass and open a window to understand matter dominance in our universe.

This talk focuses on the signal readout which is one of the most important components of a $0\nu\beta\beta$ experiment since it facilitates the conversion of charges produced within the detectors into appropriately shaped voltage signals. Current $0\nu\beta\beta$ experiments such as GERDA and MAJORANA DEMONSTRATOR use a readout solution consisting of several discrete electronic components. We are developing a highly integrated low-mass signal amplifier based on state-of-the-art *application specific integrated circuit* (ASIC) technology which allows us to combine all relevant components in a single low-mass chip. In the talk, we will focus on first results from characterization measurements of this signal readout.

This work is supported by the Max Planck society, the German Academic Scholarship Foundation and the DFG SFB 1258.

HK 29.6 Di 18:00 HS 18

Studying the impact of radon daughter removal techniques on xenon purity — Stefan Brünner, •Dominick Cichon, Guillaume Eurin, Florian Jörg, Teresa Marrodán Undagoitia, Natascha Rupp, and Hardy Simgen — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Liquid xenon (LXe) detectors play a key role in the search for new physics such as dark matter and the neutrinoless double-beta decay. For instance, XENON1T has been operating over the last years searching for dark matter interactions in its LXe time projection chamber (TPC). Although no direct evidence for particle dark matter has been found yet, the experiment set the, at the time of writing, strictest exclusion limits on the cross-section for interactions between dark matter particles and ordinary matter.

In order to increase the sensitivity of LXe detectors even further, as required by future experiments such as DARWIN, extensive R&D regarding background mitigation is needed. This is especially true when it comes to daughter nuclides of radon, which make up a major background contribution to new physics searches. This talk gives an overview about current activities linked to background reduction in LXe TPCs. The focus lies on investigating the impact of chemicals used to remove radon daughters from PTFE, a material commonly employed in LXe detectors, on the purity of xenon. For this purpose, an LXe TPC allowing for the rapid exchange of PTFE components has been built and commissioned. Results related to the detector performance as well as the subject of study are presented and discussed.

HK 29.7 Di 18:15 HS 18

Measurement of Rn-222 in water samples — •Judith Gafriller — Max-Planck-Institut für Kernphysik, Heidelberg

XENON1T is currently the most sensitive experiment for direct dark matter search. In order to reduce background events generated by radioactive decays or cosmic rays, the detector is surrounded by a water tank acting as a passive shield as well as an active Cherenkov veto system. For the upgrade XENONnT, the sensitivity will be further improved by enriching the water veto with Gadolinium. It will allow to capture and detect neutrons created within the detector materials. In order to check whether the trigger rate of the neutron veto system is sufficiently low a radon background study is necessary. For measuring radon in water a gas drying and purifying method was developed which supports the well established technique of sensitive radon measurements with proportional counters. In this talk the elaborated gas drying system and the results of the measurements will be discussed.

HK 30: Instrumentation VI

Zeit: Dienstag 16:30–18:30 Raum: HS 11

Gruppenbericht HK 30.1 Di 16:30 HS 11

Ein Spurdetektor zur Luminositätsmessung bei PANDA — •Christof Motzko[1], A. Denig[1,3], F. Feldbauer[2], M. Fritsch[2], R. Hagdorn[2], R. Klasen[1], H. Leithoff[1], S. Maldaner[1], A. Pitka[2], S. Pflüger[2], G. Reicherz[2] und T. Weber[2] für die PANDA-Kollaboration — [1]Helmholtz-Institut Mainz — [2]Ruhr-Universität Bochum — [3]Johannes Gutenberg-Universtität Mainz

Das PANDA-Experiment, welches im Antiproton-Speicherring HESR an der im Bau befindlichen Beschleunigeranlage FAIR stehen wird, ist für Fragen der Hadronenphysik optimiert. Mit dieser Anlage wird es möglich sein, neue Zustände zu entdecken und die Linienform dieser wie auch bereits bekannter Zustände sehr präzise zu vermessen. Zur Normierung der dafür verwendeten Energie-Scan-Messungen wird die exakte Kenntnis der Luminosität benötigt. Die Luminosität wird bei PANDA anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung bestimmt. Um eine absolute Messgenauigkeit von 3 % zu erreichen werden die Spuren der gestreuten Antiprotonen gemessen. Dazu werden 4 Detektorebenen mit gedünnten Siliziumsensoren verwendet (HV-MAPS). HV-MAPS sind Pixelsensoren mit integrierter Ausleseelektronik. Sie werden mit einer Sperrspannung von 60 V betrieben um die Strahlenhärte zu erhöhen. Die 4 Ebenen bestehen aus CVD-Diamanten auf denen die Sensoren aufgeklebt sind. Zur Reduktion der Vielfachstreuung wird der Aufbau im Vakuum betrieben.

Das Konzept des Luminositätsdetektors wird vorgestellt und dabei technische Aspekte wie Vakuumsystem, Kühlung und Elektronik diskutiert, sowie Einblicke in die Datenanlyse gegeben.

Gruppenbericht HK 30.2 Di 17:00 HS 11

Towards the CBM-MVD: The Group Report — •Philipp Klaus for the CBM-MVD-Collaboration — Goethe Universität, Frankfurt

The Compressed Baryonic Matter Experiment (CBM) is one of the core experiments of the future FAIR facility. It will explore the phase diagram of strongly interacting matter in the regime of high net baryon densities with numerous probes, among them open charm. The Micro Vertex Detector (MVD) will contribute to the secondary vertex determination on a 10 μm scale, background rejection in di-electron spectroscopy and reconstruction of weak decays of multi-strange baryons. The detector comprises four stations placed next to the target in vacuum, allowing for two distinct station arrangements. The stations are populated with 50 μm thin, highly-granular customized Monolithic Active Pixel Sensors (called "MIMOSIS"), featuring a spatial precision in the order of <5 μm, a readout speed of less than 10 μs/frame, a radiation tolerance of $> 10^{13} n_{eq}/\mathrm{cm}^2$ and 3 Mrad. This contribution will summarize the status of activities towards constructing the MVD, that involve in particular CMOS sensor development together with IPHC Strasbourg, characterization and read-out, as well as detector integration, cooling and control aspects.
This work has been supported by BMBF (05P15RFFC1), GSI and HIC for FAIR.

HK 30.3 Di 17:30 HS 11

MIMOSIS, a CMOS sensor for the CBM Micro Vertex Detector* — •Michael Deveaux for the CBM-MVD-Collaboration — Goethe Universität Frankfurt am Main

The Compressed Baryonic Matter Experiment (CBM) is one of the core experiments of the future FAIR facility at Darmstadt/Germany. Its Micro Vertex Detector (MVD) will determine the secondary decay vertex of open charm particles with ~ 50 μm precision, contribute to the background rejection in dielectron spectroscopy and help to reconstruct neutral decay products of strange particles by means of missing mass identification.

The MVD will be operated with a dedicated CMOS Monolithic Active Pixel Sensor named MIMOSIS, which is being developed by the PICSEL group of the IPHC Strasbourg. Its design relies on the pixel array read-out architecture of the ALPIDE sensor developed for the ALICE ITS upgrade and extends its rate capability by more than one order of magnitude. Moreover, the fixed target geometry of the MVD creates specific challenges including strong gradients in the track density and radiation load, a bombardment with direct beam ions and substantial beam intensity fluctuations.

We will discuss the requirements for the sensor technology and introduce the solutions foreseen in the MIMOSIS sensor. Moreover, test results from the first sensor prototype named MIMOSIS-0 will be reported.

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

HK 30.4 Di 17:45 HS 11

Charakterisierung des MuPix8-Sensorprototyps für den $\overline{\mathrm{P}}$ANDA-Luminositätsdetektor — •René Hagdorn[1], Achim Denig[2,3], Florian Feldbauer[1], Miriam Fritsch[1], Roman Klasen[2], Heinrich Leithoff[2], Stephan Maldaner[2], Christof Motzko[2], Andreas Pitka[1], Stefan Pflüger[1], Gerhard Reicherz[1] und Tobias Weber[1] für die PANDA-Kollaboration — [1]Ruhr-Universität Bochum — [2]Helmholtz-Institut Mainz — [3]Johannes Gutenberg-Universität Mainz

Das $\overline{\mathrm{P}}$ANDA-Experiment ist eines der Schlüsselexperimente der im Bau befindlichen Beschleunigeranlage FAIR in Darmstadt. Aufgaben des Experiments sind u.a. die Untersuchung der Struktur von Hadronen sowie ihres Verhaltens in Materie und die Suche nach exotischen Zuständen. Für die Beschreibung der auftretenden Prozesse ist die genaue Kenntnis der Luminosität erforderlich.

Der $\overline{\mathrm{P}}$ANDA-Luminositätsdetektor besteht aus vier doppelseitigen Lagen von hochspannungsbetriebenen monolithischen aktiven Pixelsensoren (HV-MAPS). Diese dienen zur Spurrekonstruktion der Antiprotonen, die in kleinen Winkeln elastisch gestreut werden. Für den aktuellen Sensorprototyp†, den MuPix8, wurden in einem Laborstand sowie bei einer Teststrahlzeit am Mainzer Mikrotron (MAMI) Chrakterisierungsmessungen vorgenommen. In diesem Vortrag werden die Ergebnisse zusammen mit einem Vergleich zu Testmessungen der Mu3e-Gruppe vorgestellt.

$\overline{\mathrm{P}}$ANDA wird gefördert durch das BMBF.

†Dieser wurde ursprünglich für das Mu3e-Experiment entwickelt.

HK 30.5 Di 18:00 HS 11

SONIC III - An advanced particle spectrometer for the HORUS setup in Cologne — •V. Everwyn[1], S. G. Pickstone[1], A. Bohn[1], M. Färber[1], F. Kluwig[1], M. Müscher[1], S. Prill[1], P. Scholz[1], M. Spieker[2], M. Steffan[1], M. Weinert[1], J. Wilhelmy[1], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]NSCL, Michigan State University, MI 48824, USA

In the last few years, the particle spectrometer SONIC at the Tandem accelerator of the University of Cologne was steadily developed and now, in its third version, consists of 12 silicon PIPS detectors (single or ΔE-E telescopes) with a total solid angle coverage of 9%[1]. In combination with the γ-ray spectrometer HORUS, consisting of 14 HPGe detectors, p-γ coincidence measurements are performed. The combined setup is well suited to investigate inelastic scattering and, in its ΔE-E configuration, also transfer reactions in a wide mass region using beams provided the a 10 MV FN Tandem accelerator. With the new version of SONIC multiple lifetime measurements were performed using the DSA method and excitation responses as well as γ-decay branching ratios were studied with an improved accuracy.

In this contribution, SONIC III and its improvements compared to prior versions will be presented.

Supported by the DFG (ZI-510/9-1). A.B. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

[1] S. G. Pickstone *et al.*, Nucl. Instr. and Meth. A **875** (2017) 104.

HK 30.6 Di 18:15 HS 11

Upgrade der Detektorkonfiguration von LYCCA am IKP Köln — •K. Wolf[1], D. Werner[1], M. Ravar[1], P. Reiter[1], C. Goergen[1], S. Thiel[1], M.A. Bentley[2], S. Fox[2], D. Rudolph[3], P. Golubev[3], C. Lorenz[3], P. Coleman-Smith[4] und I. Lazarus[4] — [1]IKP, Universität zu Köln — [2]University of York — [3]Lund University — [4]Daresbury Laboratory

Nach dem erfolgreichen Einsatz des Lund-York-Cologne CAlorimeters (LYCCA) während der NUSTAR-PreSPEC-Kampagne an der GSI, wurde die analoge Elektronik der doppelseitige segmentierten Silizium-Streifen-Detektoren (DSSSD) mit der ASIC basierten AIDA Front-end Elektronik ersetzt. Der modernisierte LYCCA-Detektor wurde danach am Tandembeschleuniger des IKP Köln in Betrieb genommen und mit Strahlmessungen getestet. Dazu wurde die ursprüngliche Detektorgeometrie für Streuexperimente bei Tandemenergien modifiziert um z.B. astrophysikalisch relevante Reaktionsstudien in Zukunft durchzuführen. Bis zu 24 DSSSDs können um die Targetposition herum angeordnet werden, um eine maximale Nachweiseffizienz im Experiment zu gewährleisten. Der Aufbau ermöglicht die Aufnahme von kinematischen Koinzidenzen in einem maximierten Winkelbereich bei gleichzeitig hoher räumlicher Auflösung. Die Ergebnisse der Streuexperimente mit schweren Ionen, die Energie- und Zeitauflösung, sowie Effizienz des geänderten Spektrometers bei Strahlenergien von 1-20 MeV werden vorgestellt. Supported by GSI F&E KREITE 1416

HK 31: Instrumentation VII and Applications

Zeit: Dienstag 16:30–18:30 Raum: HS 12

Gruppenbericht HK 31.1 Di 16:30 HS 12

Possibilities of photonuclear studies at the upgraded low-energy photon tagger NEPTUN — •Dmytro Symochko[1], Thomas Aumann[1,2], Martin Baumann[1], Patrick van Beek[1], Alexander Fuchs[1], Yevhen Kozymka[1], Daniel Körper[2], Bastian Löher[1], and Heiko Scheit[1] — [1]TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

The low-energy photon tagging facility NEPTUN at the superconducting Darmstadt linear accelerator (SDALINAC) has been constructed with the aim to study the photoabsorption cross section of the nuclei in low energy region under conditions of quasi-monochromatic gamma

beam. Recently it went through the major upgrade which included a complete rework of the focal plane detectors. The setup now allows measurements in the 30 MeV energy bite in single spectrometer settings effectively covering energy range of Pygmy- and Giant Dipole Resonances. This provides us unique chance to study the photoresponse of the nuclei below and far above particle separation threshold (up to 35 MeV) within the same experiment under the same conditions. Upgraded NEPTUN was tested in the commissioning runs and aiming for the first production runs in 2019.

The talk will be focused on the results of NEPTUN commissioning and details of the planned experimental campaign, which will combine experiments at NEPTUN, HiGS and NewSubaru facilities.

Supported by DFG (SFB 1245).

HK 31.2 Di 17:00 HS 12

Status report on NEPTUN upgrade and total photoabsorption setup PROTEUS — •Patrick van Beek[1], Thomas Aumann[1,2], Martin Baumann[1], Alexander Fuchs[1], Daniel Körper[1,2], Yevhen Kozymka[1], Heiko Scheit[1], and Dmytro Symochko[1] — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

The low-energy photon tagging facility NEPTUN at the superconducting Darmstadt linear accelerator (S-DALINAC) can be used to study the photoabsorption cross section of nuclei in the energy regions of Pygmy Dipole and Giant Dipole Resonances. From the complete photo nuclear cross section spectrum the dipole polarizability of the nucleus can be calculated, which helps constraining the symmetry energy in the equation of state. NEPTUN was undergoing a major upgrade. The setup was extended by the target positioning system PROTEUS, which ensures a precise and rapid target exchange. Its concept idea in the context of NEPTUN and a characterization will be presented.

Supported by DFG (SFB 1245).

HK 31.3 Di 17:15 HS 12

Linearly polarized photon beams at the BGO-OD experiment — •Christian Tillmanns for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, D-53115 Bonn

The BGO-OD experiment at the ELSA electron accelerator facility in Bonn studies the excitation spectra of nucleons via photoproduction of mesons. The setup combining a central BGO calorimeter and a forward magnetic spectrometer is ideally suited for the investigation of strangeness photoproduction. Linearly polarized photons enable access to polarization observables which are used to disentangle resonances. These photons are produced via koherent Bremstrahlung of electrons in crystal radiators.

The currently used method for the extraction of the degree of polarisation and it's verification will be presented.

*Supported by DFG (PN 50165297).

HK 31.4 Di 17:30 HS 12

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

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

The 8 HPGe CLOVER detectors of ELIADE are important instruments for the gamma spectroscopic study of photonuclear reactions. We investigate the possibility to operate an advanced version of an anti-Compton shield (AC shield) as escape γ-rays pair spectrometer for one of the ELIADE CLOVERS to extend the high-resolution spectroscopy to photon energies of several MeV where the pair production process dominates. The BGO shield operated as a stand-alone device can also be used as intensity monitor and to investigate the cross section for pair production near the threshold. The main tasks are to develop and test such an AC shield: a pair spectrometer consisting of BGO crystals with SiPM (silicon photomultiplier) readout. The results of prototype testing are reported. First measurements with low energy photons are planned for 2019.

This work is supported by the LOEWE-Forschungsschwerpunkt "Nukleare Photonik".

HK 31.5 Di 17:45 HS 12

Commissioning tests for (e,e'γ) coincidence experiments at the S-DALINAC * — •Gerhart Steinhilber, Tobias Klaus, Ronan Lefol, Norbert Pietralla, and Peter von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

At the Institut für Kernphysik at the TU Darmstadt high resolution electron scattering experiments at low momentum transfer are performed using the QCLAM electron spectrometer. The electron beam is delivered by the Superconducting Darmstadt Linear Accelerator S-DALINAC. The QCLAM spectrometerfeatures a comparatively large solid-angle coverage of 35 msr and a momentum acceptance of 20%. This makes it suitable for (e,e'x) coincident measurements.

We combine the large acceptance QCLAM spectrometer with fast timing LaBr:Ce detectors to perform (e,e'γ) coincidence experiments. The excitation of the nuclei is studied by measuring inelastically scattered electrons, so that the energy of the excited state is known. The decay back to the ground state is measured by a detector array consisting of high resolution LaBr:Ce detectors with excellent timing properties.

The detectors are shielded from low-energy γ background by a new lead housing. The data acquisition (DAQ) is connected to the QCLAM DAQ and was tested during a QClam beam time in fall 2018. Also, a clear coincidence time signal caused by cosmic radiation showers has been observed off-beam. The concept of the setup, data acquisition, results from the tests will be shown.

* Supported by the DFG within the CRC 1245.

HK 31.6 Di 18:00 HS 12

Advances in a Silicon Photomultiplier Readout of a Compton Camera — •Tim Binder[1,2], Maria Kawula[1], Silvia Liprandi[1], Giovanni Paolo Vinci[1], Florian Schneider[2], Katia Parodi[1], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität, Munich, Germany — [2]KETEK GmbH, Munich, Germany

Silicon Photomultipliers (SiPM) have moved into the focus of a variety of applications to substitute photomultiplier tubes (PMT) due to their limitations in some areas. SiMPs can be operated in medical applications with the presence of magnetic fields, e.g. PET/MRI, or, because of their compact package size, where PMTs would introduce intolerable amounts of dead material, e.g. in a Compton camera (CC) scatter detector. Our CC prototype was developed for online range verification in hadron therapy. The absorber component of the prototype, a monolithic $LaBr_3$:Ce crystal (read out by a multianode PMT), will alternatively be read out by SiPMs, while the currently used scatterer, consisting of six layers of double-sided silicon strip detectors (DSSSD), can alternatively be substituted by a pixelated GAGG scatterer with SiPM readout to provide common readout and data processing of the whole CC. Furthermore, a $CeBr_3$ crystal is under investigation as a cost-effective and low-background alternative to $LaBr_3$:Ce. In this work results of the characterization of the SiPM readout (including the readout electronics) will be presented. Furthermore, a summary of the characterization of the $CeBr_3$ absorber will be given. This work is supported by the DFG Cluster of Excellence Munich Centre of Advanced Photonics (MAP) and the Bayerische Forschungsstiftung.

HK 31.7 Di 18:15 HS 12

Response of different types of scintillation materials to Am-Be neutron source — •Valera Dormenev[1], Kai-Thomas Brinkmann[1], Georgy Dosovitskiy[2], Mikhail Korjik[2,3], Vitaly Mechinsky[3], Dmitry Kozlov[3], Andrey Fedorov[3], and Hans-Georg Zaunick[1] — [1]2nd Physic Institute, Justus Liebig University, Giessen, Germany — [2]National Research Center "Kurchatov Institute-IREA", Moscow, Russia — [3]Research Institute for Nuclear Problems, Minsk, Belarus

Neutron detectors have a wide range of application as for example non-destructive inspection, security systems and scientific research using different types of physical methods and equipment for detection of different types of ionizing radiation. Gadolinium and Lithium based scintillation materials can be considered as very promising candidates for such kinds of detectors. The materials have high absorption of neutrons with following prompt emission of gamma-quanta or alpha particles and detect these radiations efficiently due to high stopping power. Here we report test results of different types of scintillators, glass, ceramics and single crystals consisting or loaded with Gd and Li, obtained with standard Am-Be neutron source.

Work was done in frames of EU, INTELUM and Crystal Clear Collaboration Projects

HK 32: Hauptvorträge III

Zeit: Mittwoch 11:30–12:40 Raum: Plenarsaal

Hauptvortrag HK 32.1 Mi 11:30 Plenarsaal

Where nuclear physics meets quantum optics — •Adriana Pálffy — Max-Planck-Institut für Kernphysik, Heidelberg

Nuclear physics studies atomic nuclei and their constituents and interactions. While not particularly spectacular from nuclear physics point of view, the photo-excitation of low-lying nuclear states opens the new field of nuclear quantum optics and may bring substantial progress in the field of metrology. These developments aim to exploit the fact that nuclei are very clean quantum systems, well isolated from the environment and benefiting from long coherence times. The lecture will follow these perspectives at the borderline between nuclear and atomic physics on the one hand side and metrology and quantum optics on the other hand side. First, the present status of the efforts to use the ^{229}Th isomer at approx. 8 eV for a nuclear frequency standard will be discussed.

Second, the prospects of mutual control between nuclear transitions and x-rays will be discussed in the light of novel coherent x-ray sources such as the x-ray free electron laser. Combining the advantages of x-rays and nuclei, a prominent incentive is to use nuclei to exploit x-rays as the future quantum information carriers or for novel probing technologies based on quantum effects. Turning the tables, the control of nuclear transitions with strong x-ray sources would open the possibility to use long-lived nuclear excited states as a compact and clean energy storage solution. The lecture will follow the developments on the emerging field of x-ray quantum optics and focus on the mutual control of coherent x-ray radiation and nuclear transitions.

Hauptvortrag HK 32.2 Mi 12:05 Plenarsaal

COLLAPS: revealing nuclear structures of short lived isotopes by collinear laser spectroscopy at CERN-ISOLDE — •Simon Kaufmann for the COLLAPS-Collaboration — Institut für Kernphysik, TU Darmstadt

High-resolution laser spectroscopy is a proven tool to investigate the structure, size and shape of a variety of nuclei by probing the distortions in the energy schemes of the electrons caused by the nucleus. Collinear laser spectroscopy (CLS) allows the investigation of short-lived isotopes far away from stability down to lifetimes in the millisecond range. Established in the 1980s at the RIB facility CERN-ISOLDE, the COLLAPS experiment evolved throughout the years by various upgrades and developments, but in its core principle it is still in operation today [1, 2]. During these years, also the radioactive ion beam production at ISOLDE was upgraded constantly, enabling CLS on isotopes even further away from stability.

In this talk recent highlights of work at COLLAPS will be presented including measurements in the nickel region ($Z = 28$) and in the much heavier tin region ($Z = 50$). The development of the charge radius along with Z and N is hereby of special interest and the outcome of these measurements serve as an important benchmark for nuclear theories in both mass regions.

[1] R Neugart, 1981, Nucl. Instrum. Methods Phys. Res. 186 165
[2] R Neugart et al, 2017, J. Phys. G: Nucl. Part. Phys. 44 064002

HK 33: Hadron Structure and Spectroscopy V

Zeit: Mittwoch 14:00–16:00 Raum: HS 13

Gruppenbericht HK 33.1 Mi 14:00 HS 13

Perspectives for Ξ Baryon Spectroscopy in $\bar{p}p$ Collisions with the PANDA Detector — •Albrecht Gillitzer, Alessandra Lai, Jennifer Pütz, James Ritman, and Tobias Stockmanns for the PANDA-Collaboration — Forschungszentrum Jülich, Jülich, Deutschland

Due to the lack of experimental data, our knowledge of the excitation spectrum of double strange baryons is very poor. While within SU(3) flavor symmetry the Ξ baryon spectrum should have as many states as the N and Δ spectrum together, only a few Ξ^* states have been established, most of them without spin parity quantum number assignment. An extension of the data base on baryon resonances to the (multi-)strangeness sector is however important to scrutinize the theoretical models based on studies of the N and Δ spectrum. The $\bar{p}p$ entrance channel has a relatively large cross section for the production of double strange (anti-)baryons in the final state. The corresponding high production rates together with the large detector acceptance for both charged and neutral particles make the PANDA experiment the ideal place for Ξ spectroscopy. An important part of the PANDA physics program is therefore devoted to the study of the Ξ spectrum. Results of feasibility studies to identify Ξ^* resonances in the final states $\bar{\Xi}^+\Lambda K^-$ (and its charge conjugate), $\bar{\Xi}^+\Xi^-\pi^0$, and $\bar{\Xi}^+\Xi^-\pi^+\pi^-$ will be reported, and the perspective of studying further decay modes will be discussed.

Gruppenbericht HK 33.2 Mi 14:30 HS 13

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

Hadron spectroscopy has for many years been used to explore the relevant internal degrees of freedom of the nucleon. Despite the wealth of data there remain many "missing resonances" which are predicted by quark models but are not observed experimentally. Since the conception these models, there has been discussion of the possibility of baryons and mesons of more than three and two constituent quarks respectively. These could manifest as single colour bound objects, or evolve from meson-baryon and meson-meson interactions, opening a possibility of molecular systems and meson re-scattering effects near production thresholds. Indeed, models including meson-baryon interactions have had improved success in describing both strange and non-strange resonance spectra.

To study such effects experimentally, access to a low momentum exchange region is crucial. The BGO-OD experiment at ELSA, comprised of a forward spectrometer and central calorimeter, is uniquely suited for the study of strangeness photoproduction in this region of forward meson angles. First promising results exhibit unprecedented statistics for the associated photoproduction of charged kaons with both ground state and excited hyperons, and neutral kaons identified via both neutral and charged decay modes.

Supported by the DFG PN 50165297.

HK 33.3 Mi 15:00 HS 13

$K^+\Lambda(1405)$ photoproduction at the BGO-OD experiment — •Georg Scheluchin for the BGO-OD-Collaboration — Physikalisches Institut, Nussallee 12, D-53115 Bonn

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

The Λ(1405) can be produced in the reaction $\gamma p \to K^+\Lambda(1405)$. The pure I=0 decay mode into $\Sigma^0\pi^0$ is prohibited for the mass-overlapping Σ(1385). Combining a large aperture forward magnetic spectrometer and a central BGO crystal calorimeter, the BGO-OD experiment is ideally suited to measure this decay with the K^+ in the forward direction. Preliminary results using the newest available data will be presented.

*Supported by DFG (PN 50165297).

HK 33.4 Mi 15:15 HS 13

Electromagnetic decay of excited hyperons at HADES — •Waleed Esmail, Tobias Stockmanns, and James Ritman for the HADES Kollaboration-Collaboration — Forschungszentrum Jülich GmbH, IKP1, 52428 Jülich, Germany

The electromagnetic (EM) decay of excited hyperons states is a very sensitive probe of the structure of hyperons, since the electromagnetic transitions provide a relatively clean probe of the wave functions of the initial and final baryon states. We propose to measure of EM decay channels of excited hyperons produced in p+p reactions at 4.5GeV

using HADES spectrometer. Results from HADES on both photon and dielectron decays such as $\Sigma(1385) \rightarrow \Lambda\gamma(e^+e^-)$ will have significant impact on the understanding of the structure of the strange resonances in the region of small q^2. The hyperon reconstruction will significantly benefit from the proposed Forward Detector (FD) that extends HADES acceptance in the forward direction towards lower polar angles $0.5^o - 6.5^o$. This detection system consists of two tracking stations based on straw tubes followed by a time-of-flight wall based on RPC technology. The goal is to perform a semi-inclusive reconstruction of excited hyperon decays tagged by the reconstruction of the $\Lambda \rightarrow p\pi^-$ ground state in association with a photon/dielectron pair. Since the FD will be operated in a region without magnetic field, a reconstruction of the momentum vector will be provided by a time-of-flight measurement in the RPC, and measurement of the track direction by means of the straw tube stations. This talk will provide a brief overview of the science case and the simulation results of the expected performance.

HK 33.5 Mi 15:30 HS 13

Kaon-proton femtoscopy in ALICE: going beyond scattering experiments — •Valentina Mantovani Sarti for the ALICE-Collaboration — TUM Munich

Scattering experiments have been one of the main sources of information on hadron-hadron interactions. The large amount of such data in the nucleon-nucleon sector allows the development of a solid and deep knowledge of the nucleon-nucleon interaction.
The situation is completely different when a new degree of freedom such as strangeness is introduced.
In the meson-baryon sector the K^--nucleon interaction relies only on old and rather imprecise scattering data above threshold and on the kaonic atom measurement at threshold. More data are needed to constrain this low-energy QCD regime where chiral symmetry breaking is dominant and where a molecular state as the $\Lambda(1405)$ is present.
In this talk we present the latest femtoscopy measurements for kaon-proton pairs in pp collisions from ALICE which provide a complementary tool to measure the kaon-proton strong interactions in the low momenta regime with a high precision. We will show results on the K^+-proton and K^--proton correlation function in pp collisions at $\sqrt{s} = 5, 7$ and 13 TeV.
The high-precision femtoscopic data from ALICE provide a unique opportunity to test the predictions of theoretical models. In particular, they are useful at low momenta where they provide experimental evidence for the first time of the opening of the coupled isospin breaking channel $\bar{K}^0$-n.

HK 33.6 Mi 15:45 HS 13

$K^0_S\Sigma^0$ photoproduction at the BGO-OD experiment — •Katrin Kohl — Physikalisches Institut, Nussallee 12, D-53115 Bonn

The BGO-OD experiment at the ELSA accelerator facility uses an energy tagged bremsstrahlung photon beam to investigate the exitation structure of the nucleon in meson photoproduction.

The setup with a BGO calorimeter surrounding the target and an open dipole spectrometer covering the forward region is ideally suited for investigating low momentum transfer processes, in particular in strangeness photoproduction.

The associated photoproduction of K^0_S and hyperons is essential to understand the role of K^* exchange mechanisms. A cusp-like structure observed in the $\gamma p \rightarrow K^0_S\Sigma^+$ reaction at the K^* threshold is described by models including dynamically generated resonances from vector meson-baryon interactions. Such interactions are predicted to give a peak like structure in $K^0_S\Sigma^0$ photoproduction off the neutron.

This talk presents a preliminary analysis of the reaction $\gamma n \rightarrow K^0_S\Sigma^0$ from a new deuterium target dataset taken in 2018.

*Supported by DFG (PN 50165297).

HK 34: Heavy-Ion Collisions and QCD Phases VI

Zeit: Mittwoch 14:00–16:00 Raum: HS 15

Gruppenbericht HK 34.1 Mi 14:00 HS 15

Overview of neutral meson and direct photon production at the LHC measured with ALICE. Energy and system size dependence. — •Ana Marin for the ALICE-Collaboration — GSI Helmholtzzentrum für Schewerionenforschung, Planckstr. 1, 64291 Darmstadt

The ALICE experiment is dedicated to the study of the Quark-Gluon Plasma (QGP) formed in heavy-ion collisions. Among other observables, the properties of the QGP can be addressed by studying neutral meson and direct photon production in nucleus-nucleus collisions. Direct photons provide information about the initial stage of the collision as well as the space-time evolution of the QCD medium. In particular, the thermal photon spectrum and flow carry information about the temperature and development of collective flow in hot medium. Measurements of neutral meson production in different kinds of collision are interesting for many reasons: in pp collisions they serve as reference spectra, as well as a test of pQCD predictions and other theoretical model calculations; in p-Pb collisions cold nuclear matter effects are measured; in AA collisions neutral meson spectra give insights on the energy loss of partons traversing the hot and dense medium.

In this talk, an overview of neutral meson production as well as direct photon production and flow in pp, p-Pb and AA collisions at energies provided by the LHC and measured with ALICE will be presented.

HK 34.2 Mi 14:30 HS 15

Photon-photon scattering in the resonance region at midrapidity at the LHC — •Rainer Schicker — Phys. Inst., Heidelberg

A study is presented to extend the measurements of photon-photon scattering in ultra-peripheral Pb-Pb collisions at the LHC into the diphoton mass range $0.4 < W_{\gamma\gamma} < 5$ GeV. The elementary photon-photon scattering cross section discussed in Ref.1 is extended to these low masses which include the pseudoscalar resonances η and η'. The main background to two-photon final states, arising from double π^0 production with two of the four decay photons escaping detection, is examined, and possible kinematical conditions are discussed to suppress the background for such measurements at midrapidity. The residual background is subtracted by a sideband subtraction such that the signal-to-background ratio is larger than one (S/B > 1) in the considered range of diphoton masses.

Ref.1: M. Klusek-Gawenda, P. Lebiedowicz, A. Szczurek, Phys.Rev.C93 (2016) no.4, 044907.

HK 34.3 Mi 14:45 HS 15

Low-mass dielectron measurements in minimum-bias pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE — •Leonhardt Viebach and Raphaelle Bailhache for the ALICE-Collaboration — Institut fuer Kernphysik, Goethe-Universitaet Frankfurt

The production of low-mass dielectrons is the most promising tool for the understanding of the chiral-symmetry restoration and of the thermodynamical properties of the Quark-Gluon plasma (QGP) created in heavy-ion collisions. In the intermediate-mass region, the measurement of thermal dielectrons from the QGP is nevertheless very challenging at the LHC due to the dominant contribution of e^+e^- pairs from open-charm and -beauty hadron decays. To single out the interesting signal characteristics of the QGP, the primordial e^+e^- pair production in vacuum needs to be first understood. It can be studied in minimum-bias proton-proton collisions. Dielectron measurements in elementary collision systems serve not only as a reference for the heavy-ion analysis but provide also a test for Monte-Carlo event generators, aiming to reproduce the heavy-flavour production mechanisms.

In this talk, we present the status of the dielectron analysis in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE. The dielectron yield is studied as a function of invariant mass, pair transverse momentum, and pair transverse impact parameter (DCA_{ee}). The latter helps to disentangle prompt and non-prompt dielectron sources. The results will be compared to the expectations from known hadronic sources and their implications for the heavy-flavour production will be discussed.

Supported by BMBF and the Helmholtz Association.

HK 34.4 Mi 15:00 HS 15

Reconstruction of eta meson at CBM-RICH detector using conversion method* — •Ievgenii Kres, Karl-Heinz Kampert, and Christian Pauly for the CBM-Collaboration — Bergische Universität Wuppertal

The Compressed Baryonic Matter (CBM) experiment is part of a worldwide research program devoted to study the phase diagram of strongly interacting matter at high baryon density ρ_B and moderate temperatures T in A+A collisions from $2-11$ $AGeV$ (SIS100). One of the main physics motivations of CBM is dilepton measurements. Lepton pairs offer the unique possibility to look into the fireball and to study the microscopic properties of hot and dense strongly interacting matter, since they are not affected by hadronic final state interactions. A central component of the proposed detector setup is a Ring Imaging Cherenkov Detector (RICH), which is intended to identify leptons among all other particles. The measured dilepton invariant mass spectrum at low mass region is dominated by physical background from decays of π^0 and η mesons. The presented analysis aims to reconstruct η mesons via double conversion ($\eta \to \gamma + \gamma \to (e^+e^-) + (e^+e^-)$) in order to scale these background channels accurately in the integral e^+e^- invariant mass spectrum. Proper counting of the η mesons requires an exact description of the combinatorial background below the η invariant mass peak, which is achieved using the event mixing technique. First results of this conversion analysis are presented, including reconstruction efficiencies and signal to background estimation.

*gefördert durch BMBF 05P15PXFCA, und GSI

HK 34.5 Mi 15:15 HS 15

Measurement of ω and η mesons with ALICE in pp collisions at $\sqrt{s} = 7$ TeV — •Florian Jonas for the ALICE-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

ALICE has been designed as a heavy-ion experiment and its research focuses on the phase space of strongly interacting matter, in particular the properties of the quark-gluon plasma (QGP) – a phase in which quarks and gluons exist as unconfined particles. The measurement of neutral meson cross sections allows to test and constrain pQCD predictions of meson production. Furthermore, the cross sections are needed as input for other analyses such as direct photon and di-lepton measurements.

In this contribution, the differential invariant cross sections of ω and η meson production at mid-rapidity in proton-proton collisions at $\sqrt{s} = 7$ TeV are presented. Both mesons are reconstructed using their $\pi^+\pi^-\pi^0$ decay channel, requiring the measurement of charged pions using ALICE's tracking capabilities as well as the reconstruction of neutral pions via their decay into two photons. All methods available in ALICE to measure photons at mid-rapidity are used: Its two calorimeters, the EMCal and the PHOS, as well as the so-called Photon Conversion Method (PCM), which allows to measure photons via pair conversions. In addition, two hybrid approaches are used for the neutral pion reconstruction which combine calorimeter photon measurements with the PCM.

HK 34.6 Mi 15:30 HS 15

Measurement of Neutral Mesons in pp Collisions at the LHC with ALICE — •Jens Robert Lühder for the ALICE-Collaboration — Institut für Kernphysik, Münster

In ALICE, the measurement of photons is performed in two different ways: First, via the tracking of e^+-e^- pairs and secondly, via their energy deposits in electromagnetic calorimeters. The first method is called PCM (Photon Conversion Method) as photons may convert to e^+-e^- pairs when interacting with the detector material. By using the measured photons to reconstruct the amount of neutral mesons, the fraction of decay photons out of all measured photons can be acquired. The talk will cover the measurement principles of the hybrid method, which combines these two methods in order to benefit from both detection principles and a first look into the PCM-PHOS analysis of neutral mesons in the data of LHC Run 2 with a center of mass energy $\sqrt{s} = 13$ TeV will be shown.

HK 34.7 Mi 15:45 HS 15

Measurement of transverse momentum spectra of neutral mesons with the ALICE calorimeters — •Adrian Mechler for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt, Deutschland

The ALICE experiment at the CERN LHC investigates the properties of the quark-gluon plasma (QGP) which is believed to be produced in Pb–Pb collisions at high collision energies. Hadron production measurements in pp collisions provide information about the underlying QCD processes and fragmentation functions. Furthermore, pp results provide an important baseline for the interpretation of heavy-ion collisions. In ALICE, neutral mesons can be measured via their two-photon decay channel facilitating the ALICE calorimeters EMCal, PHOS and DCal to measure the position and energy of the decay photons.

This talk will discuss measurements of neutral mesons in various collision systems from the recently finished RUN2 data taking period using the ALICE calorimeters. The talk will focus on transverse momentum spectra and their dependence on the different collision systems.

Supported by BMBF and the Helmholtz Association.

HK 35: Heavy-Ion Collisions and QCD Phases VII

Zeit: Mittwoch 14:00–15:45 Raum: HS 12

Gruppenbericht HK 35.1 Mi 14:00 HS 12

Spectral Functions from the Functional Renormalization Group — •Christopher Jung[1], Ralf-Arno Tripolt[2], Lorenz von Smekal[1], and Jochen Wambach[3,4] — [1]JLU, Giessen — [2]GU, Frankfurt — [3]ECT*, Trento — [4]TU Darmstadt

We present the current status on spectral functions as obtained by applying the non-perturbative functional renormalization group approach (FRG) and a recently proposed analytic continuation method to an effective low-energy theory motivated by the gauged linear sigma model. Here we study the in-medium behavior of the spectral functions of the ρ and a1 meson in different regimes of the phase diagram where we focus on signatures in these data for a critical endpoint (CEP) and the restoration of chiral symmetry. We also present results for in-medium electromagnetic spectral functions and aim at computing temperature and chemical potential dependent dilepton rates within this setup.

HK 35.2 Mi 14:30 HS 12

Application of the fast vectorised Kalman filter based track fit to the STAR experiment — •Artemiy Belousov[1], Yuri Fisyak[3], Ivan Kisel[1,2], and Maksym Zyzak[2] for the CBM-Collaboration — [1]FIAS — [2]GSI — [3]Brookhaven National Laboratory

Modern experiments in high energy physics tend to increase the amount of data to be processed, thus, the execution speed of the algorithms becomes crucial. However, the efficiency and precision of the applied procedures cannot be compromised. Therefore, the Kalman filter method is usually used as a basis in particle tracks reconstruction, since it satisfies the above-mentioned requirements.

Current implementation of the Kalman filter method for reconstruction of charged particle trajectories is added to the TPC CA track finder of the STAR experiment within the FAIR Phase 0 program. The algorithm will be applied in the High Level Trigger of STAR during the Beam Energy Scan II (BES II) program, which requires high operational speed. At the same time, quality of the fitting procedure should stay high. The developed Kalman filter based track fit uses all specific technical data we can capture from a detector. Therefore we improve the quality of the fitting procedure.

As a part of the preparation for the BES II program the track fitting procedure is required to be extended to the outer ToF and MTD detectors, where the magnetic field and the TPC gas parameters are not homogeneous. The Kalman filter based track fit was modified to cope with these complicated conditions. It shows correct distributions of track parameter residuals and pulls, and χ^2.

HK 35.3 Mi 14:45 HS 12

Application and improvement of Cellular Automaton track finder in the TPC detector — •Grigory Kozlov[1,2] and Ivan Kisel[1,3] for the CBM-Collaboration — [1]FIAS, Frankfurt am Main, Germany — [2]JINR, Dubna, Russia — [3]GSI, Darmstadt, Germany

Track finding procedure is one of the most important part of event reconstruction in high energy physics experiments. Tracking algorithms combine hits into tracks and reconstruct trajectories of particles flying through the detector. Due to the high combinatorics, they are usually considered as the most time consuming tasks. Calculation speed is critical in heavy ion experiments, especially for online reconstruc-

tion. Thus, tracking procedure mast be extremely fast, keeping high efficiency at the same time. The Cellular Automaton (CA) algorithm provides a perfect solution for this task. Because of its properties, it provides required speed, efficiency and can be massively parallelised on the modern many core computing platforms. The CA track finder algorithm was investigated in application to the TPC CA track finder in the STAR experiment within the FAIR Phase 0 as a part of preparation to the Beam Energy Scan II (BES II) program. The initial implementation of the TPC CA algorithm is dominated by the data copying, that complicates an efficient utilisation of the advantages of the SIMD unit. In this work we consider several improvements of the CA algorithm, which allows us to get the maximum benefit from using vectorized calculations. New approaches are compatible and interchangeable with existing CA methods. This allows full use of the SIMD-registers and sufficiently high efficiency at the maximal calculation speed.

HK 35.4 Mi 15:00 HS 12

Application of the 3-Fluid Hydrodynamic Event Generator THESEUS to CBM — •Elena Volkova for the CBM-Collaboration — Tuebingen university, Germany

The Compressed Baryonic Matter experiment (CBM) at FAIR will measure nucleus-nucleus collisions at beam energies up to 11 AGeV for Au. The key objective of CBM is to investigate the QCD phase diagram in the region of the highest net-baryon-densities. The experiment is well suited to explore the Equation-of-State of nuclear matter at densities as they might occur in the interior of neutron stars or during neutron star mergers. Recently, a new event generator, THESEUS, has been developed. It is based on the three-fluid hydrodynamics approach for the early stage of the collision, followed by a particlization at the hydrodynamic decoupling surface to join to a microscopic transport model, i.e., UrQMD. This accounts for hadronic final state interactions. The three-fluid approximation is a minimal way to simulate the finite stopping power at the initial stage of the collision. The model incorporates the evolution of three baryon-rich fluids: a target and projectile fluid, and a fluid describing the hot fiereball of participant matter. The generator allows, e.g., to employ different Equations-of-State for the description of nuclear matter. We plan to investigate the physics performance of the CBM detector by testing the sensitivity of various observables (e.g. flow) to different EoS as THESEUS generator input. The first results of the CBM with THESEUS events will be present.

HK 35.5 Mi 15:15 HS 12

(Non-)equilibrium dynamic critical phenomena — •Dominik Schweitzer[1], Sören Schlichting[2], and Lorenz von Smekal[1] — [1]Justus-Liebig-Universität, Gießen, Germany — [2]Universität Bielefeld, Germany

Uncovering the phase diagram of QCD is one of the main goals of heavy-ion collision experiments. One expects to find a critical point at the end of the chiral transition line at finite temperature and baryon chemical potential. To confirm and locate it, one will have to find signatures of critical behaviour in collision experiments.

Collision experiments inherently are dynamic in nature; therefore, one has to study the dynamics of critical phenomena.

Close to a critical point, different theories show the same universal behaviour. This allows us to gain meaningful insight without looking at full QCD. We use one-component ϕ^4 theory on the lattice and calculate spectral functions from real-time simulations. From those we extract relaxation times and the dynamic critical exponent z.

By introducing a coupling to a heat bath and an explicit symmetry breaking, we can force the system along Trajectories through its phase diagram. This then allows us to numerically study the non-equilibrium critical dynamics of a field theory.

HK 35.6 Mi 15:30 HS 12

Particle Production via Strings and Baryon Stopping in a Hadronic Transport Approach — •Justin Mohs[1,2,3], Sangwook Ryu[1], and Hannah Elfner[1,2,3] — [1]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [2]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany

The changing shape of the rapidity spectrum of net protons over the SPS energy range is still lacking theoretical understanding. A model for string excitation and string fragmentation is implemented in order to describe high energy interactions between hadrons within a hadronic transport approach. Free model parameters are tuned to match experimental data for proton-proton collisions. Using the fixed set of parameters we investigate baryon stopping in heavy ion collisions at SPS energies. The interaction of string fragments is of major importance for describing the stopping of baryons. Varying the influence of different parameters of the particle formation, such as formation time or cross section scaling factors, and comparing to experimental data might contribute to a better understanding of the formation process.

HK 36: Structure and Dynamics of Nuclei VI

Zeit: Mittwoch 14:00–16:00 Raum: HS 14

Gruppenbericht HK 36.1 Mi 14:00 HS 14

Investigation of the dipole response in atomic nuclei in different mass regions using photon scattering experiments — •J. Wilhelmy[1], P. Erbacher[2], J. Isaak[3], B. Löher[4], M. Müscher[1], D. Savran[4], P. Scholz[1], R. Schwengner[5], M. Spieker[6], W. Tornow[7], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]Goethe University of Frankfurt — [3]Institute for Nuclear Physics, TU Darmstadt — [4]GSI, Darmstadt — [5]HZDR, Dresden-Rossendorf — [6]NSCL, Michigan State University, USA — [7]Department of Physics, Duke University, USA

The nuclear γ-ray strength function (γ-SF) has great impact on reaction rates within nuclear synthesis processes. Level lifetimes, γ-decay branching ratios and parity quantum numbers of excited $J = 1$ states are extracted from high-resolution photon scattering experiments in a model-independent way. Results of complementary measurements with continuous photon flux distributions (at the bremsstrahlung facilities DHIPS [1] and γELBE [2]) and quasi-monoenergetic beams (at HIγS [3]) for nuclei in several mass regions will be presented and discussed within their systematics [4].

Supported by the BMBF (05P15PKEN9).

[1] K. Sonnabend *et al.*, NIM A **640** (2011) 6-12
[2] R. Schwengner *et al.*, NIM A **555** (2005) 211
[3] B. Löher *et al.*, NIM A **723** (2013) 136
[4] J. Wilhelmy *et al.*, Phys. Rev. C **98** (2018) 034315

HK 36.2 Mi 14:30 HS 14

Bestimmung von Paritätsquantenzahlen von Dipolzuständen des Isotops ^{142}Ce — •J. Sieber[1], T. Beck[1], S. Finch[2,3], U. Gayer[1], J. Isaak[1], R. Janssens[3,4], J. Kleemann[1], FNU Krishichayan[2,3], M. Müscher[5], O. Papst[1], N. Pietralla[1], D. Savran[6], W. Tornow[2,3], V. Werner[1] und J. Wilhelmy[5] — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]IKP, Universität zu Köln, Germany — [4]Department of Physics, Duke University, Durham, NC, USA — [5]Triangle Universities Nuclear Laboratory, Durham, NC, USA — [6]Department of Physics and Astronomy, University of North Carolina, Chapel Hill, NC, USA

Für die Untersuchung der niedrig-liegenden E1-Stärke unterhalb der Dipolriesenresonanz, wurde die Dipolstärkeverteilung von ^{142}Ce unterhalb der Neutronenseparationsschwelle vermessen. Zur Vervollständigung der vorhandenen Daten wurden die Paritätsquantenzahlen der dipolangeregten Kernzustände im Anregungsenergiebereich von 4 - 5 MeV mithilfe von azimuthaler Winkelverteilung in Kernresonanzfluoreszenz-Experimenten an der High Intensity γ-ray Source (HIγS) bestimmt. Damit konnte die E1-Stärke von ^{142}Ce zwischen 4 und 5 MeV eindeutig identifiziert werden. Die Datenanalyse und die Ergebnisse werden präsentiert und mit der Dipolstärkeverteilung von ^{140}Ce [1,2] verglichen.

*Gefördert durch die DFG im Rahmen des SFB1245.

[1] R.-D. Herzberg et al., PLB 390 (1997) 49.
[2] S. Volz et al., NPA 779 (2006) 1.

HK 36.3 Mi 14:45 HS 14

Dipole strength of ^{164}Dy below the neutron separation threshold — •O. Papst[1], V. Werner[1,2], N. Pietralla[1], T.

Beck[1], J. Beller[1], C. Bernards[2], M. Bhike[3,4], N. Cooper[2,5], B. P. Crider[6,7,8], U. Gayer[1], J. Isaak[1], J. Kleemann[1], FNU Krishichayan[3,4], B. Löher[1], F. Naqvi[2,7], E. E. Peters[6], F. M. Prados-Estevez[6], R. S. Ilieva[9], T. J. Ross[4], D. Savran[10], M. Scheck[1,11,12], W. Tornow[3,4], J. R. Vanhoy[5,13], S. W. Yates[5], and M. Zweidinger[1] — [1]IKP, TU Darmstadt — [2]WNSL, Yale University, New Haven, CT, USA — [3]TUNL, Durham, NC, USA — [4]Duke University, Durham, NC, USA — [5]UND, Notre Dame, IN, USA — [6]UKY, Lexington, KY, USA — [7]MSU, East Lansing, MI, USA — [8]MSU, Starkville, MS, USA — [9]UNIS, Guildford, UK — [10]GSI, Darmstadt — [11]UWS, Paisley, UK — [12]SUPA, Glasgow, UK — [13]USNA, Annapolis, MD, USA

Low-lying E1 strength in heavy nuclei is frequently addressed as a Pygmy Dipole Resonance and associated to a semi-collective neutron-skin oscillation. It can be expected to be sensitive to the nucleus' symmetry axes, separating into two parts for axially deformed nuclei (K-splitting). Data are sparse for such nuclei. In nuclear resonance fluorescence experiments conducted at the γ^3 setup at the High Intensity γ-ray Source (HIγS), the dipole strength above 4 MeV of the deformed nucleus ^{164}Dy was studied using a polarized, quasi-monochromatic γ-ray beam, such that E1 and M1 strengths can be discussed. Resulting average quantities are compared to statistical model calculations.

* Supported by the DFG, Collaborative Research Center 1245.

HK 36.4 Mi 15:00 HS 14

Investigation of the Pygmy Dipole Resonance in ^{120,124}Sn using the combined γ-ray and particle spectrometers CAGRA and Grand Raiden — •M. Weinert for the CAGRA-Collaboration — University of Cologne, Institute for Nuclear Physics, Germany

During the CAGRA+GR campaign in 2016, the magnetic spectrometer Grand Raiden at the RCNP in Osaka (Japan) has been used in combination with the clover-detector array CAGRA to study the excitation and decay behavior of the Pygmy Dipole Resonance (PDR) in various nuclei. Placing the Grand Raiden spectrometer at very forward angles, dipole excitations can be investigated with high sensitivity, while the CAGRA spectrometer observes the corresponding γ-decays with high efficiency. These types of experiments have already shown that the observed electric dipole response of atomic nuclei strongly depends on the excitation mechanism. A splitting of the states in the PDR region into at least two groups of states with different underlying isospin character has already been observed in other nuclei [1-3]. This contribution will present first results from the measurements of ^{120}Sn(α,α'γ)@130MeV and ^{124}Sn(p,p'γ)@80MeV from the CAGRA+GR campaign. A comparison of results from different experiments using complementary probes on these two nuclei will be given and possible evidence for an isospin splitting in ^{120}Sn will be discussed.

Supported by DGF (ZI 510/7-1 and SFB 1245).

[1] J. Endres *et al.*, Phys. Rev. C **85**, 064331 (2012)
[2] L. Pellegri *et al.*, Phys. Lett. B **738** (2014) 519
[3] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16

HK 36.5 Mi 15:15 HS 14

Multi-messenger investigation of the Pygmy Dipole Resonance in ^{140}Ce — •D. Savran[1], V. Derya[2], S. Bagchi[1,3], J. Endres[2], M.N. Harakeh[3], J. Isaak[4], N. Kalantar-Nayestanaki[3], E.G. Lanza[5], B. Löher[4], A. Najafi[3], S. Pascu[2,6], S.G. Pickstone[2], N. Pietralla[4], V.Yu. Ponomarec[4], C. Rigollet[3], C. Romig[4], M. Spieker[2], A. Vitturi[7,8], and A. Zilges[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Institut für Kernphysik, Universität zu Köln — [3]KVI-CART, University of Groningen, the Netherlands — [4]Institut für Kernphysik, TU Darmstadt — [5]INFN Sezione di Catania, Italy — [6]National Institute for Physics and Nuclear Engineering, Bucharest — [7]Dipartimento di Fisica e Astronomia Galileo Galilei, Universita di Padova, Italy — [8]INFN Sezione di Padova, Italy

Beside the Giant Dipole Resonance, many nuclei show the feature of additional low-lying electric dipole (E1) strength, which is usually denoted as Pygmy Dipole Resonance (PDR). Most of the available data has been obtained in photon induced reactions or coulomb excitation, which are, however, not sensitive to the structure of the E1 excitations. We have therefore started a campaign to provide additional experimental data using complementary probes or observables. For the semi-magic nucleus ^{140}Ce we combine the results from different experiments using proton, α as well as photon scattering in a multi-messenger investigation [1]. The results are presented and compared to calculations within the Quasi-particle Phonon Model.

[1] D. Savran et al., Phys. Lett. B 786 (2018) 16

HK 36.6 Mi 15:30 HS 14

Studying the Pygmy Dipole Resonance in ^{90}Zr in a (p,p'γ) experiment — •M. Steffan, A. Bohn, V. Everwyn, M. Färber, F. Kluwig, M. Müscher, S. G. Pickstone, S. Prill, P. Scholz, M. Weinert, J. Wilhelmy, and A. Zilges — University of Cologne, Institute for Nuclear Physics, Germany

This talk will present experimental data of a proton scattering experiment on ^{90}Zr which was performed at the combined setup SONIC@HORUS in the energy region of the Pygmy Dipole Resonance [1]. The 10MV FN Tandem accelerator delivered a 15 MeV proton beam to the particle-γ coincidence spectrometer. The coincident detection of scattered protons and γ-rays allows the determination of branching ratios and, thus, extends the knowledge on the $J^\pi = 1^-$ states of ^{90}Zr previously identified by nuclear resonance fluorescence measurements [2]. For this a comparison to NRF data will be given, including the excitation behavior of both methods. Furthermore, aspects of the experimental procedure and their impact on observations will be discussed.

Supported by DFG (ZI 501/7-1). AB and MS are supported by the Bonn Cologne Graduate School of Physics and Astronomy.

[1] D. Savran, T. Aumann, A. Zilges, Prog. Part. Nucl. Phys. **70** (2013) 210
[2] R. Schwengner *et al.*, Phys. Rev. C **78** (2008) 064314

HK 36.7 Mi 15:45 HS 14

Probing pygmy mode inhibition by the nuclear deformation in stable Ge Isotopes — •Nadia Benouaret[1], Ronald Schwengner[2], Daniel Bemmerer[2], Ronald Beyer[2], Arnd Junghans[2], and Andreas Wagner[2] — [1]University of Sciences and Technologie USTHB, 16111Alger, Algeria — [2]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden

In a previous Nuclear Resonance Fluorescence (NRF) Experiment on the low-lying dipole response in the stable isotope ^{74}Ge near the neutron threshold, no significant enhancement of dipole strength has been observed [1]. This extra strength denoted as Pygmy resonance on the low energy tail of the isovector Giant dipole resonance impacts the radiative rapid neutron capture rates in astrophysical environment.

The spherical ^{70}Ge (Q=0.04 b) being from the same isotopic chain as ^{74}Ge is a good candidate to check whether this behavior in ^{74}Ge is linked to its nuclear deformation (Q=-0.19 b). We present preliminary Results on ^{70}Ge from an NRF Experiment carried out at the γELBE Bremsstrahlung facility (HZDR). The dipole transition distribution shows a significant enhancement of the dipole strength forming a resonance-like structure just below the neutron threshold $S_n = 11.5MeV$ in comparison to that observed previously in ^{74}Ge. This is quite surprising since as pointed before the strength should increase with the neutron number. This finding may provide a hint to the deformation which inhibits the Pygmy mode excitation.

[1] R. Massarczyk et al., Phys. Rev. C 92, 044309 (2015).

HK 37: Structure and Dynamics of Nuclei VII

Zeit: Mittwoch 14:00–16:00 Raum: HS 16

Gruppenbericht HK 37.1 Mi 14:00 HS 16

Behavior of the collective rotor in wobbling motion — •Qibo Chen[1], Egor Streck[1], Norbert Kaiser[1], and Ulf-G. Meissner[2,3,4] — [1]Physik-Department, Technische Universität München, D-85747 Garching, Germany — [2]Helmholtz-Institut für Strahlen- und Kernphysik and Bethe Center for Theoretical Physics, Universität Bonn, D-53115 Bonn, Germany — [3]Institute for Advanced Simulation, Institut für Kernphysik, Jülich Center for Hadron Physics and JARA-HPC, Forschungszentrum Jülich, D-52425 Jülich, Germany — [4]Ivane Javakhishvili Tbilisi State University, 0186 Tbilisi, Georgia

In recent years, the investigation of wobbling motion of triaxially de-

formed nuclei has become one of hottest topics in nuclear structure physics. In our work [1], the behavior of the collective rotor in wobbling motion is investigated within the particle-rotor model for ^{135}Pr by transforming the rotational wave functions from the K-representation to the R-representation. The evolution of the wobbling mode in ^{135}Pr, from transverse at low spins to longitudinal at high spins, is illustrated by the azimuthal plot. The coupling schemes of the angular momenta of the rotor ($\vec{R}$) and the high-j particle ($\vec{j}$) for transverse and longitudinal wobbling are obtained from the analysis of R-plots and K_R-plots.

Work supported by CRC 110 (DFG Grant No. TRR110 and NSFC Grant No. 11621131001), CAS PIFI (Grant No. 2018DM0034), and by VolkswagenStiftung (Grant No. 93562).

[1] E. Streck, Q. B. Chen, N. Kaiser, and Ulf-G. Meißner, Phys. Rev. C 98, 044314 (2018).

HK 37.2 Mi 14:30 HS 16

Weak decays within an effective theory — •Catharina Brase[1,2], Eduardo A. Coello Pérez[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We explore Gamow-Teller and forbidden β decays within an effective theory. In the effective theory, nuclei are described as spherical cores coupled to a neutron and/or proton, depending on the nucleus of interest. We calculate the matrix elements for β decays into low-lying states of the daughter nucleus and estimate the associated theoretical uncertainty based on the power counting and Bayesian methods. Our results for Gamow-Teller and unique first-forbidden β decays are in good agreement with experiment within the estimated uncertainties.

*This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Projektnummer 279384907 – SFB 1245.

HK 37.3 Mi 14:45 HS 16

Electroweak currents from chiral EFT in few-nucleon systems — •Rodric Seutin[1,2,3], Sebastian König[1,2], Kai Hebeler[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

Using chiral EFT one is able to construct current operators at the many-body level. As a result of this, it is guaranteed that the current operators can be evaluated consistently with the appropriate nuclear wave functions, obtained as well from chiral interactions. This consistency is a key advantage of the EFT framework. In this talk, we discuss the development of electroweak currents in few-nucleon systems and their applications to electromagnetic form factors as well as electroweak transitions in light nuclei. In particular we look at triton and helium-3.

* This work is supported by the IMPRS-PTFS and the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Projektnummer 279384907 - SFB 1245.

HK 37.4 Mi 15:00 HS 16

Probing novel nuclear forces with the IM-SRG — •Jan Hoppe[1,2], Kai Hebeler[1,2], Achim Schwenk[1,2,3], and Johannes Simonis[4] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Institut für Kernphysik and PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

We apply consistent nucleon-nucleon plus three-nucleon interactions at N^{3}LO in chiral effective field theory with realistic saturation properties in the in-medium similarity renormalization group. To this end we use three-nucleon forces fitted within a new Monte-Carlo framework to saturation properties and the triton binding energy. We present results for ground-state energies as well as charge radii of closed- and open-shell nuclei, with the goal to explore connections between predictions for finite nuclei and nuclear-matter properties. We further investigate this by the impact of variations of the low-energy constants on our results.

*This work was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Projektnummer 279384907 - SFB 1245 and the ERC Grant No. 307986 STRONGINT.

HK 37.5 Mi 15:15 HS 16

Derivation of a density-dependent in-medium NN interaction from subleading chiral three-nucleon forces — •Bhawani Singh and Norbert Kaiser — Technische Universität München

We derive from the subleading contributions from the chiral three-nucleon force (in particular the long-range terms) a density-dependent two-nucleon interaction V_{med} in isospin-symmetric nuclear matter. The contributions to V_{med} are derived from the topologies of 3N-diagrams ($1\pi1\pi$-exchange, $1\pi2\pi$-exchange, the ring diagrams) by joining an out-going nucleon line to another in-going nucleon line or by closing a nucleon line to a loop independent with the implementation of the medium insertion.
The momentum and k_f-dependent potentials associated with the isospin operators $(1, \vec{\tau}_1 \cdot \vec{\tau}_2)$ and five spin structures are expressed in terms of loop functions which are either given in closed analytical from or require at most one numerical integration.
Our results for V_{med} are most helpful to implement subleading chiral 3N forces into nuclear many-body calculations.
Work supported in part by DFG, NSFC (CRC110) and The Tata Trusts.

HK 37.6 Mi 15:30 HS 16

Energy-density functionals from local chiral interactions — •Lars Zurek[1,2], Eduardo Antonio Coello Pérez[1,2], and Achim Schwenk[1,2,3] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We employ the density-matrix expansion introduced by Negele and Vautherin and further developed by Gebremariam et al. in order to rewrite one-body density matrices in terms of local densities and their derivatives. The resulting approximations for the density matrices are applied to calculate energy-density functionals at the Hartree-Fock level based on local interactions derived from chiral effective field theory. The accuracy of this approach is investigated and analyzed for various approximations and choices in the density-matrix expansion.

* Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Projektnummer 279384907 - SFB 1245.

HK 37.7 Mi 15:45 HS 16

Extraction of nuclear parameters from spectra of heavy muonic atoms — •Niklas Michel, Natalia S. Oreshkina, and Christoph H. Keitel — Max Planck Institute for Nuclear Physics, Heidelberg, Germany

We consider bound states between an atomic nucleus and a muon, so called muonic atoms. Such systems can be considered as hydrogen-like and therefore the spectra can be predicted with high accuracy [1,2]. Just as in common electronic atoms, there is fine and hyperfine splitting, but the significance of the various contributions differs dramatically. In particular, nuclear structure effects can scale up to 50% of the binding energy, and vacuum polarization effects due to virtual electron-positron pairs are larger than all other corrections from quantum electrodynamics. We calculate the level structure in heavy muonic atoms and analyze the dependence on nuclear parameters like quadrupole moments and RMS charge radii. In connection with recent experiments performed by the muX Collaboration, we discuss the extraction of nuclear parameters from measured x-ray spectra of muonic atoms.

[1] N. Michel, N. S. Oreshkina, C. H. Keitel, Phys. Rev. A 96, 032510
[2] N. Michel, N. S. Oreshkina, arXiv:1809.06623

HK 38: Nuclear Astrophysics III

Zeit: Mittwoch 14:00–15:45 Raum: HS 18

Gruppenbericht HK 38.1 Mi 14:00 HS 18

Direkte Reaktionen für die Astrophysik — •Philipp Erbacher, Lukas Bott, Benjamin Brückner, Stefan Fiebiger, Kathrin Göbel, Tanja Heftrich, Christoph Langer, Markus Reich, René Reifarth, Zuzanna Slavkovská, Benedikt Thomas, Meiko Volknandt, Kafa Khasawneh, Deniz Kurtulgil, Fabian Hebermehl, Sabina Krasilovska, Ozan Dogan, Christian Schwarz und Mario Weigand — Goethe-Universität Frankfurt a. M., Germany

Die Häufigkeitsverteilung der Elemente im Sonnensystem bildet einen Forschungsschwerpunkt der Nuklearen Astrophysik. Für das Verständnis der zugrunde liegenden Nukleosynthese in Sternen werden Daten über eine Vielzahl von Reaktionsraten benötigt. Sukzessive Neutroneneinfänge und Betazerfälle in Sternen verschiedener Stadien erzeugen die Elemente schwerer als Eisen. Dabei sind für den s-Prozess vor allem die Maxwell-gemittelten Neutroneneinfangsquerschnitte bei Temperaturen von 25 keV und 90 keV von Interesse. Eine etablierte Methode zur Erzeugung eines 25 keV Maxwell-Boltzmann-Spektrums ist die Reaktion ^{7}Li(p,n) bei einer Protonenenergie von E_{p}=1912 keV.
Wir haben eine Methode entwickelt um ein Maxwell-Boltzmann Spektrum bei 90 keV und höheren Energien mit der Reaktion ^{7}Li(p,n) zu reproduzieren. Der Beitrag stellt die Methode vor und zeigt erste Ergebnisse für 25 keV und 90 keV.
Gefördert durch: DFG-Projekt GAIN (RE 3461/4-1)

HK 38.2 Mi 14:30 HS 18

Messung der Neutronentransmission von ^{20}Ne an ELBE — •Erik Borris[1], Roland Beyer[3], Toni Kögler[3], Sebastian Urlass[3], Jan Glorius[2], Arnd Junghans[3], Axel Frotscher[3], Marcel Grieger[3], Daniel Bemmerer[3], Daniel Veltum[1], Mario Weigand[1], Joachim Görres[4], Rene Reifarth[1] und Hye Young Lee[5] — [1]Goethe Universität Frankfurt — [2]GSI Helmholtzzentrum f. Schwerionenforschung — [3]Helmholtzzentrum Dresden Rossendorf — [4]University of Notre Dame — [5]Los Alamos National Laboratory

Aufgrund der hohen Häufigkeit des ^{16}O Isotopes während des schwachen s-Prozesses, kommt es durch die Reaktion ^{16}O(n,γ)^{17}O dabei vermehrt zu Neutroneneinfängen. Im darauffolgenden Reaktionspfad entscheidet das Verhältnis der Reaktionen ^{17}O(α,γ) zu ^{17}O(α,n)^{20}Ne, ob die vorher eingefangenen Neutronen an ^{16}O wieder frei gesetzt werden können oder endgültig nicht mehr zur Nukleosynthese der schweren Elemente zur Verfügung stehen. Entsprechend müssen beide Reaktionen an ^{17}O gut bekannt sein. Um die Reaktionsrate von ^{17}O(α,n)^{20}Ne besser zu verstehen und um mögliche niedrig-liegende Resonanzen aufzulösen, wurde eine hochaufgelöste Neutronentransmissionsmessung am ^{20}Ne durchgeführt. Dabei wird derselbe Zwischkern, ^{21}Ne, bevölkert. Das Experiment fand am nELBE Elektronenbeschleuniger statt. In dieser Studie wurde die Neutronentransmission an einer mit natürlichem Neon gefüllten Gaszelle im Energiebereich von 0.5 bis 1.5 MeV durch die Flugzeitmethode untersucht.

HK 38.3 Mi 14:45 HS 18

Measurement of ^{69,71}Ga(n,g) at astrophysical energies using time of flight — •D. Kurtulgil[1], K. Göbel[1], S. Fiebiger[1], F. Käppeler[2], C. Lederer-Woods[3], S.-J. Lonsdale[3], R. Reifarth[1], M. Weigand[1], and P. Woods[3] for the nTOF-Collaboration — [1]Goethe University Frankfurt, Germany — [2]Karlsruhe Institute of Technology, Karlsruhe, Germany — [3]University of Edinburgh, Edinburgh, United Kingdom

The origin of elements heavier than iron in stellar nucleosynthesis can in large parts be explained by neutron capture reactions, namely the r- and s-process. In order to reproduce the observed isotopic abundances in nucleosynthesis simulations, an exact knowledge of the involved reaction rates at astrophysical energies is necessary.

The stable isotopes ^{69}Ga and ^{71}Ga play an important role in the weak s-process, but experimental data for these reactions are scarce.

The cross-section of neutron capture onto isotopically enriched ^{69}Ga and ^{71}Ga samples was measured at the n_TOF experiment's EAR1 beamline at CERN, Geneva, using the time of flight technique to cover a neutron energy range of eV to several hundred keV.

We will present the current status of the analysis.

This project is supported by DFG (RE 3461/4-1), HGS-HIRe and HIC for FAIR.

HK 38.4 Mi 15:00 HS 18

Investigation of total cross sections of the ^{93}Nb(p,γ)^{94}Mo reaction — •M. Müller, F. Heim, E. Hoemann, M. Körschgen, J. Mayer, P. Scholz, and A. Zilges — Institute for Nuclear Physics, University of Cologne

The nucleosynthesis of p-nuclei is an important field of research in the area of nuclear astrophysics and a lot of questions remain unanswered. One example is the observed relative abundance of the ^{94}Mo nucleus, which is higher than the predicted one by orders of magnitude [1]. To extend experimental data, total cross sections of the ^{93}Nb(p,γ)^{94}Mo reaction have been measured at three beam energies between 3 MeV and 4.5 MeV. The measurements have been performed using the HORUS γ-spectrometer consisting of up to 14 high purity germanium detectors [2]. The beam was provided by the 10 MV FN Tandem accelerator, located at the University of Cologne's Institute for nuclear physics.
Preliminary results and their comparison to Hauser Feshbach statistical model calculations will be presented [3].

Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy.

[1] M. Arnould and S. Goriely, Phys. Rep. **384**, 1 (2003).
[2] L. Netterdon *et al.*, Nucl. Instr. Meth. **754**, 94 (2014).
[3] W. Hauser and H. Feshbach, Phys. Rev. **87**, 366 (1952).

HK 38.5 Mi 15:15 HS 18

Investigating total and partial cross sections of the ^{107}Ag(p,γ)^{108}Cd reaction — •F. Heim, M. Körschgen, J. Mayer, M. Müller, P. Scholz, and A. Zilges — University of Cologne, Institute for Nuclear Physics

For many nucleosynthesis processes in various astrophysical scenarios cross sections and reaction rates need to be predicted by statistical model calculations. One of those processes is the γ process, which plays an important role in the nucleosynthesis of the majority of the p nuclei. The calulated values depend heavily on nuclear physics input-parameters like nuclear level densities (NLD), γ-ray strength functions (γ-ray SF) and nucleon+nucleus optical model potentials (OMPs). Precise cross-section measurements at astrophysical energies can be used to test and validate microscopic theoretical approaches for these nuclear physics models. For this reason, total and partial cross-sections of the ^{107}Ag(p,γ)^{108}Cd reaction were measured via the in-beam method at the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne. Proton beams with energies between 2.0 and 5.0 MeV were provided by the 10 MV FN-Tandem accelerator. Microscopic models for the NLD and γ-ray SF have been adjusted in a way, that they do not only agree with the total and partial cross-section results but also preserve physical reliability.
Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy.

HK 38.6 Mi 15:30 HS 18

Investigation of (α,γ) reaction cross sections of ruthenium isotopes — •M. Koerschgen, F. Heim, E. Hoemann, J. Mayer, M. Mueller, P. Scholz, and A. Zilges — Institute for Nuclear Physics, University of Cologne

Photodesintegration networks are one of the main processes in the nucleosynthesis of p-nuclei. Especially (γ,α) reactions play a crucial role in the production of the heaviest p-nuclei [1]. Practically they are obtained by the measurement of inverse (α,γ) reaction cross sections at sub coulomb energies and statistical model calculations. The latter requires fundamental knowledge of optical model potentials (OMPs), nuclear level densities (NLDs) and the γ-ray strength functions (γ-ray SFs).
This talk will cover a project aiming to measure (α,γ) reaction cross sections on ruthenium isotopes applying the 4π summing method [2]. The measurements take place at the Dynamitron Tandem Laboratorium of the Ruhr-Universität Bochum, Germany, using a 12 by 12 inch NaI(Tl) crystal.
This work is supported by the DFG (ZI-510/8-1).
[1] M. Arnould and S. Goriely, Phys. Rep. **384** (2003) 1.
[2] A. Spyrou, H.W. Becker, A. Lagoyannis, S. Harrisopulos, and C. Rolfs, Phys. Rev. C **76** (2007) 1.

HK 39: Instrumentation VIII

Zeit: Mittwoch 14:00–15:45 Raum: HS 11

Gruppenbericht HK 39.1 Mi 14:00 HS 11

The PANDA DIRC Detectors — •Ilknur Koseoglu for the PANDA-Collaboration — JLU Giessen, Giessen, Germany — GSI, Darmstadt, Germany

The PANDA experiment at the new Facility for Antiproton and Ion Research (FAIR) near Darmstadt/Germany is planned to investigate fundamental questions of hadron physics. The PANDA detector is designed as a fixed-target experiment by using antiproton beam with a momentum range of 1.5 to 15 GeV/c colliding on a hydrogen or nuclear target. In order to achieve excellent particle identification (PID), two DIRC detectors have been developed. The Barrel DIRC will cover the polar angles from 22°-140° and perform π/K separation with 3 σ or more for momenta from 0.5 to 3.5 GeV/c. The design of the Barrel DIRC is based on the successful BaBar DIRC and the SuperB FDIRC R&D with several improvements to optimize the performance for PANDA. The novel Endcap Disc DIRC (EDD) will cover the polar angle range from 5° to 22° and will provide π/K separation up to 4 GeV/c with a separation power of about 3 σ. Both PANDA DIRC use synthetic fused silica bars or plates as radiators and lightguides and lifetime-enhance Microchannel Plate PMTs (MCP-PMTs) as sensors. The Cherenkov radiator for the EDD is a 2 cm thin plate of synthetic fused silica, divided into 4 identical quadrants. In order to conserve the Cherenkov angle during propagation, the surfaces of the 4 quadrants are polished with high precision. The technical design of the two DIRC detectors and the results of beam tests at CERN for two prototypes will be presented.

HK 39.2 Mi 14:30 HS 11

Prototype test for the PANDA Barrel DIRC — Ahmed Ali[1,2], Anastasios Belias[1], •Roman Dzhygadlo[1], Andreas Gerhardt[1], Dorothe Lehmann[1], Klaus Peters[1,2], Georg Schepers[1], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

The Barrel DIRC (Detection of Internally Reflected Cherenkov light) detector will be an essential part of the hadronic PID system of the PANDA experiment at GSI, Darmstadt. Covering the polar angle range of 22-140 degrees, it will provide pion-kaon separation power of at least 3 standard deviations for a charge particle momenta between 0.5 GeV/c and 3.5 GeV/c.

The design of the Barrel DIRC features the narrow bar radiator made from synthetic fused silica, a complex multi-layer spherical lens focusing system, a prism-shaped fused silica expansion volume, and MCP-PMTs (MicroChannel-Plate PhotoMultiplier Tubes) to detect the location and arrival time of the Cherenkov photons. All components were tested and successfully validated with a sophisticated prototype in a mixed hadron particle beam at CERN during 2015-2017. Additional test was conducted at CERN in 2018 with a purpose to optimize the number of used MCP-PMTs. Result of the optimization with the analysis and a comparison to the Geant4 simulation will be presented.

HK 39.3 Mi 14:45 HS 11

Performance of most advanced 2-inch MCP-PMT tubes from PHOTONIS and Hamamatsu — •Markus Pfaffinger, Merlin Böhm, Steffen Krauss, Albert Lehmann, Daniel Miehling, Márton Németh-Csóka, Nico Schwarm, and Samuel Stelter — Physikalisches Institut , Universität Erlangen-Nürnberg

The $\bar{\text{P}}$ANDA experiment at the new FAIR facility will use two DIRC detectors for particle identification. The focal plane of both detectors will be located inside a magnetic field of >1 Tesla. Microchannel-Plate Photomultipliers (MCP-PMTs) are the favored sensors for the detection of the Cherenkov photons.

Coating the MCPs with an atomic layer deposition (ALD) technique has increased the lifetime of MCP-PMTs more than a factor of 50 making them durable enough to be used in high luminosity experiments like $\bar{\text{P}}$ANDA. The performance of the most recent lifetime-enhanced tubes from PHOTONIS (XP85112/A1-Q-HA 9002108) and Hamamatsu (R13266-07-M64M YH0250) have been tested in Erlangen. The results concerning QE, gain, time resolution, rate capability, darkcount rate, afterpulsing and crosstalk will be discussed in this talk.

These sensors have meanwhile also been included in the Erlangen lifetime setup where their quantum efficiency (QE) is monitored in correlation with the integrated anode charge (IAC). The lifetime performance of both new devices will be compared to other lifetime-enhanced MCP-PMTs measured with the same setup.

- Funded by BMBF and GSI -

HK 39.4 Mi 15:00 HS 11

Evaluation und Qualifikation optischer Filter für den PANDA Endcap Disc DIRC — •Lisa Brück, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, Ilknur Köseoğlu, Mustafa Schmidt, Marc Strickert, Simon Bodenschatz, Jan Niclas Hofmann, Sophie Kegel und Jhonathan Pereira de Lira für die PANDA-Kollaboration — Justus Liebig-Universität Gießen, II.Physikalisches Institut, Gießen

Der Endcap Disc DIRC Detektor für das PANDA Experiment nutzt den Cherenkov-Effekt zur Identifikation von geladenen Teilchen. Zur Verbesserung der Auflösung des Detektors, welche maßgeblich durch chromatische Dispersion beeinflusst wird, sollen im finalen Detektor optische Filter, die bestimmte Wellenlängen der Cherenkov Photonen herausfiltern, eingesetzt werden. Die Filter müssen dabei hohe Anforderungen an den Transmissionsgrad der Photonen und die Strahlungshärte erfüllen. In diesem Zusammenhang wurden diverse Filter getestet und qualifiziert.

HK 39.5 Mi 15:15 HS 11

DIRC detector upgrade for the GlueX experiment — •Ahmed Ali[1,2], Roman Dzhygadlo[1], Klaus Peters[1,2], Jochen Schwiening[1], and Carsten Schwarz[1] for the GlueX-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

The upgrade of the GlueX experiment at Jefferson Lab with a DIRC (Detection of Internally Reflected Cherenkov light) counter will significantly improve the particle identification (PID) capabilities in the forward region of the detector by providing clean π/K separation for momenta up to 4 GeV/c. The GlueX DIRC combines four bar boxes from the decommissioned BaBar DIRC detector with new compact photon cameras based on the SuperB FDIRC concept. Two reconstruction algorithms were developed to optimize the hadronic PID performance. Benchmark physics channels of cleanly identified exclusive events will be used for DIRC performance studies. The DIRC counter will be installed into the GlueX experiment during the winter 2018/2019 shutdown and commissioned with beam in February 2019. We will discuss the status of the GlueX DIRC detector and first impressions from the commissioning run.

HK 39.6 Mi 15:30 HS 11

Ein Cosmic-Teststand für die Entwicklung des Endcap Disc DIRC Detektors — •Jhonatan Pereira de Lira, Simon Bodenschatz, Lisa Brück, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, Jan Niclas Hofmann, Sophie Kegel, Ilknur Köseoğlu, Mustafa Schmidt und Marc Strickert für die PANDA-Kollaboration — "Justus-Liebig-Universität Gießen, II.Physikalisches Institut, Gießen"

Der Endcap Disc DIRC (EDD) ist ein Cherenkov-Detektor, der derzeit in Gießen von der AG Düren entwickelt wird. Dieser Detektor wird zukünftig in Darmstadt im PANDA-Experiment eingesetzt und wurde dafür entworfen, Pionen und Kaonen die diesen Detektor mit Impulsen von bis zu 4 GeV/c in einem Polarwinkelbereich von 5° und 22° durchqueren, mit einer Separation-Power von drei Standardabweichungen zu identfizieren. Mit Hilfe von Monte-Carlo-Simulationen wurden verschiedene Konfigurationen und Materialien für den EDD untersucht und deren Ergebnisse mit Tests an Prototypen im CERN und im DESY bestätigt. Um Tests des EDDs flexibler und nicht nur an externen Beschleunigeranlagen durchführen zu können, wird zurzeit ein Teststand aufgebaut, der die myonische Komponente der sekundären kosmischen Strahlung zunutze macht. Dieser Vortrag umfasst einerseits den Aufbau des Cosmic-Teststandes und andereseits die aktuellen Ergebnisse die mit Monte-Carlo-Simulationen erhalten wurden.

HK 40: Hadron Structure and Spectroscopy VI

Zeit: Mittwoch 16:30–18:30 Raum: HS 13

Gruppenbericht HK 40.1 Mi 16:30 HS 13

The quark-mass dependence of light meson masses and decay constants — •Xiao-Yu Guo[1] and Matthias F.M. Lutz[1,2] — [1]GSI Helmholtzzentrum, Planckstr. 1, 64291 Darmstadt, Germany — [2]Technische Universität Darmstadt, D-64289 Darmstadt, Germany

We study the dependence of light meson masses and decay constants on the up, down and strange quark masses. The role of dynamical vector meson degrees of freedom is scrutinized in terms of an effective chiral Lagrangian based on the hadrogenesis conjecture. It is illustrated that an order-by-order renormalizable effective field theory arises once specific conditions on the low-energy constants are imposed. At the one-loop level, we derive the chiral corrections to the self-energies of the Goldstone bosons and vector mesons as well as the decay constants of the Goldstone bosons. According to the chiral formula, we scrutinize QCD lattice data on the masses of the light vector mesons from PACS-CS, QCDSF-UK and HSC. Particular attention is paid to the $\omega - \phi$ mixing phenomenon, which is demonstrated to show a strong mass dependence. Applying the low-energy constants determined accordingly, further implications are computed on the pion and kaon decay constants for QCD lattice ensembles of HPQCD, CLS and ETMC. The dynamical vector mesons lead to significant impact on the evaluation of Gasser and Leutwyler's LECs.

HK 40.2 Mi 17:00 HS 13

Toplogical effect for three-particle problems in a box — •Martin Ebert[1] and Hans-Werner Hammer[1,2] — [1]IKP, TU Darmstadt — [2]EMMI, GSI Darmstadt

The binding energy of bosonic three-particle systems in a box is investigated with an effective field theory. The finite volume corrections to the binding energy are calculated perturbatively in inverse powers of box size L. Besides the effect described by Lüscher [1], special interest is given to the influence of the topological effect [2]. It describes the possibility of a composite particle leaving the finite volume through periodic boundaries. We show that this effect can be neglected at LO and becomes important at NLO. The analytic results are compared to numerical calculations analogous to [3].

* Supported by HGS-HIRe.

[1] M. Lüscher, Nucl. Phys. B 354, 531 (1991)
[2] S. Bour *et al.*, Phys. Rev. D 84, 091503 (2011)
[3] M. Döring *et al.*, Phys. Rev. D 97, 114508 (2018)

HK 40.3 Mi 17:15 HS 13

Monte Carlo acceptance studies of the diffractive production of the $\eta^{(\prime)}\pi^-$ system at COMPASS — •Henri Pekeler, Mikhail Mikhasenko, Waldemar Renz, Mathias Wagner, and Bernhard Ketzer for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The diffractive production of the $\eta^{(\prime)}\pi^-$ system in the $p\pi^- \to \eta^{(\prime)}\pi^- p'$ channel is very exciting because the partial wave with orbital angular momentum $L = 1$ between the two pseudoscalars carries spin-exotic quantum numbers $J^{PC} = 1^{-+}$. The observation of a resonance in this wave is considered a smoking gun for a hybrid meson with gluonic degrees of freedom.

For the partial-wave analysis, a precise knowledge of the acceptance of the apparatus is essential. At COMPASS, there exists a new GEANT4-based simulation framework, which needs to be validated for the given processes. In addition to the correct geometric description of the COMPASS experiment, the responses of the recoil proton detector, the tracking system and the electromagnetic calorimeters have been investigated. For the production of the large Monte Carlo data sample, BlueWaters, one of the most powerful supercomputers in the world, located at the University of Illinois campus in Champaign, is used. In the talk, I will present the validation of the Monte Carlo chain and discuss the multi-dimensional acceptance deduced therewith.

Supported by BMBF.

HK 40.4 Mi 17:30 HS 13

Hadronic decays of the excited pseudoscalar glueball, hybrid mesons and charmonium states — •Walaa Eshraim[1], Stefan Schramm[2], Christian Fischer[3], and Francesco Giacosa[4] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Str. 1, D 60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Goethe University, Ruth-Moufang-Str. 1, D 60438 Frankfurt am Main, Germany — [3]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, 35392 Giessen, Germany — [4]Institute of Physics, Jan Kochanowski University, ul. Swietokrzyska 15, 25-406 Kielce, Poland.

We study three different chiral Lagrangians that describe the two- and three-body decays of an excited pseudoscalar glueball, $J^{PC} = 0^{*-+}$, into light mesons and charmonium states as well as into a scalar and pseudoscalar glueball. We compute the decay channels for an excited pseudoscalar glueball with a mass of 3.7 GeV and consider a ground state pseudoscalar glueball of mass 2.6 GeV, following predictions from lattice QCD simulations. Furthermore, we enlarge the extended Linear Sigma Model (eLSM) by including nonets of low-lying hybrids in a chiral invariant frameowrk. Then, we predict the masses and decay modes of the (lightest) hybrid states in the framework (eLSM). Moreover, we calculate the two- and three-body decays of the ground-state (pseudo-)scalar charmonia η_c and χ_{c0} in the framework of a $U(4)_r \times U(4)_l$ symmetric linear sigma model with (pseudo-)scalar and (axial-) vector mesons.

HK 40.5 Mi 17:45 HS 13

Coupled partial wave analysis of two-photon reactions at BESIII — •Meike Küssner — Institut für Experimentalphysik I, Ruhr-Universität Bochum

The BESIII experiment at the BEPCII electron-positron collider in Beijing offers excellent opportunities to study two-photon reactions, due to the numerous high statistics data samples which were recorded at center of mass energies between $\sqrt{s} = 2 - 4.6$ GeV.
Decades ago, particles that consist solely of gluons, so-called glueballs, have been predicted from theory. According to present knowledge, lattice-QCD predicts several glueball candidates in the mass range of light mesons between 1.5 and 4 GeV/c^2. Studying the nature of light mesons in two-photon decays, offers indirect information of their gluonic content and acts as a glueball filter. However, it turns out that experimental identification of glueballs is often ambiguous due to the mixing of glueballs with ordinary mesons and interference.
In this analysis a coupled partial wave analysis will be used to disentangle these ambiguities. Besides a discussion of the performed data selection, preliminary results of the performed partial wave analysis will be presented as well as future perspectives.

Supported by DFG (FOR 2359)

HK 40.6 Mi 18:00 HS 13

Study of Light Mesons in Two-Photon Interactions at BESIII — •Jiaqi Li — Ruhr-Universität Bochum, Germany

The BESIII experiment at the symmetric electron-positron collider BEPCII in Beijing has recorded large data samples at center of mass energies between 2 and 4.6 GeV. The experiment is well suited to study the production of light mesons in two-photon interactions.

Two-photon physics provides an excellent opportunity to study light mesons with quantum numbers such as $0^{\pm+}$ and $2^{\pm+}$. The $\gamma\gamma$ width of resonances can be determined from two-photon processes, which is an important measurement to understand the nature of some resonances like $a_2(1320)$ and $\eta(1405)$, which are discussed to be exotic particles.

Recent results and future prospects will be presented in this contribution.

This work is supported by the DFG (FOR 2359).

HK 40.7 Mi 18:15 HS 13

Insights into the spin-exotic $\pi_1(1600)$ meson — •Fabian Krinner for the COMPASS-Collaboration — Technische Universität München - Physik Department - E18

The COMPASS experiment is a two-stage multi-purpose spectrometer. One of its main goals is the study of the light-meson spectrum. The flagship channel is the diffractive process $\pi^- p \to \pi^-\pi^+\pi^- p$, for which COMPASS has collected a large data sample of 46×10^6 events.

One focus of our analysis lies on mesons that have spin-exotic quantum numbers forbidden for $q\bar{q}$ states. The controversial $\pi_1(1600)$ with $J^{PC} = 1^{-+}$ quantum numbers is a prominent example. To search for this state, a detailed partial-wave analysis (PWA) was performed on

the collected data employing a novel method, called freed-isobar PWA. This method not only reduces potential model bias of the PWA and but also allows us to study the dynamic amplitudes of the 2π subsystems with well-defined J^{PC} quantum numbers in the 3π final state. Using the freed-isobar PWA, we have studied the $J^{PC} = 1^{-+}$ wave with unprecedented level of detail and dimensionality.

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 Universtiät und der Technischen Universität München.

HK 41: Heavy-Ion Collisions and QCD Phases VIII

Zeit: Mittwoch 16:30–18:30 Raum: HS 15

Gruppenbericht HK 41.1 Mi 16:30 HS 15

Two-Pion Intensity Interferometry in Collisions of Au+Au @ 1.23AGeV — •Robert Greifenhagen[1,2] and Roland Kotte[1] for the HADES-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

The HADES apparatus provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron and hadron production in heavy-ion collisions with unprecedented precision. With the high statistics of seven billion Au-Au collisions at 1.23 AGeV, the investigation of collective effects and particle correlations is possible with so far unrivalled accuracy.

We present results on identical pion intensity interferometry (HBT) with substantial charge sign difference. Our data allow access to the dependence of the pion emitting source on both the pair transverse momentum and the collision centrality. Comparing our femtoscopic results at $\sqrt{s_{\mathrm{NN}}} = 2.4$ GeV to similar results achieved for heavy-ion collisions in a wide range of beam energies we see a very smooth evolution of the source parameters, contrary to the preexisting picture.

Furthermore, the high statistics measurements of flow coefficients for protons, deuterons and tritons are presented here. In addition to the directed (v1) and elliptic (v2) flow components also the higher coefficients v3 and v4 are investigated for the first time in this energy regime.

Together with the transverse momentum spectra of identified particles a consistent picture emerges which provides strong evidence for a substantial collective expansion already at these low beam energies.

HK 41.2 Mi 17:00 HS 15

Collective flow and correlation measurements with HADES in Au+Au collisions at 1.23 AGeV — •Behruz Kardan — Goethe-Universität, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron and hadron production in heavy-ion collisions with unprecedented precision. The high statistics measurements of flow coefficients for protons, deuterons and tritons in Au+Au collisions at 1.23 AGeV (performed with the HADES experiment at SIS18/GSI) are presented here. In addition to the directed (v1) and elliptic (v2) flow components also the higher coefficients v3 and v4 are investigated for the first time in this energy regime. All flow coefficients are studied multi-differential, i.e. as a function of transverse momentum pt and rapidity over a large region of phase space and for several intervals of reaction centrality. This provides the possibility to characterize the particle production in heavy-ion collisions as a full 3D-picture in momentum space and puts strong constraints on the determination of the properties of dense matter, such as its viscosity and equation-of-state (EOS). Information on radial flow can be obtained from the analysis of pion HBT-correlations and transverse momentum spectra of identified particles. We will present new results on these observables extracted from the HADES data and discuss their correlations. From these a consistent picture emerges which provides strong evidence for a substantial radial expansion already at these low beam energies.

Supported by BMBF (05P15RFFCA), HGS-HIRe and H-QM.

HK 41.3 Mi 17:15 HS 15

Probing initial state fluctuations by the directed flow of spectators with ALICE at the LHC — •Lukas Kreis for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg

Particles produced in relativistic heavy-ion collisions show azimuthally anisotropic transverse momentum distributions. They result from the initial spatial distributions of participant and spectator nucleons, which fluctuate from event to event, combined with a rapid transverse expansion. The interplay between the initial momentum transfer to spectator nucleons and the spatial profile of the energy density in the nuclei overlap region is reflected in the relation between anisotropies present in the spectator and participant region.
Previous measurements by ALICE at the LHC revealed a non-zero rapidity-even and odd directed flow and a weak correlation between participant and spectator symmetry planes. In this talk, the correlation of flow magnitude of the spectators and produced particles in Pb-Pb collisions recorded by ALICE is studied using the event-shape-engineering method.

HK 41.4 Mi 17:30 HS 15

Identified particle correlations at high $\mathbf{p}_T$ — •Lucia Anna Husova for the ALICE-Collaboration — Westfälische Wilhelms Universität, Münster, Germany

Due to high particle multiplicities produced in Pb-Pb collisions, it is difficult to reconstruct the low-energy jets in such a collision system. Instead the method of two-particle correlations can be used to study jet properties. This work reports results coming from two-particle correlations in pp collisions at 13 TeV collected at ALICE experiment at LHC, which can be used as basis for the same analysis by Pb-Pb collisions. Two-particle correlations were done with identified and unidentified trigger particles at high p_T up to 15 GeV/c. Strange V^0 particles K^0_S,Λ and $\bar{\Lambda}$ were chosen, because of their good reconstruction also at high p_T. The per trigger yield at near and away side was studied as a function of p_T trigger particle and the collision multiplicity. The dependace of the yield on the trigger particle at the near side will be discussed.

HK 41.5 Mi 17:45 HS 15

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

The Quark-Gluon Plasma, a state of matter in which quarks and gluons are deconfined from nuclei, is produced in the early stages of our universe and also in ultra-relativistic heavy ion collisions. A Large Ion Collider Experiment (ALICE) aims to investigate properties of this strongly-interacting medium under extreme experimental conditions. Hard-scattered partons, which fragment into clusters of hadrons known as 'jets', are created in the initial stages of the collision, and then propagate through the medium. The interaction between partons and the medium leads to a modification of the jet properties, such as broadening, energy loss, and an additional medium response triggered by jets. By investigating the angular correlation between hadrons and jets, we explore the interaction between partons and the medium and quantitatively study the medium response around jets.

We present an analysis of angular correlations of inclusive hadrons and identified protons with respect to the axis of charged jets in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with the ALICE detector. The correlation functions are fully corrected for detector acceptance and tracking efficiency. Although both the jet-hadron and the jet-proton correlations contain the medium response, since the proton abundance in the medium is relatively higher than in jet fragmentation, we expect to see an amplified medium signal in the jet-proton correlations.

This work is supported by BMBF and HGS-HIRe.

HK 41.6 Mi 18:00 HS 15

Azimuthal particle correlations as a probe of collectivity in deep inelastic electron-proton collisions at HERA — •Dhevan Gangadharan for the ZEUS-Collaboration — Univeristat Heidelberg

Recent observations at RHIC and the LHC of two- and multi-particle correlations in high multiplicity relativistic proton-proton and proton-ion collisions and similarity of the results to those observed in central heavy-ion collisions are often interpreted as an evidence for collective particle production in small collision systems. These results motivate a study in even smaller systems, such as produced in relativistic electron-

proton collisions.

A measurement is presented of two-particle correlations in collisions of electron beams at 27.5 GeV with beams of protons at 920 GeV, which corresponds to 318 GeV centre-of-mass energy. A sample of events equivalent to the integrated luminosity of 430 inverse pb was recorded with the ZEUS experiment in 2003-2007. The correlations are measured for charged hadrons as a function of event multiplicity for the lab pseudorapidity range -1.5<ηlab<2. To probe the possible contribution due to collective effects, the correlations are studied as a function of the particle's pair separation in pseudorapidity and the pair mean transverse momentum. The observed correlations are compared to available Monte Carlo models of deep inelastic electron-proton scattering. Observations based on the analysis of the ZEUS data put a limit on the possible collective effects in high multiplicity electron-proton collisions.

HK 41.7 Mi 18:15 HS 15

Feasibility study for the measurement of a photon HBT signal — •Nicole Löher[1], Jürgen Berges[2], Oscar Garcia[2], Aleksas Mazeliauskas[2], and Klaus Reygers[1] — [1]Physikalisches Institut, Universität Heidelberg — [2]Institut für Theoretische Physik, Universität Heidelberg

A theoretical study on a possible measurement of Hanbury-Brown Twiss (HBT) correlations of direct photons in nucleus-nucleus collisions is presented. The spatial-temporal evolution of the Quark Gluon Plasma (QGP) at LHC energies ($\sqrt{s_{NN}} = 2.74$ TeV) is simulated using the hydrodynamic code iEBE-VISHNU. Photon invariant yields are then calculated based on the photon rates from P. Arnold, G. Moore and L. Yaffe for the QGP phase and parameterizations by M. Heffernan, P. Hohler and R. Rapp for the hadron gas phase. The HBT signal for thermal photons is determined. In addition, two extra sources for photons are investigated. An early source based on nonequilibrium Yang-Mills dynamics and a photon enhancement near the critical temperature T_c are discussed. The photon HBT signal is calculated for all three scenarios and the results are compared. Based on these calculations an estimate for the required statistics for a possible measurable signal in the ALICE detector system is given.

HK 42: Structure and Dynamics of Nuclei VIII

Zeit: Mittwoch 16:30–18:30 Raum: HS 14

Gruppenbericht HK 42.1 Mi 16:30 HS 14

Systematics of the Electric Dipole Response in Stable Tin Isotopes* — •Sergej Bassauer[1], Peter von Neumann-Cosel[1], and Atsushi Tamii[2] for the E422-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]RCNP, Osaka, Japan

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

*Supported by the DFG through SFB 1245.

HK 42.2 Mi 17:00 HS 14

Electric Dipole Response of Neutron Rich Tin Isotopes — Andrea Horvat[1], Thomas Aumann[1,2], •Philipp Schrock[3], Konstanze Boretzky[2], Igor Gasparic[4], Dominic Rossi[1], Fabia Schindler[1], and Lorenzo Zanetti[1] for the R3B-Collaboration — [1]TU Darmstadt, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany — [3]CNS, The University of Tokyo — [4]Ruder Boskovic Institute, Zagreb, Croatia

One of the most active pursuits in nuclear physics nowadays is to arrive at a better understanding of forces which bind the nucleus and govern the behavior of objects such as neutron stars, involving a great deal of theoretical and experimental effort. Accurate measurements of observables sensitive to isovector properties are needed in order to provide better constraints on nuclear interaction models in the isovector channel. For this purpose an experimental campaign investigating the electric dipole response via Coulomb excitation along the tin isotope chain ($^{124-134}$Sn) has been carried out at the R3B (Reactions with Relativistic Radioactive Beams) setup at GSI (Helmholtzzentrum für Schwerionenforschung). Coulomb excitation cross sections have been extracted in the 1, 2 and 3 neutron decay channels.

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

HK 42.3 Mi 17:15 HS 14

Investigation of the low-lying dipole response in ^{120}Sn — •M. Müscher[1], M. Färber[1], D. Savran[2], P. Scholz[1], R. Schwengner[3], M. Spieker[4], J. Wilhelmy[1], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Darmstadt, Germany — [3]HZDR, Dresden-Rossendorf, Germany — [4]NSCL, Michigan State University, MI 48824, USA

The low-lying dipole strength of the proton-magic nucleus ^{120}Sn was investigated in a real-photon scattering experiment. The measurement was performed at the γELBE facility at the Helmholtz-Zentrum Dresden-Rossendorf [1] where bremsstrahlung was used as photon source with an endpoint energy of 9.5 MeV.

The nucleus ^{120}Sn is a well-suited candidate for a systematic study of the Pygmy Dipole Resonance (PDR) because the tin isotopic chain covers a large range of N/Z ratios. Furthermore, the results of a previous bremsstrahlung experiment on ^{120}Sn neither confirmed the expectation of an increase of the electric dipole strength with an increasing N/Z ratio [2] nor fit to the results of a (p,p') measurement [3]. To investigate these discrepancies this additional (γ, γ') experiment was performed. Experimental details and preliminary results will be presented.

Supported by the BMBF (05P15PKEN9) and the Alliance Program of the Helmholtz Association (HA216/EMMI).

[1] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211.
[2] B. Özel-Tashenov *et al.*, Phys. Rev. C **90** (2014) 024304.
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HK 42.4 Mi 17:30 HS 14

Electric dipole excitation of neutron-rich nuclei in a relativistic energy density functional approach — •Stefan Typel — Institut für Kernphysik, Technische Universität Darmstadt — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Neutron-rich nuclei are expected to exhibit a low-lying pygmy resonance in the strength distribution of electric dipole excitations that is correlated with the neutron skin thickness and the slope of the nuclear symmetry energy. This feature can be studied theoretically with the help of relativistic energy density functionals employing a systematic variation of the isovector part in the effective interaction. In contrast to conventional RPA-type calculations, a shell-model inspired approach is explored in the present contribution with particular interest in the evolution of the dipole strength distribution across neutron shell closures.

HK 42.5 Mi 17:45 HS 14

Study of dipole excitations in ^{124}Sn via inelastic proton scattering @ 15 MeV — •M. Färber[1], A. Bohn[1], V. Everwyn[1], M. Müscher[1], S.G. Pickstone[1], S. Prill[1], P. Scholz[1], M. Spieker[2], M. Weinert[1], J. Wilhelmy[1], and A. Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]NSCL, Michigan State University, MI 48824, USA

The E1 strength distribution of a nucleus can be investigated via different excitation mechanisms. The tin isotopic chain is perfect for systematic studies, favoured by their magic proton number. Experiments on ^{124}Sn using $(\alpha,\alpha'\gamma)$ [1], (γ,γ') [2] as well as $(^{17}O,^{17}O'\gamma)$ [3] were already performed. The different excitation pattern observed in experiments with hadronic probes compared to electromagnetic probes might indicate a more isospin-mixed character of the Pygmy Dipole Resonance in contrast to the isovector character of the Giant Dipole Resonance [4]. To further investigate this phenomenon, a (p,p'γ) ex-

periment at E_p=15 MeV was performed at the Cologne Tandem accelerator. The combined setup SONIC@HORUS was used, enabling a coincident measurement of the scattered protons and γ-rays. Apart from the excitation response, preliminary results on branching ratios will be presented. Supported by DFG(ZI 510/7-1). A.B. is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.

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[4] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70**, 210 (2013).

HK 42.6 Mi 18:00 HS 14

Looking below the threshold: low energy spectrum for neutron-rich Tin isotopes — •Lorenzo Zanetti[1], Thomas Aumann[1,2], Philipp Schrock[3], Kostanze Boretzky[2], Igor Gasparic[4], Dominic Rossi[1], Dmytro Symochko[1], Andrea Horvat[1], and Fabia Schindler[1] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum — [3]CNS, The University of Tokyo — [4]Ruder Boskovic Institute, Zagreb, Croatia

Research on the nuclear equation of state (EOS) is very active: many theoretical frameworks provide a way to put constraint on the EOS's isovector properties, using observables relating to the electric dipole response of neutron-rich nuclei. One of such observables is the dipole polarizability, α_D.

A Coulomb excitation experiment was performed at GSI to investigate the E1 response of neutron-rich isotopes of Tin with the R3B/LAND setup. The data collected during the campaign, especially for ^{132}Sn, can be used to estimate α_D, provided a good enough understanding of the gamma deexcitation of the nucleus is reached. We are currently analysing the lower energy (below the neutron separation threshold) part of the gamma spectrum in order to reach such understanding.

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

HK 42.7 Mi 18:15 HS 14

Low-energy dipole response of the halo nuclei ^{6,8}He — •Christopher Lehr[1] and Thomas Aumann[1,2] for the NeuLAND-SAMURAI-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

The heaviest bound helium isotopes ^{6}He and ^{8}He are 2- and 4-neutron halo nuclei with a clear alpha plus 2n and 4n structure.

The multi-neutron decay of ^{6}He and ^{8}He after heavy-ion induced electromagnetic excitation reactions has been measured kinematically complete to study the dipole response of these nuclei.

An experiment was performed at the RIBF facility at the RIKEN Nishina Center in Japan. The combination of the neutron detectors NEBULA and NeuLAND at the SAMURAI setup and the high beam intensities available at RIBF made this measurement possible for the first time. The experimental method is based on the measurement of the differential cross section via the invariant-mass method, which allows to extract the dipole strength distribution dB(E1)/dE and the photo-absorption cross section. To induce electromagnetic excitation reactions of ^{6}He and ^{8}He and to treat the contribution of nuclear reactions, a series of targets with increasing Z was used.

During the talk the experimental setup and the method are explained. An update on the analysis is presented, focusing on the fragment identification and neutron reconstruction.

This work is supported by the DFG through grant no. SFB 1245, the GSI-TU Darmstadt cooperation and the BMBF project 05P15RDFN1.

HK 43: Astroparticle Physics III

Zeit: Mittwoch 16:30–18:30 Raum: HS 16

Gruppenbericht HK 43.1 Mi 16:30 HS 16

From first tritium data towards neutrino mass measurements with the KATRIN Experiment — •Magnus Schlösser for the KATRIN-Collaboration — Karlsruhe Institute of Technology

The KArlsruhe TRitium Neutrino (KATRIN) experiment at the Karlsruhe Institute of Technology aims for a direct neutrino mass determination with a sensitivity of 200 meV/c^2 (90% C.L.). The measurement is performed by precise spectroscopy of the tritium-β-decay electrons near the kinematic endpoint of 18.6 keV. That is achieved by employing a high-resolution ($\Delta E < 1$ eV) MAC-E-type high-pass energy filter coupled to a high-luminosity (10^{11} Bq) windowless gaseous tritium source. In Spring 2018, the first operation of KATRIN with traces of tritium has been successfully conducted. One principal aim of this campaign, the stability of the tritium source at an activity of about 0.5% ($\approx$ 500 MBq) of the nominal level, has been demonstrated. In this talk, the achievements of the first tritium campaign are demonstrated and the first ever high-resolution spectra from tritium beta-decay electrons by KATRIN are presented. Insights into the ongoing KATRIN run are given in which the source activity was stepwise ramped up to the nominal source strength of 10^{11} Bq in order to achieve the targeted statistics for the neutrino mass goal.

This work is supported by the Helmholtz Association (HGF), the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3), the Helmholtz Alliance for Astroparticle Physics (HAP), and the Helmholtz Young Investigator Group (VH-NG-1055).

HK 43.2 Mi 17:00 HS 16

Results of First Tritium Measurements at the KATRIN Experiment — •Martin Slezák for the KATRIN-Collaboration — Max Planck Institute for Physics, Munich, Germany

The aim of the **Ka**rlsruhe **Tri**tium **N**eutrino (KATRIN) experiment is to search for the effective electron antineutrino mass with a sensitivity of 0.2 eV/c^2 (90 % C.L.) using electrons from tritium β-decay.

First Tritium measurements were taken in Summer 2018 with the goal of commissioning the full KATRIN system with 1 % nominal tritium activity and demonstrating a global system stability on the 0.1 % level. In addition, the data provides the opportunity to investigate the β-spectrum for systematic effects and cross-check the analysis tools and strategies.

This talk gives an overview of the preliminary results from the high-level analysis of First Tritium measurements. In particular, I will discuss different analysis strategies, relevant systematic effects, and stability of the analysis results.

HK 43.3 Mi 17:15 HS 16

Backgrounds in KATRIN — •Anna Pollithy for the KATRIN-Collaboration — Technische Universität München, Fakultät für Physik, 85748 Garching

The Karlsruhe Tritium Neutrino (KATRIN) experiment is designed to determine the effective electron anti-neutrino mass with a sensitivity of 200 meV/c^2 (90% C.L.) by investigating the energy spectrum of tritium beta-electrons near the endpoint. For the full neutrino mass sensitivity a very low background level of 10^{-2} cps is required. The residual background shows characteristics that point towards ionization of highly excited 'Rydberg' atoms as a potential background source. These 'Rydberg' atoms can be created by radioactive decays in the walls. In this contribution dedicated measurements to investigate this kind of background creation mechanism will be presented. This work is supported by the SFB1258 and the Max Planck Society.

HK 43.4 Mi 17:30 HS 16

Measurement of KATRINs energy loss function using a time of flight method — •Caroline Rodenbeck and Rudolf Sack for the KATRIN-Collaboration — WWU Münster

The **Ka**rlsruhe **Tri**tium **N**eutrino experiment (KATRIN) is a next generation tritium beta decay experiment improving the sensitivity on direct neutrino mass measurements by one order of magnitude over the predecessor experiments. It allows a model independent investigation of the absolute neutrino mass scale with an estimated sensitivity of 0.2 eV/c^2 (90% C.L.)

Understanding energy losses of electrons inside the windowless gaseous tritium source (WGTS) of KATRIN is essential for measuring the tritium beta decay spectrum with the required precision. The electrons can scatter elastically and inelastically off tritium molecules in the WGTS loosing energy in the process and resulting in a modification of the spectrum.

The talk presents a high resolution measurement of the shape of this energy loss function, which was obtained using a time of flight method with monoenergetic electrons from a photoelectron source at the endpoint energy of the tritium beta spectrum of 18.6 keV.

This work is funded by DFG through the Research Training Group 2149 and by BMBF under contract number 05A17PM3.

HK 43.5 Mi 17:45 HS 16

KATRIN analysis with the covariance matrix approach — •Lisa Schlüter for the KATRIN-Collaboration — MPP München

The KArlsruhe TRItium Neutrino (KATRIN) experiment is designed to determine the effective mass of the electron-antineutrino with an sensitivity of 200 meV/c^2 (90% C.L.) in a direct and model-independent way. The neutrino mass can be inferred from the shape of the endpoint region of the tritium β-decay spectrum, which is measured using a MAC-E filter and a Windowless Gaseous Tritium Source (WGTS). This talk presents an analysis of the KATRIN Tritium commissioning measurements, including systematic effects based on the covariance matrix approach, using the Samak simulation analysis package.

HK 43.6 Mi 18:00 HS 16

TRISTAN measurements at Troitsk nu-mass experiment — •Tim Brunst for the KATRIN-Collaboration — Max Planck Institute for Physics — Technical Universtity of Munich

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV (90% C.L.) after an effective data taking time of three years. The TRISTAN (tritium beta-decay to search for sterile neutrinos) group aims at detecting a sterile neutrino signature by measuring the entire tritium beta-decay spectrum with an upgraded KATRIN system. One of the greatest challenges is to handle the high signal rates generated by the strong activity of the KATRIN tritium source. Therefore, a novel multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 Mcps with an excellent energy resolution for electrons of 300 eV (FWHM) at 10 keV. First seven-pixel prototype detectors were successfully installed and operated at the Troitsk nu-mass experiment, one of KATRIN's technological predecessors. This talk presents the results of these measurement campaigns.

HK 43.7 Mi 18:15 HS 16

Characterization of the TRISTAN prototype detectors with electrons — •Daniel Siegmann for the KATRIN-Collaboration — Max Planck Institut for Physics — Föhringer Ring 6

The KATRIN (Karlsruhe Tritium Neutrino) experiment investigates the energetic endpoint of the tritium beta-decay spectrum to determine the effective mass of the electron anti-neutrino with a sensitivity of 200 meV (90% C.L.) after an effective data taking time of three years starting in March 2019.

After the data taking for the neutrino mass survey is completed the TRISTAN (TRitium Invetigations of STerile to Active Neutrino mixing) project will upgrade the current detector in the KATRIN experiment to search for the signature of a keV sterile neutrino in the entire tritium beta decay spectra. One of the greatest challenges is to handle high signal rates as a result of the strong activity of the KATRIN tritium source. Therefore, a novel 3500 multi-pixel silicon drift detector is being designed which is able to handle rates up to 100 kcps in each pixel while maintaining an excellent energy resolution of 300 eV (FWHM) at 20 keV.

To fulfill these requirements in the future multiple smaller 7 channel prototypes were designed and characterized. The investigation of various detector entrance window technologies and their effect on the detector response for electrons are discussed in this talk.

This work is supported by the Max Planck society and the TU Munich ("Chair for Dark Matter, Susanne Mertens").

HK 44: Instrumentation IX

Zeit: Mittwoch 16:30–18:30 Raum: HS 11

Gruppenbericht HK 44.1 Mi 16:30 HS 11

The Silicon Tracking System of the CBM Experiment at FAIR — •Ievgeniia Momot for the CBM-Collaboration — Goethe-Universität, Frankfurt — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — KINR, Kyiv, Ukraine

The Compressed Baryonic Matter (CBM) experiment at FAIR is designed to study dense nuclear matter in the laboratory with help of heavy nuclei up to kinetic energies of 11AGeV.

One of the detector systems in this experiment is the Silicon Tracking System (STS). Its task is to measure the trajectories of up to 800 charged particles per nuclear collision at interaction rates up to 10MHz. In order to guarantee the required performance over the full lifetime of the experiment, the detector system has to have a low material budget, a high granularity, a high signal-to-noise (SNR) ratio, and a high radiation tolerance. As a result of optimisation studies, the STS consists of double-sided silicon microstrip sensors, which have to provide readout with SNR>10, even after irradiation with the expected lifetime fluence of 10^{14}n/cm^2 1MeV equivalent.

The STS will be located in the gap of a superconducting dipole magnet comprising 8 tracking stations, which consist of 896 modules mounted on 106 ladders. The readout features self-triggering front-end electronics that streams data to a computing farm for online analysis.

Recent progress with detector design, component development towards start of series production, and the mSTS detector demonstrator during the mCBM campaign at GSI's SIS18 accelerator will be covered in this talk.

HK 44.2 Mi 17:00 HS 11

Online tracking with the ALICE Transition Radiation Detector — •Marten Ole Schmidt for the ALICE-Collaboration — Physikalisches Institut, University of Heidelberg

After the ongoing maintenance work at the LHC, the ALICE detectors will collect data in a continuous readout mode instead of the triggered mode used before. Major upgrades are conducted on most of the subdetectors to allow for this new readout scheme.

The Transition Radiation Detector (TRD) will keep its current design and only update its readout chain. Up to now, both digits from hits in the TRD as well as on-the-fly reconstructed TRD tracklets were stored on tape. The digits were used for the offline performed tracking, while the tracklets were used to generate online trigger decisions. Due to bandwidth constraints, the TRD read out after the upgrade is restricted to tracklets, such that the tracking implementation must change.

Tracks reconstructed in the inner detectors of ALICE will be prolonged to the TRD and used as seeds. The new TRD tracking was developed and tested in the ALICE High Level Trigger during data taking in 2018 both in p–p and Pb–Pb collisions. We present the performance of the new tracking algorithm in both collision systems and discuss the status of the implementation on GPUs which is foreseen for the new Online-Offline computing framework of ALICE for the next data taking periods.

HK 44.3 Mi 17:15 HS 11

Development of cooling demonstrator for the CBM Silicon Tracking System — •Kshitij Agarwal for the CBM-Collaboration — Physikalisches Institut - Eberhard Karls Universität Tübingen, Tübingen, Germany

As the core detector of the CBM experiment, the Silicon Tracking System (STS) located in the dipole magnet provides track reconstruction & momentum determination of charged particles from beam-target interactions.

Due to the expected irradiation damage (fluence - 10^{14} n_{eq}(1MeV)/cm^2), the silicon microstrip sensors will dissipate < 6 mW/cm^2 at -10°C. Thus it is imperative to keep the sensors at or below -10°C at all times to avoid thermal runaway and reverse annealing by forced N_2 cooling. The corresponding electronics connected via microcables are placed outside detector acceptance and bi-phase CO_2 cooling will be used to remove $\sim$ 40kW power dissipated.

To experimentally verify the aforementioned concepts under realistic mechanical constraints, a thermal demonstrator comprising a half-layer of STS is under development. This contribution will describe the recent R&D on several subcomponents, such as CO_2 cooling plant and corresponding distribution system, optimised CO_2 heat exchanger plates,

dummy silicon heaters, thermal enclosure, etc. In addition, future plans on the demonstrator integration and design will be also presented.

This work is supported by GSI/FAIR.

HK 44.4 Mi 17:30 HS 11

A PANDA Track Finding Algorithm based on the Apollonius Problem — •Anna Scholl, Tobias Stockmanns, and James Ritman for the PANDA-Collaboration — Forschungszentrum Jülich GmbH, IKP1, Jülich

One of the main components of the PANDA experiment is the Straw Tube Tracker (STT). It consists of over 4200 gas-filled drift tubes. When a charged particle ionizes the gas in one of the drift tubes, the electrons drift to the anode, which is located in the center of each tube. Since only the drift time of the electrons to the anode is known, as well as the position of the anode wire, only the radius around the anode where the ionization must have taken place can be calculated. This results in a circle (isochrone) around the center of the tube. The track of the charged particle must pass tangentially to the isochrone.

Algorithms based on two or three dimensional hitpoints, usually do not use the additional isochrone information. For the STT, however, a tracking algorithm is needed that finds tracks that are tangential to every isochrone. To deal with this challenge, this work presents an approach based on the Apollonius problem. The Apollonius problem is a mathematical problem of connecting three circles with a fourth circle that is tangential to the other three circles. This mathematical description is the basis for a Hough transformation to find the track of the charged particle. In this presentation first results of the algorithm described above will be presented.

HK 44.5 Mi 17:45 HS 11

Using neural networks for event reconstuction at NeuLAND — •E. Hoemann, J. Mayer, P. Scholz, and A. Zilges — University of Cologne, Institute for Nuclear Physics

In various fields of modern data processing, neural networks play a key role. Popular applications like speech and face recognition are already part of our everyday lives. Where can we apply them in science for similar questions?

For the New Large Area Neutron Detector NeuLAND[1] we come across two classification problems: How many neutrons have interacted in the detector and which clusters are created through primary interactions? Humans need to reduce the data set to special quantities to gain information, but some underlying correlations could be missed in this process. In contrast, a neural network can use the whole data set, complex structures, and optimization algorithms to profit from these correlations.

The talk will address different approaches to construct a neural network for the mentioned classification problems and its performance in comparison to the conventional methods.

Supported by the BMBF(05P19PKFNA).

[1]Technical Report for the Design, Construction and Commissioning of NeuLAND, available at https://edms.cern.ch/document/1865739/1

HK 44.6 Mi 18:00 HS 11

Particle-Track Reconstruction with Artificial Neural Networks — Lukas Bierwirth, Laura Fabbietti, Martin Jan Losekamm, Stephan Paul, and •Thomas Pöschl — Technische Universität München

Finding the parameters of a particle's track in a detector in real time is a resource-intensive pattern recognition task. Artificial neural networks are a promising approach to this problem because of their ability to self-learn complex features from training data while still achieving a short reconstruction time per event.

We develop a neural network to analyze the data of the RadMap Telescope, which will measure the radiation environment aboard the International Space Station. We compare the performance of the neural network to a classical algorithm based on the Hough transform using simulated data and measurements from a test campaign at Paul Scherrer Institute.

HK 44.7 Mi 18:15 HS 11

Particle-Antiparticle Discrimination Using Neural Networks — Laura Fabbietti, Martin J. Losekamm, •Jan Henrik Müller, Stephan Paul, and Thomas Pöschl — Technische Universität München

Cosmic-ray antiproton measurements are challenging because of the small flux of antiprotons in comparison to the large background flux of ordinary ions, requiring an effective particle-identification algorithm. A classical approach is to fully reconstruct the event topology to draw conclusions about the incoming particle's species. However, for space-based experiments, this can be impracticable since the available computing power and calculation time are not sufficient to allow such complex calculations. An alternative approach is the use of neural networks: They can be trained on high-power computers on ground and then implemented on the detector's front-end electronics to provide fast reconstruction with small computational effort. In this work, we assess different types of neural networks for identifying antiprotons, protons, and heavy ions in the Multi-Purpose Active-Target Particle Telescope and evaluate their performance with simulated detector data. We analyze the result, focusing on events that were wrongly classified. This is necessary because the signal-to-background ratio of antiprotons is in the order of 10^{-4} and rare misclassifications have a large impact on the flux measurement. We also discuss possibilities to increase the network's reconstruction ability for rare events.

HK 45: Instrumentation X and Applications

Zeit: Mittwoch 16:30–18:30 Raum: HS 12

Gruppenbericht HK 45.1 Mi 16:30 HS 12

Multi-neutron detection with NeuLAND — •J. Mayer and A. Zilges for the R3B- and the NeuLAND-SAMURAI-Collaboration — Institute for Nuclear Physics, University of Cologne

The high-resolution, large-acceptance time-of-flight spectrometer NeuLAND is the new neutron detector for the R^3B setup (Reactions with Relativistic Radioactive Beams) at FAIR. NeuLAND is dedicated to the detection of high-energy neutrons up to 1 GeV.

In this talk, we will give an overview on construction, experiments, and software: NeuLAND consists of plastic scintillator bars (5 cm x 5 cm x 250 cm) which are arranged to so-called double planes. An experimental campaign with four double planes was performed at the SAMURAI setup at RIKEN, Japan, from 2015 to 2017 [1]. We verified simulations of the detector with this experimental data and studied the detector response for the upcoming experiments in FAIR Phase 0. To extract the multiplicity and the interaction points of primary neutrons, analysis software was prepared. Here we present different event reconstruction algorithms and their performance for simultaneous detection of up to five neutrons.

Supported by the BMBF (05P15RDFN1, 05P19PKFNA, 05P15RFFN1), the DFG (SFB 1245), and the GSI-TU Darmstadt cooperation agreement.

[1] J. Kahlbow *et al.*, GSI-FAIR Scientific Report 2017 (RESEARCH-NUSTAR-KR-3)

HK 45.2 Mi 17:00 HS 12

Simulating the high-rate performance of MRPC detectors for the CBM TOF wall — •Christian Simon and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, D-69120 Heidelberg

The large-area time-of-flight (TOF) wall of the future Compressed Baryonic Matter (CBM) experiment is composed of multi-gap resistive plate chambers (MRPC). In CBM, heavy nuclei are accelerated to kinetic energies of up to 11 AGeV (SIS100) and interact in a fixed-target geometry at unprecedented rates of up to 10 MHz which generates strongly varying particle fluxes on the TOF wall. Closer to the beam pipe where several tens of kHz/cm^2 are expected, low-resistive glass will serve as resistive material for the MRPC detectors while the periphery of the rectangular 120 m^2 wall has been designed with float-glass counters which do not need to (and can intrinsically not) cope with fluxes of more than a kHz/cm^2. To facilitate the analysis and interpretation of results from in-beam rate tests of MRPC prototypes, equipped with both types of glass, a dedicated MRPC rate-response simulation has been developed in the CbmRoot software framework. The parametric description of the detector response function with re-

spect to incident particle flux allows for reproducing and predicting the MRPC performance under a given load once the model parameters are derived from experimental test beam data. An exemplary simulation of an MRPC in-beam test at CERN/SPS in 2015/16 will be presented. The project is partially funded by BMBF 05P15VHFC1.

HK 45.3 Mi 17:15 HS 12

Detector simulation developments in ALICE in view of LHC Runs 3 and 4 — •Benedikt Volkel for the ALICE-Collaboration — CERN, Switzerland — Ruprecht-Karls-Universität Heidelberg, Germany

With an expected increase of acquired data by two orders of magnitude in ALICE Runs 3 and 4, the simulation requirements will also notably increase. For the planned physics programme involving multiple analysis topics, it is estimated that the simulation requirements will increase by a factor of 20 with respect to the current production. Most of this increase is planned to be met by using fast or parametrised Monte-Carlo simulations. Simulations performed for Runs 1 and 2 employ the transport codes GEANT3, GEANT4 and FLUKA used through the Virtual Monte Carlo (VMC) interface and a common geometry modeller and navigator within the ROOT software package.

In addition to using one transport code in the event simulation, core extensions of the VMC package will be presented which allow to share the simulation of a single event among different transport codes. This provides the possibility to combine advantages of multiple transport engines depending on the simulation requirements.

Furthermore, first preliminary performance results of fast simulation implementations will be presented.

HK 45.4 Mi 17:30 HS 12

TGeoArbN: A ROOT class for tessellated geometries — •Ben William Salisbury for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

Simulations of particle physics experiments require a simulatable geometry representation of the experiment's detector system, such as the forward endcap of the $\bar{\mathrm{P}}$ANDA experiment. A new geometry object called TGeoArbN was implemented which uses a tessellated approximation of a CAD-shape. It is intended to be used as addition to the ROOT framework, allowing to simulate any geometry without the overhead of having to combine ROOT-geometry primitives to form an approximation of a complex shape. The tessellated approximation is stored as a mesh consisting of simple planar geometries, such as triangles. This mesh is then processed during the simulation to determine the relative location of a point (particle position) to the approximated geometry. An optimization scheme in form of a partition structure (Octree) was implemented to reduce processing time by determining the relevant mesh part for a specific point. In this talk a short overview of the concepts used by TGeoArbN and processing time determinations are presented.

Funded by the BMBF.

HK 45.5 Mi 17:45 HS 12

Performance simulations of the Silicon Tracking System of the CBM Experiment at FAIR — •Evgeny Lavrik for the CBM-Collaboration — Facility for Antiproton and Ion Research, Germany

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) aims to study the properties of nuclear matter at high net-baryon densities and moderate temperatures.

The Silicon Tracking System (STS) is the key detector to reconstruct with a high efficiency up to 1000 charged particle trajectories created in heavy-ion collisions at interaction rates of up to 10 MHz. It will determine the momentum of the particles with a momentum resolution $\Delta p/p \approx$ 1-2% which requires low detector material budget of 0.3-1% X_0 per detection layer. The detector comprise eight layers of double-sided silicon micro-strip sensors and will be placed inside the 1 Tm superconducting magnet.

This contribution describes the simulated analog and digital response of the STS and its performance with regard to different geometries, sensor layouts and varied sensor thicknesses. Key metrics such as track and primary vertex reconstruction efficiencies, momentum resolution will be presented. In addition the effect of delta-electrons originating from beam-target interactions on the detector performance and read-out data rates will be shown.

HK 45.6 Mi 18:00 HS 12

Validating the Digitization in the O^2 TPC Simulation — •Thomas Klemenz for the ALICE-Collaboration — Technische Universität München, Physik Department E62, Excellence Cluster 'Universe', Garching

The ALICE detector will be upgraded in the course of the LHC high luminosity upgrade starting 2019. In particular, the present readout of the ALICE TPC will not be able to cope with the enhanced interaction rates provided by the LHC in Run3. Therefore, the readout will rely on continuously read out GEM-based readout chambers. This upgrade will also severely affect the data processing. The new Online-Offline computing system, O^2, will replace the current framework, AliRoot, to cope with the continuous readout.

The upgrade of the readout demands an update of the implementation of the signal formation in all sub-detectors, and mostly relevant for this work, the TPC. Therefore, the digitization of the TPC was validated with data from a test beam of electrons and pions that was taken with a 4-GEM inner readout chamber from the pre-production stage at the CERN PS in 2017.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe', BMBF, HGF and the SFB 1258.

HK 45.7 Mi 18:15 HS 12

Dark photon search at MAGIX — •Pepe Gülker for the MAGIX-Collaboration — JGU Mainz

The multi-purpose MAGIX experiment at the future electron accelerator MESA will be perfectly suited to extend the search for invisible dark photon decays to an unprecedented parameter range. We plan to perform scattering experiments on a windowless gas-jet target with low-energy electron probes delivered by MESA. They are produced in an energy-recovering acceleration mode, which yields a beam current of 1 mA. By this we will, in theory, be able to take data with very high accuracy.

To find suitable kinematics and get estimations for the sensitivity, a dedicated Monte-Carlo-simulation of the signal- and most relevant background-processes was performed and will be presented in this contribution.

HK 46: Hauptvorträge IV

Zeit: Donnerstag 11:00–12:45 Raum: Plenarsaal

Hauptvortrag HK 46.1 Do 11:00 Plenarsaal

Non-equilibrium dynamics in high-energy Heavy-Ion collisions — •Soeren Schlichting — Universität Bielefeld, Bielefeld, Germany

Heavy-ion collision experiments at the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC) have revealed exciting properties of the Quark-Gluon Plasma (QGP) – a new state of hot and dense strong-interaction matter created in high-energy collisions. Strong collective phenomena observed in these collisions, suggest that the QGP behaves as a nearly ideal fluid for a significant part of its space-time evolution. Despite a successful phenomenology based on fluid dynamical descriptions of the QGP beyond time scales 1 fm/c, a first principles understanding of the emergence of fluid dynamical behavior in nucleus-nucleus (AA) collisions remains an outstanding challenge. Based on a general introduction, I will discuss recent theoretical progress in understanding the microscopic and macroscopic features of the early time non-equilibrium dynamics of heavy-ion collisions, which eventually lead to the formation of a fluid dynamic QGP.Besides applications to the dynamical description of nucleus-nucleus (AA) collisions, I will also discuss how these theoretical advances can be used to characterise the conditions for the formation of a QGP in hadronic collisions and quantify the importance of the non-equilibrium stage in smaller collision systems created in proton-nucleus (pA) and proton-proton (pp) collisions.

Hauptvortrag HK 46.2 Do 11:35 Plenarsaal
Probing the Quark-Gluon Plasma with low-mass dileptons in heavy-ion collisions — •Raphaelle Bailhache — Institut für Kernphysik, Goethe-Universität Frankfurt

Ultrarelativistic heavy-ion collisions are used to study the physics of strongly interacting matter under extreme conditions, i.e. high temperature and density, similar to those of the early universe. In such collisions a deconfined state of quarks and gluons, the Quark-Gluon Plasma (QGP), is formed. Dileptons (e^+e^-, $\mu^+\mu^-$) provide an excellent probe of the QGP. Lepton pairs are emitted during all stages of the collision and carry information about the medium properties at the time of emission as they are unaffected by strong final-state interactions. The measurement of their invariant mass can be used to study the decay of massive particles, e.g. the in-medium modified spectral shape of ρ mesons related to the restoration of chiral symmetry. The latter is spontaneously broken in vacuum and accounts for most of the hadron masses. At the same time, thermal radiation from the medium, contributing over a broad mass range, gives insight into the temperature of the medium. Measurements of such signals are extremely challenging due to a large background from ordinary light- and heavy-flavour hadron decays.

This talk will review the low-mass dilepton measurements in heavy-ion collisions from SPS to LHC energies. In particular the latest results of ALICE at the LHC will be shown. Finally, future perspectives at the LHC and at facilities at lower energies will be shortly discussed.

Supported by BMBF and the Helmholtz Association.

Hauptvortrag HK 46.3 Do 12:10 Plenarsaal
QCD correlation functions from lattice QCD and the bound-state approach to hadron physics — •Andre Sternbeck — Friedrich-Schiller-Universität Jena

Lattice QCD provides access to many hadronic quantities through Monte-Carlo calculations of gauge-invariant correlators. These calculations have become sufficiently mature to provide estimates for hadronic observables of immediate relevance for experimental programs. In recent years, also continuum functional methods have been improved and increasingly applied to problems of QCD. Their systematic error is however hard to control without lattice QCD results for the basic ingredients, the QCD n-point functions. In this talk I will review lattice results for these n-point functions in Landau gauge and compare the two approaches to QCD and hadron physics.

HK 47: Hadron Structure and Spectroscopy VII

Zeit: Donnerstag 14:00–16:00 Raum: HS 13

Gruppenbericht HK 47.1 Do 14:00 HS 13
Baryons as relativistic three-quark bound states — •Reinhard Alkofer — Institut für Physik, Universität Graz

The spectrum and electromagnetic properties of baryons described as relativistic three-quark bound states within QCD are described. The composite nature of baryons results in a rich excitation spectrum, whilst leading to highly non-trivial structural properties explored by the coupling to external (electromagnetic and other) currents. Both present many unsolved problems despite decades of experimental and theoretical research. In this talk I will discuss the progress in these fields from a theoretical perspective, focusing on non-perturbative QCD as encoded in the functional approach via Dyson-Schwinger and Bethe-Salpeter equations. Recent results on the spectrum of non-strange and strange baryons, their elastic and transition form factors as well as the issues of two-photon processes and Compton scattering determined in the Dyson-Schwinger framework are confronted with those of lattice QCD and the available experimental data. The general aim is to identify the underlying physical mechanisms behind the plethora of observable phenomena in terms of the underlying quark and gluon degrees of freedom.

HK 47.2 Do 14:30 HS 13
Cascading decays of nucleon resonances via meson-pair emission — •Mariana Nanova and Volker Metag for the CBELSA/TAPS-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen, Germany

Photoproduction of mesons provides important information about the excitation spectrum of the nucleon that is still not sufficiently understood despite various long-lasting experimental and theoretical efforts [1]. Reactions with multiple-meson final states are important, in particular $\pi^0\eta$ since the η acts as an isospin filter and provides information on the nature of the intermediate resonances. Particular attention has been paid to the recently claimed narrow structure observed at 1685 MeV in the $N\pi\eta$ channel [2]. We have studied the two-meson photoproduction with the CB/TAPS detector system at the ELSA accelerator in Bonn in the reaction $\gamma p \to p\pi^0\eta$. High statistics have been obtained in irradiating a liquid hydrogen target with photon beams in the incident energy range from 0.9 to 3.0 GeV. A kinematic fit has been used in the reconstruction and identification of the exit channels. Preliminary results on the search for the narrow structure at 1685 MeV will be presented.

[1] V. Crede and W. Roberts, *Rep. Prog. Phys.* **76** (2013) 076301
[2] V. Kuznetsov *et al.*, *JETP Letters* **106** (2017) 693

*Supported by DFG through SFB/TR16.

HK 47.3 Do 14:45 HS 13
η' beam asymmetry at threshold using the BGO-OD experiment — •Stefan Alef for the BGO-OD-Collaboration — Physikalisches Institut Universität Bonn

The unexpected nodal structure of the beam asymmetry recently reported by the GRAAL collaboration in η' photoproduction very close to threshold could be explained by a previously unobserved very narrow resonance. Therefor, the measurement is important to be independently confirmed.
This possibility is offered by the BGO-OD experiment. It is well suited for the detection of forward going charged particles which in the threshold region of interest allows the identification of the reaction $\gamma p \to \eta' p$ solely based on the proton going in forward direction. This yields unprecedented statistics if in the missing mass analysis of the η' meson the background can be sufficiently well controlled. A linearly polarized photon beam produced via coherent bremsstrahlung off a diamond radiator makes it possible to measure the η' beam asymmetry.
In this talk I will present preliminary results on the determination of the η' beam asymmetry in several energy and angular bins close to threshold.

Supported by DFG (PN 50165297).

HK 47.4 Do 15:00 HS 13
Truncated partial wave analysis (TPWA) of the reactions $\gamma p \to \pi^0 p$ and $\gamma p \to \eta p$ — •Philipp Krönert[1], Yannick Wunderlich[1], Farah Afzal[1], Annika Thiel[2], and Reinhard Beck[1] for the CBELSA/TAPS-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]School of Physics & Astronomy, University of Glasgow

According to the current scientific knowledge, quarks are the fundamental components of the nucleon. Their interaction is described theoretically by quantum chromodynamics. The study of the excitation spectrum of the nucleon can validate and improve the understanding of the underlying theory.
A possible mechanism for the excitation of nucleon resonances is the photoproduction of mesons. The reaction of pseudoscalar meson photoproduction $\gamma N \to \varphi N$ in particular allows for the extraction of 16 polarization observables.
An introduction to a model-independent analysis scheme will be given in the talk, namely the technique of truncated partial wave analysis. This permits the study of different contributions from partial waves to the full reaction amplitude via so-called moment analysis. Furthermore, attempts can be made to extract partial waves, up to one overall phase, from polarisation data at single energies.

Preliminary results for the photoproduction reactions $\gamma p \to \pi^0 p$ and $\gamma p \to \eta p$ will be shown.

HK 47.5 Do 15:15 HS 13
Studying the p$-\Sigma^0$ interaction employing femtoscopy in AL-

ICE — •Andreas Mathis, Max Korwieser, and Laura Fabbietti for the ALICE-Collaboration — Technische Universität München, Physik Department E62, Excellence Cluster 'Universe'

Pioneering studies by the ALICE Collaboration demonstrated the potential of employing femtoscopy to investigate and constrain baryon−baryon interactions with unprecedented precision. In particular, the small size of the particle-emitting source in pp and p−Pb collision systems at ultrarelativistic energies is well suited to study short-ranged strong potentials. Newly developed analysis tools allow comparing the measured correlation function between the particle pairs of interest to theory predictions using either potentials or wave functions as input.

In this contribution, we present measurements of p−Σ^0 correlations by the ALICE Collaboration in high multiplicity triggered pp collisions at $\sqrt{s} = 13$ TeV. The p−Σ^0 interaction is investigated and constrained by comparing the measured correlation function to model predictions and determining the compatibility with a wide range of scattering parameters.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe' and the SFB 1258.

HK 47.6 Do 15:30 HS 13

Studying the Λ–Λ interaction and the existence of a H-dibaryon using femtoscopy — •Dimitar Mihaylov for the ALICE-Collaboration — Technische Universität München, James-Franck-Straße, 85748, Garching, Germany

The femtoscopy method can be used to investigate both the emission source and the interaction potential between particle pairs by measuring their correlation function. The small emission source in pp and p–Pb collision systems at TeV energies results in an enhanced sensitivity to the strong interaction potential. Thus femtoscopy studies performed at the LHC can provide deep insights into the interaction between different baryon pairs.

In this study the ALICE collaboration performed a combined analysis of three different data sets, namely pp at $\sqrt{s}$ =7,13 TeV and p–Pb $\sqrt{s_{\rm NN}}$ = 5.02 TeV, to investigate the Λ–Λ interaction potential. The emission source is obtained by using the p–p correlation as a reference, while the Λ–Λ interaction is studied within the effective range expansion, obtaining an exclusion plot for the scattering length and the effective range of the potential. The results allow to test the compatibility of different theoretical models to the ALICE data, as well as obtain tighter constraints on the allowed binding energy of the H-dibaryon, a hypothetical Λ–Λ bound state.

This work is supported by SFB1258.

HK 47.7 Do 15:45 HS 13

Femtoscotpic studies on proton-Ω correlations with ALICE — •Oton Vazquez Doce for the ALICE-Collaboration — TU - Munich

It has been recently demonstrated that for particle emitting sources of small size (of about 1fm), like those created after proton-proton collisions, the femtoscopic technique applied to baryon-baryon pairs allows to study the short range strong interaction between them. In this contribution the the study of correlations between proton-Ω produced in high-multiplicity proton-proton collisions at 13TeV measured by the ALICE collaboration will be presented. The experimentally obtained correlation in function of the relative momentum of the pair can be compared with predictions from local potentials. This research was supported by the DFG cluster of excellence *Origin and Structure of the Universe* and the SFB 1258.

HK 48: Heavy-Ion Collisions and QCD Phases IX

Zeit: Donnerstag 14:00–16:00 Raum: HS 15

Gruppenbericht HK 48.1 Do 14:00 HS 15

Electromagnetic radiation of hot and dense QCD matter formed in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 2.4 GeV — •Szymon Harabasz for the HADES-Collaboration — TU Darmstadt

In heavy-ion collisions at energies 1-2 GeV per nucleon the QCD matter reaches the baryon density a few times higher than normal nuclear matter density. Its properties can be studied by means of electromagnetic radiation.

HADES has investigated dileptons produced in N+N, N+A, A+A and π+A reactions in this energy regime. Spectra obtained in elementary hadron collisions support the validity of Vector Meson Dominance (VMD) model. The results from the largest system – Au+Au at $\sqrt{s_{\rm NN}}$ = 2.4 GeV – are characterized by nearly exponential shape of low invariant mass spectra. These findings suggest strong modification of vector meson spectral function in medium, due to coupling to abundant baryon resonances.

In this contribution, final results of differential data analysis will be presented and compared to the available model calculations. They will be accompanied by preliminary results on dilepton polarization and azimuthal anisotropy.

HK 48.2 Do 14:30 HS 15

4D track reconstruction in the CBM experiment — •Valentina Akishina for the CBM-Collaboration — Goethe-Universität, Frankfurt, Germany

The future heavy-ion Compressed Baryonic Matter (CBM) ex- periment will focus on the measurement of very rare probes at inter- action rates up to 10 MHz with data ow of up to 1 TB/s. The beam will provide free stream of beam particles without bunch structure. That requires full online event reconstruction and selection not only in space, but also in time, so-called 4D event building and selection. One of the most challenging reconstruction parts is the time-based reconstruction of tracks and grouping them into event-corresponding clusters. The core algorithms of the track reconstruction in CBM are Kalman lter and Cellular Automaton (CA) methods, which are used for the track reconstruction and tting. The algorithms are highly optimised with respect to speed and highly parallelised to be e ciently running online at the many-core architectures of the CBM online farm. The CA track nder algorithm used to reconstruct tracks in the main tracking detector Silicon Tracking System (STS) has been generalized and applied to simultaneous reconstruction of tracks in combined detector system STS and Muon Chamber (MuCh). Tests with simulated collisions have been performed. The resulting track reconstruction efciency is at the level of 90%.

HK 48.3 Do 14:45 HS 15

Very soft dielectron production in pp collisions at $\sqrt{s}$=13 TeV with ALICE — •Jerome Jung — Institut für Kernphysik, Goethe-Universität Frankfurt

Low-mass dielectrons present an exceptional tool to deepen our understanding of the Quark-Gluon Plasma (QGP) created in the collision of ultra-relativistic heavy-ions, since they are produced at all stages of the collision while being unaffected by the strong interaction. To single out the interesting signal characteristics of the QGP, the primordial e^+e^- pair production in vacuum has to be understood first.
At the Intersecting Storage Rings (ISR) at CERN, an excess of dielectron pairs over the expectation from know dielectron sources had been measured at low invariant mass and small pair $p_{\rm T,ee}$ in pp collisions at $\sqrt{s}$ = 63 GeV. In ALICE the reconstruction efficiency of low-$p_{\rm T}$ electrons can be increased by reducing the magnetic field of the central barrel solenoid. This allows a better electron background rejection and simultaneously gives the opportunity to access a similar phase space as the ISR experiments.
In this talk, results of the dielectron measurement in pp collisions at $\sqrt{s}$ = 13 TeV taken with reduced magnetic field will be presented including the analysis of new data from 2018. They are compared to the published nominal-field data, to illustrate the benefits of the low-field setting and to the expected yield from known hadronic sources to address the question of a possible excess at LHC energies.
Supported by BMBF and the Helmholtz Association.

HK 48.4 Do 15:00 HS 15

Dielectron production in p-Pb collisions at sqrt(sNN)= 5.02 TeV with ALICE — •Sebastian Scheid for the ALICE-Collaboration — IKF, Uni Frankfurt

Dileptons are a prime probe of the deconfined state of strongly-interacting matter, the Quark-Gluon Plasma (QGP), produced in high-energy heavy-ion collisions, as they are not affected by final-state in-

teractions and produced at all stages of the collision. A measurement of the thermal radiation from the QGP in the dielectron intermediate-mass region gives information on the medium temperature.

In this region, the main component of the dielectron continuum is coming from correlated semi-leptonic decays of D- and B-mesons, which may be affected by the interaction of the heavy quarks with the QGP or the modification of their production cross section via the parton distribution function in the heavy nuclei with respect to protons. The latter can be studied in proton-lead collisions. Moreover, a small contribution from thermal radiation from the hadronic and partonic phase of the collision is predicted in such collision systems.

In this talk, first measurements of correlated e^+e^- pairs in p-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE will be presented. In particular, we will show how the distance of closest approach (DCA) of the electrons to the primary vertex of the collision gives experimental means to single out dielectrons from heavy-flavour decays and provides constraints on a possible contribution from thermal radiation.

HK 48.5 Do 15:15 HS 15

Dielectron production in Pb–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with ALICE — •Carsten Klein — Institut für Kernphysik, Goethe-Universität Frankfurt

Electron-positron pairs are an excellent probe to investigate the properties of the Quark-Gluon Plasma (QGP) created in ultra-relativistic heavy-ion collisions. Because they are produced at all stages of the collision and do not interact strongly with the medium, their spectra reflect the entire space-time evolution of the system. At low invariant mass, the dielectron production is sensitive to the properties of vector mesons in the dense medium which is related to the predicted restoration of chiral symmetry. In the intermediate-mass region, the dielectron continuum gives further insight into the heavy-quark energy loss in the QGP via the measurement of correlated electron-positron pairs from charm- and beauty-hadron decays.

In this talk, preliminary results of the dielectron production in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE will be presented. For the first time in heavy-ion collisions, a hint for a suppression of the heavy-flavour production in comparison to the N_{coll}-scaled vacuum expectations is observed. Finally, the status of the measurement of virtual direct photons will be discussed.
Supported by BMBF

HK 48.6 Do 15:30 HS 15

Application of MVA techniques to the J/ψ measurement via the di-electron decay channel with ALICE at the LHC — •Alena Harlenderova for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

The J/ψ meson is an important probe of the Quark-Gluon Plasma due to the color screening of the quark-antiquark potential in the hot deconfined medium. At LHC energies, a strong reduction of J/ψ suppression in comparison to lower RHIC energies has been observed in Pb-Pb collisions, consistent with additional J/ψ production via (re)generation mechanisms. A precise measurement of J/ψ in pp collisions serves as a baseline for studies in Pb-Pb collisions.

At mid-rapidity, ALICE has the unique capability to reconstruct J/ψ down to zero p_T at the LHC. However, this measurement via the di-electron decay channel suffers from a small signal-to-background ratio, in particular in Pb-Pb collisions. The use of MultiVariate Analysis (MVA) techniques can help us to suppress the background while keeping the signal largely unaffected. The resulting larger signal significance leads to an improvement of the precision of the J/ψ measurement. In this talk, the application of MVA techniques to the J/ψ analysis via the di-electron decay channel will be presented.

HK 48.7 Do 15:45 HS 15

Measurement of electrons from heavy-flavour hadron decays in pp collisions at $\sqrt{s}$ = 8 TeV with ALICE at the LHC — •Regina Michel for the ALICE-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung — Technische Universität Darmstadt

Measurements of heavy-flavour production in proton-proton collisions are important as a reference for measurements in heavy-ion collisions and to test perturbative Quantum Chromo Dynamics (pQCD). Heavy-flavour hadron production can be investigated via the measurement of electrons from their semileptonic decays. In ALICE electrons can be identified via their specific energy loss dE/dx in the Time Projection Chamber (TPC) and their time of flight measured by the Time of Flight detector (TOF). To determine the inclusive electron sample it is important to estimate the hadron contamination by applying different TOF cuts to the candidate sample after the dE/dx selection. The inclusive electron sample has a contribution from heavy-flavour decays but also a substantial background, which consists mainly of electrons coming from photon conversions and Dalitz decays of light neutral mesons. This background needs to be quantified and subtracted via the photonic-tagging method, which reduces the sample to the yield of electrons from semileptonic decay of heavy-flavour hadrons. The current status of the analysis will be presented and the results will be discussed in the context of pQCD calculations and in view of corresponding measurements in Pb-Pb collisions.

HK 49: Structure and Dynamics of Nuclei IX

Zeit: Donnerstag 14:00–16:00 Raum: HS 14

Gruppenbericht HK 49.1 Do 14:00 HS 14

Consequences of broken axial symmetry in heavy nuclei - observed for surprisingly many spectroscopic features in the valley of stability — •Eckart Grosse[1], Arnd R. Junghans[2], Ralph Massarczyk[3], and Jon N. Wilson[4] — [1]IKTP, TU Dresden — [2]IRP, Helmholtz-Zentrum Dresden-Rossendorf, 01314 Dresden — [3]LANL, New Mexico 87545, USA — [4]INP and CNRS/IN2P3, F-91406 Orsay, France

When about 80 years ago the hyperfine structure observed in atomic spectra suggested the concept of nuclear deformation no experimental information on nuclear axiality was available. This lead to the ad-hoc assumption of symmetry about one axis and as this concept results in large advantages for theoretical concepts and calculations it became widely used for heavy nuclei and triaxiality was considered - if at all - only for a few nuclides, like in studies for odd nuclei [e.g. Toki and Faessler, Nucl. Phys. A253 (1975) 231], on e-m transitions to nonyrast levels [e.g. Casten et al., PRC 60 (1999) 021304] and regarding the splitting of magnetic strength [Palumbo and Richter, PLB 158 (1985) 101]. But more recent work on dipole strength in the IVGDR [Junghans et al.,J.Kor.PhSoc 59 (2011) 1872; Grosse et al., EPJA53 (2017) 225] and of low spin level densities [Grosse et al., PLB739 (2014) 1] showed triaxiality as being non-negligible for more or less all heavy nuclei. Present studies extending such predictions to all spins without using VMI fits for the yrast sequences indicate a surprising result for many heavy nuclei: Allowing a breaking of axial symmetry leads to their reasonable description with spin-independent moments of inertia.

HK 49.2 Do 14:30 HS 14

Shape coexistence in ^{178}Hg — •Claus Müller-Gatermann, Christoph Fransen, Alfred Dewald, Thomas Braunroth, Alina Goldkuhle, Julia Litzinger, Marcel Beckers, Karl-Oskar Zell, Andrey Blazhev, and Jan Jolie — Institut für Kernphysik, Köln, Deutschland

Since the first application of isotope-shift measurements a sharp shape transition in the ground states of light odd-mass mercury isotopes was observed, and shape coexistence near the Z=82 shell has been an actively studied phenomenon. In neutron-deficient even-mass mercury isotopes a weakly deformed oblate ground-state band is found to coexist with a more deformed prolate band. The prolate states are interpreted as a π(4p-6h) excitation across the Z=82 shell gap. The energy of this prolate structure is lowest in ^{182}Hg and shows a parabolic trend of excitation energy as a function of the neutron number. So far ^{180}Hg is the most exotic nucleus for which lifetimes of excited states are known. These can be used to determine model-independent B(E2)-values and absolute values of deformation employing the rotor model. A breakdown of the shape-coexistence is predicted with further decreasing neutron number. We will present lifetime measurements of excited states in ^{178}Hg using the Recoil Distance Doppler-Shift (RDDS) method. The recoil-decay tagging (RDT) technique was applied to select the ^{178}Hg nuclei and associate the prompt γ-rays with

the correlated characteristic ground state α-decay.

HK 49.3 Do 14:45 HS 14

New isomeric state and study of deformation of ^{200}Au — •P.R. John[1], J.J Valiente-Dobon[2], A. Dai[3], D. Mengoni[4,5], V. Modamio[1,6], S. Lunardi[4,5], C. Wheldon[7], D. Bazzacco[6], and N. Pietralla[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]Laboratori Nazionali di Legnaro, Legnaro, Italy — [3]School of Physics, Peking University, China — [4]Dipartimento di Fisica e Astronomia, Universitá di Padova, Italy — [5]Istituto Nazionale di Fisica Nucleare, Sezione di Padova, Italy — [6]Department of Physics, University of Oslo, Norway — [7]School of Physics and Astronomy, University of Birmingham, United Kingdom

The neutron-rich nucleus ^{200}Au is investigated via isomeric decay γ-ray spectroscopy in order to study the evolution of the 5^+ isomeric states and the shape in the very neutron-rich gold isotopes. Multi-nucleon transfer reactions were used to populate excited states of ^{200}Au and the Advanced Gamma Ray Tracking Array (AGATA) detected the delayed γ-ray transitions. The binary-partner method was applied and the level scheme of ^{200}Au was extended. The results are compared to Total Routhian Surface calculations.

HK 49.4 Do 15:00 HS 14

RDDS Lifetime Measurement on Zr-98 - Fixing the Critical Point of the Quantum Phase Transition — •W. Witt[1,2], V. Werner[1], N. Pietralla[1], C. Costache[1,3], T. Glodariu[3], P. John[1], R. Kern[1], P. Koseoglou[1,2], N. Marginean[3], R. Mihai[3], A. Mitu[3], S. Pascu[3], P. Petkov[3], L. Stan[3], A. Turturica[3], S. Ujeniuc[3], and J. Wiederhold[1] — [1]IKP TU Darmstadt, Darmstadt, Deutschland — [2]GSI, Darmstadt, Deutschland — [3]IFIN-HH, Magurele, Rumänien

Recent theoretical work emphasizes the contribution of the tensor interaction between nucleons to the structural evolution in nuclei [1]. The Zr isotopic chain was suggested as example of the predicted shape phase transition. Our previous experimental results [2] established the nucleus Zr-98 as closest to the critical point in this uniquely-abrupt structural change. The presented follow-up RDDS level lifetime measurement on Zr-98 significantly improves on the accuracy of the previous results and agrees with other recent result [3]. It allows further interpretation in the frame of type-II shell evolution and corresponding state-of-the art shell-model calculations.

[1] T. Togashi et al., Phys. Rev. Lett. 117, 172502 (2016)
[2] W. Witt et al., Phys. Rev. C 98, 041302(R) (2018)
[3] P. Singh et al., Phys. Rev. Lett. 121, 192501 (2018)

HK 49.5 Do 15:15 HS 14

Yrast transition strengths in ^{116}Te — •Christoph Fransen, Marcel Bast, Marcel Beckers, Thomas Braunroth, Alfred Dewald, Alina Goldkuhle, Jan Jolie, Julia Litzinger, and Claus Mueller-Gatermann — Institut für Kernphysik, Universität zu Köln

An anomalous behaviour of the $B(E2, 2_1^+ \to 0_1^+)$ and $B(E2, 4_1^+ \to 2_1^+)$ values was found in Sn isotopes below mid-shell. However, the puzzling $B(E2; 2_1^+ \to 0_1^+)$ systematics around $N = 60$ was understood very recently in state-of-the-art Monte-Carlo shell model calculations [1] by activating protons in the $1g_{9/2}$ orbit and a second-order quantum phase transition from the moderately deformed phase to the pairing (seniority) phase that occurs around $N = 66$. But a sharp drop of the $B(E2, 4_1^+ \to 2_1^+)$ values below $N = 66$ leading to unusual small $B(E2; 4_1^+ \to 2_1^+)/B(E2; 2_1^+ \to 0_1^+)$ values is not understood so far. In neighboring Te isotopes a similar situation seems to be present, where especially data on $B(E2; 4_1^+ \to 2_1^+)$ values are lacking that would allow a clear conclusion. In this framework ^{116}Te$_{64}$ represents an interesting case as it is just at the edge of the shape transition observed in neighboring Sn isotopes as is also supported by experimental data on ^{112,114}Te. Therefore, we determined $B(E2)$ values between the lowest states in ^{116}Te from level lifetimes measured with the recoil distance Doppler-shift method. We will present these results and relate them both to the systematics along the Te isotopic chain and to the interpretation of the Sn isotopes.

[1] T. Togashi et al., Phys. Rev. Lett. 121, 062501 (2018)

HK 49.6 Do 15:30 HS 14

High-spin structures of transitional Xe and Ba nuclei in the $50 \leq Z, N \leq 82$ region — •L. Kaya[1], A. Vogt[1], P. Reiter[1], M. Siciliano[2,3], and A. Gargano[4] — [1]IKP, Universität zu Köln — [2]INFN - LNL, Italy — [3]INFN Padova, Italy — [4]INFN Napoli, Italy

The 50 $\leq$ Z, N $\leq$ 82 region is a fertile testing ground for the predictions of modern shell-model calculations. Xe and Ba nuclei with $A \approx 130$ form an important link in the smooth evolution from spherical to deformed shapes. Transitional hard-to-reach Xe and Ba nuclei are investigated after multinucleon-transfer employing the γ-ray tracking array AGATA coupled to the mass spectrometer PRISMA and in several fusion-evaporation reactions employing the HORUS γ-ray array at the University of Cologne. The high-spin level schemes of ^{133}Xe, ^{135}Ba and ^{136}Ba are considerably extended. The identification of $J^\pi = 23/2^+$ isomers in the millisecond range in ^{133}Xe and ^{135}Ba closing a gap in the systematics along the $N = 79$ isotones towards the proton subshell-closure at $Z = 64$. Exploiting angular-correlation investigations, the ground-state band in ^{136}Ba was found to be interrupted by negative-parity states only a few hundred keV above the $J^\pi = 10^{(+)}$ isomer. Large-scale shell-model calculations employing the SN100PN, GCN50:82, and a realistic effective interaction reproduce the experimental findings and provide guidance to the interpretation of the observed high-spin features. Supported by the German BMBF (05P15PKFN9 TP1, 05P18PKFN9 TP1) and ENSAR-TNA03.

HK 49.7 Do 15:45 HS 14

Lifetime measurement on ^{177}Hf using the EXILL&FATIMA spectrometer — •Lukas Knafla[1], Jean-Marc Régis[1], Jan Jolie[1], Ulli Köster[2], Gabriela Thiamova[3], and Petr Alexa[4] for the EXILL-FATIMA-Collaboration — [1]Institut für Kernphysik, Universität zu Köln — [2]Institut Laue-Langevin, Grenoble — [3]LPSC Grenoble — [4]VŠB-Technical University of Ostrava

Lifetimes of high spin states in the odd-A nucleus ^{177}Hf were measured using the EXILL&FATIMA spectrometer equiped with eight HPGe-clover detectors and 16 fast-timing $LaBr_3$(Ce) detectors [1]. For the determination of lifetimes in the pico- to nanosecond regime, the well established Generalized Centroid Difference (GCD) method was used [2]. Lifetimes of ten states were measured including seven lifetimes that were determined for the first time. From these lifetimes reduced transition probabilities were extracted and compared to particle-rotor model (PRM) calculations and quasiparticle-phonon model (QPM) calculations.

[1] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. A 763 (2014)
[2] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. A 726 (2013)

HK 50: Structure and Dynamics of Nuclei X

Zeit: Donnerstag 14:00–15:45 Raum: HS 16

Gruppenbericht HK 50.1 Do 14:00 HS 16

Towards a direct energy determination of the ^{229}Th nuclear isomer — •Benedict Seiferle, Ines Amersdorffer, Lars von der Wense, and Peter G. Thirolf — LMU Munich, 85748 Garching, Germany.

The nuclear first excited state in ^{229}Th (^{229m}Th) offers the unique possibility of a direct optical control of a nucleus with today's laser technology. The energy of 7.8(5) eV and it's lifetime make it a promising candidate for a nuclear optical clock. The large uncertainty of the excitation energy, however, impedes progress towards a nuclear clock. Therefore the objective of our experiment is a precise determination of the excitation energy of ^{229m}Th via the measurement of electrons emitted during the internal conversion decay of the excited state. First measured spectra will be presented.

This work was supported by DFG (Th956/3-2) and by the EU's Horizon 2020 research and innovation programme under grant agreement 6674732 "nuClock".

HK 50.2 Do 14:30 HS 16

Towards a ^{229m}Th energy determination with 40 μeV

accuracy — •L. von der Wense[1], B. Seiferle[1], Ch. Schneider[2], J. Jeet[2], I. Amersdorffer[1], N. Arlt[1], F. Zacherl[1], R. Haas[3,4,5], D. Renisch[3,4], Pa. Mosel[6], Ph. Mosel[6], M. Kovacev[6], U. Morgner[6], Ch.E. Düllmann[3,4,5], E.R. Hudson[2], and P.G. Thirolf[1] — [1]Ludwig-Maximilians-Universität München — [2]University of California, Los Angeles — [3]Johannes Gutenberg-Universität Mainz — [4]Helmholtz-Institut Mainz — [5]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [6]Leibniz Universität Hannover

The development of a nuclear clock has been a long-standing objective [1]. There is only one nuclear excitation known which could allow for the development of a nuclear clock due to its exceptionally low energy of only a few eV above the ground state. This is the metastable first excited state in ^{229}Th [1, 2]. The development of a ^{229}Th-based nuclear clock is so far hindered by an insufficient knowledge of the excited state's energy. A new scheme of experimental search will be presented, which could allow to pin down the isomeric energy value to 40 μeV accuracy, thereby paving the way to the development of a nuclear clock [3]. The concept makes use of a direct nuclear laser excitation scheme.

[1] L. v.d.Wense et al., Nature 533, 47-51 (2016).
[2] B. Seiferle et al., PRL 118, 042501 (2017).
[3] L. v.d.Wense et al., PRL 119, 132503 (2017).

Supported by DFG grant TH956/3-2 and Horizon 2020 research and innovation programme under grant agreement 664732 “nuClock".

HK 50.3 Do 14:45 HS 16

Magnetic dipole moment predictions for ^{229}Th — •Adriana Pálffy[1] and Nikolay Minkov[1,2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]Institute of Nuclear Research and Nuclear Energy, Sofia, Bulgaria

The ^{229}Th actinide isotope has a $I = 3/2$ isomeric state lying only 7.8 eV above the ground state. This extremely small energy renders for the first time a nuclear transition accessible to vacuum ultraviolet lasers. Novel applications such as a nuclear frequency standard with unprecedented accuracy based on this transition are anticipated.

A recent laser spectroscopy experiment [1] has determined for the first time the magnetic dipole moment of the isomeric state. The measured value differs by a factor of approx. 5 from previous nuclear theory predictions based on the Nilsson model, raising questions about our understanding of the underlying nuclear structure. Here, we present a new theoretical prediction based on a nuclear model with coupled collective quadrupole-octupole and single-particle motions. Our calculations yield an isomer magnetic dipole moment of $\mu_{IS} = -0.35\mu_N$ in surprisingly good agreement with the experimentally determined value of $-0.37(6)\mu_N$, while overestimating the ground state dipole moment by a factor 1.4 [2]. The model provides further information on the states' parity mixing, the role and strength of the Coriolis mixing and the most probable value of the gyromagnetic ratio g_R and its consequences for the transition probability $B(M1)$.

[1] J. Thielking *et al.*, Nature (London) 556, 321 (2018).
[2] N. Minkov and A. Pálffy, arXiv:1812.03921 [nucl-th] (2018).

HK 50.4 Do 15:00 HS 16

Nuclear excitation by electron capture in a beam-target scenario — •Yuanbin Wu and Adriana Pálffy — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, D-69117 Heidelberg, Germany

A recent nuclear physics experiment [1] reports the first direct observation of nuclear excitation by electron capture (NEEC) in the depletion of the ^{93m}Mo isomer. The experiment used a beam-based setup in which Mo highly charged ions with nuclei in the isomeric state ^{93m}Mo at 2.4 MeV are slowed down in a solid-state target and electron recombination can excite the nucleus to produce isomer depletion via a triggering level lying 4.85 keV above the isomer. The reported excitation (and subsequent depletion) probability $P_{\text{exc}} = 0.01$ was attributed to the so-far unobserved process of NEEC.

In this work, we investigate theoretically the beam-based setup and calculate isomer depletion rates based on state-of-the-art NEEC cross sections [2] and different ion stopping power models. For all scenarios, our calculated NEEC probability is several orders of magnitude smaller than the measured P_{exc}. This large discrepancy suggests that the observed isomer depletion has a different underlying nuclear excitation mechanism than NEEC.

[1] C. J. Chiara, J. J. Carroll, M. P. Carpenter, *et al.*, Nature 554, 216 (2018).
[2] Y. Wu, J. Gunst, C.H. Keitel, and A. Pálffy, Phys. Rev. Lett. 120, 052504 (2018).

HK 50.5 Do 15:15 HS 16

Laser-assisted nuclear excitation by electron capture — •Pavlo Bilous and Adriana Pálffy — Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, D-69117 Heidelberg, Germany

Transitions within the low-lying nuclear spectrum can often efficiently couple to the atomic shell [1]. The process of laser-assisted nuclear excitation by electron capture (LANEEC) is an excitation mechanism for low-lying nuclear levels via photoionization of the electronic shell with an X-ray photon with subsequent nuclear excitation by electron capture (NEEC). NEEC is the time-reversed process of internal conversion. The electron can recombine either into a vacancy in an open electronic shell or with a hole created prior to NEEC with another X-ray photon.

On the one hand, LANEEC may allow usage of X-ray free-electron lasers (XFEL) for nuclear excitations at energies which cannot be reached by direct photoexcitation today, for instance, the nuclear state at 29.19 keV of the ^{229}Th isotope. On the other hand, the LANEEC process could provide especially large enhancement for highly forbidden transitions, such as the excitation of the 76 eV isomer in ^{235}U proceeding via an electric octupole (E3) channel. In this work we consider the LANEEC process for nuclear excitation in several isotope species and compare the obtained rates to the ones achievable in direct one- or two-photon excitation which do not involve the electronic shell. The obtained results may be useful in the area of X-ray quantum optics with nuclei.

[1] A. Pálffy, Contemporary Phys. 51, 471 (2010).

HK 50.6 Do 15:30 HS 16

Sudden regime of laser-nucleus interaction — •Sergei Kobzak, Hans Weidenmüller, and Adriana Pálffy — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

Recent experimental developments in laser physics and laser-driven acceleration promise to deliver coherent photon beams with energies ranging up to several MeV. Novel experiments employing a laser beam with photon energies comparable to typical nuclear excitation energies will shed light on a number of questions and will open new unexplored avenues for nuclear physics [1,2].

In this work we investigate theoretically the interaction between coherent gamma-ray laser pulses and medium-weight or heavy nuclei. The time-dependent interplay between the average photon absorption, the compound nucleus statistical equilibration rate and the neutron evaporation rate is studied with the help of the master equation [2]. The sudden regime of laser-nucleus interaction refers to the case when photon absorption occurs faster than the nuclear equilibration of the nucleus. Consequently, nucleons are excited independently and are expelled from the common average potential. Multiple photon absorption may lead to complete evaporation of the nucleus if the duration of the laser pulse of several MeV per photon is long enough. We investigate the time scale and the characteristic parameters for the sudden regime.

[1] A. Pálffy and H. A. Weidenmüller, Phys. Rev. Lett. 112, 192502 (2014).
[2] A. Pálffy, O. Buss, A. Hoefer and H. A. Weidenmüller, Phys. Rev. C 92, 044619 (2015).

HK 51: Nuclear Astrophysics IV

Zeit: Donnerstag 14:00–15:15 Raum: HS 18

Gruppenbericht HK 51.1 Do 14:00 HS 18

Nuclear Pasta Matter in the Intermediate Density Regime — •Bastian Schuetrumpf and Gabriel Martínez-Pinedo — GSI Helmholzzentrum für Schwerionenforschung, Planckstraße 1, 64291 Darmstadt, Germany

Nuclear matter as present on earth in the center of atoms is almost isotropic with a central density of the nuclear saturation density. This changes drastically in astrophysical environments such as neutron stars or core-collapse supernova. In particular, in the inner crust of neutron stars at sub-saturation densities (10% - 80% of saturation density), nucleonic matter is expected to form complex structures commonly referred to as "pasta" phases. Because of high densities at macroscopic dimensions, pasta phases represent a unique environment, which is not present on earth and cannot be recreated in the laboratory.

In my talk I will focus on density functional theory calculations of different topologies of nuclear pasta matter and its properties, such as the static structure factor which quantifies the influence e.g. on neutrino opacity. In detail I will present the slab configuration as well a several minimal surface configuration. It turns out that the binding energy per nucleon is very similar for all configurations. In contrast, the properties of the different configurations are very divers.

HK 51.2 Do 14:30 HS 18

Signals in the tidal deformability for phase transitions in compact stars with constraints from GW170817 — •Jan-Erik Christian, Andreas Zacchi, and Jürgen Schaffner-Bielich — Institut für Theoretische Physik, Goethe-Universität Frankfurt

Since the measurement of the merger event GW170817 tidal deformabilies are pivotal in constraining the equation of state for compact stars. We compute the tidal deformabilities for equations of state with a strong first order phase transition producing a new separate branch in the mass-radius diagram. A case is found where all three possible pairs of combinations between these two neutron star branches are present for the total mass of $M = 2.7_{\odot}$ of the observed merger event GW170817. It is demonstrated that the plot of the two tidal deformabilities Λ_1 and Λ_2 of the binary neutron star can show up to three separate branches. We propose that the future detections of neutron star merger events with the same value for Λ_1 but different values of Λ_2 serve as a signal for the existence of a strong first order phase transition in neutron star matter.

HK 51.3 Do 14:45 HS 18

Neutron star merger accretion discs — •Christian Schwebler[1,2], Kevin Ebinger[1,2], and Gabriel Martínez Pinedo[1,2] — [1]Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]Gesellschaft für Schwerionenforschung Darmstadt, Planckstr. 1, D-64259 Darmstadt, Germany

The merger of binary neutron stars results in the formation of a hyper massive neutron star or a black hole and an accretion disk. During the merger a part of the material outflows as dynamical ejecta and from the disc secular ejecta gets expelled which is an important source of rapid neutron capture (r-process) nucleosynthesis which produces heavy elements like gold. To understand how and what amounts of heavy elements are created in this scenarios we investigate the conditions in these accretion disks and the outflowing material with general-relativistic hydrodynamic simulations using the Einstein Toolkit.

HK 51.4 Do 15:00 HS 18

Exploring the astrophysical conditions for the creation of the first r-process peak — •Stylianos Nikas[1,2], Andre Sieverding[1,2], Gabriel Martinez - Pinedo[1,2], and Meng Ru Wu[3] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [3]Institute of Astronomy and Astrophysics, Academia Sinica, Taipei, Taiwan

The r-process is responsible for the production of about half of the heavy elements observed in the solar abundances. The site of the r-process was unknown until recent observations. The gravitational wave event GW170817, which was identified as a binary Neutron Star Merger (NSM), was followed by the detection of fast fading optical counterpart consistent with the predictions for a kilonova, associated with r-process nucleosynthesis. The observation of bright, fast fading UV component, established the production of heavy element in the aftermath of NSM.

The complicated atomic structure of lanthanides implies high opacity ejecta which would shift the wavelength of the observed light to the red, the blue color of the ejecta indicates relatively high Y_e and consequently low lanthanide production. We present a study of nucleosynthesis for conditions of high Y_e outflows from NSMs and investigate the effect of various nuclear properties and the astrophysical conditions under which this could be the site for the production of the elements of the r-process abundance pattern for A < 100.

This work was supported by DFG through Grant No. SFB1245 and HGS-HIRe.

HK 52: Instrumentation XI, Accelerators and Applications

Zeit: Donnerstag 14:00–16:00 Raum: HS 11

Gruppenbericht HK 52.1 Do 14:00 HS 11

The strangness S=-2 nuclear physics setup at PANDA: status and prospects — Patrick Achenbach, Sebastian Bleser, Michael Bölting, Josef Pochodzalla, Birte Sauer, Falk Schupp, and •Marcell Steinen for the PANDA-Collaboration — Helmholtz Institute Mainz, Johannes Gutenberg University, 55099 Mainz

PANDA at FAIR will address the physics of strange baryons with S=-2 in nuclei by several novel and unique measurements. In particular, PANDA will extend the studies on double hypernuclei by performing high resolution γ-spectroscopy of these nuclei for the first. Furthermore, PANDA offers the unique possibility to search for X-rays from very heavy hyperatoms as e.g. Ξ^--^{208}Pb. This will complement experiments at J-PARC which attempt to measure X-rays in medium-heavy nuclei. Finally, the exclusive production of hyperon-antihyperon pairs close to their production threshold in $\overline{p}$ - nucleus collisions offers a unique and hitherto unexplored opportunity to elucidate the behaviour of antihyperons in nuclei.

In this contribution we will review the strangness $S = -2$ nuclear physics program at PANDA with emphasis on the hyperatom part. We will also present the design of the detection system and the current status of the prototype. Test results of the various detector components will be discussed.

HK 52.2 Do 14:30 HS 11

A feedback system to minimize the electron bunch arrival-time jitter between femtosecond laser pulses and electron bunches for Laser-Driven Plasma Wakefield Accelerators — •Stefano Mattiello[1], Holger Schlarb[2], and Andreas Penirschke[1] — [1]Technische Hochschule Mittelhessen, Friedberg, Deutschland — [2]DESY, Hamburg, Deutschland

In a laser driven plasma based particle accelerator a stable synchronization of the electron bunch and of the plasma wake field in the range of less than 2 fs is necessary in order to optimize the acceleration. For this purpose we are developing a new shot to shot feedback system with a time resolution of less than 1 fs. We plane to generate stable THz pulses by optical rectification of a fraction of the plasma generating high energy laser pulses in a nonlinear lithium niobate crystal. With these pulses we will energy modulate the electron bunches shot to shot before the plasma to achieve the time resolution. In this contribution we will focus on realization aspects of the shot to shot feedback system and the lithium niobate crystal itself. Here we compare different approximations for the modeling of the generation dynamics (second order or first order calculation) and of the dielectric function (influence of the dispersion relation, of the free carries generated by the pump adsorption and their saturation, depletion of the pump) in order to investigate the importance of a detailed description of the optical

properties for the THz generation.

HK 52.3 Do 14:45 HS 11

Upgrade of the FRS Ion Catcher RFQ beamline — •Lizzy Gröf[1], Daler Amanbayev[1], Samuel Ayet[1,2], Sönke Beck[2], Julian Bergmann[1], Timo Dickel[1,2], Hans Geissel[1,2], Florian Greiner[1], Christine Hornung[1], Jennifer Koch[2,3], Israel Mardor[4,5], Ivan Miskun[1], Wolfgang Plass[1,2], and Christoph Scheidenberger[1,2] — [1]Justus-Liebig Universität Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Beuth Hochschule für Technik, Berlin, Germnay — [4]Soreq NRC, Yavne, Israel — [5]Tel Aviv University, Israel

At the FRS Ion Catcher at GSI high precision mass measurements of thermalized exotic nuclei can be performed. Projectile and fission fragments are produced at the FRS at relativistic energies, seperated in-flight and slowed-down and thermalized in a cryogenic stopping cell (CSC). The FRS Ion Catcher consists of three main parts, the CSC, an RFQ beamline and a multiple-reflection time-of-flight mass-spectrometer (MR-TOF-MS). The RFQ beamline connects the CSC and the MR-TOF-MS. Its upgrade includes new features, for example a Laser Ablation Carbon Cluster Ion Source (LACCI). It can provide ions for calibration over a broad mass range with masses close to the ions of interest and is ideally suited for the requirements of MR-TOF-MS. Another part of the upgrade is an RFQ mass filter, which allows an additional stage of mass selection before the ions reach the MR-TOF-MS. Futhermore the upgrade improves the differential pumping of the system, which leads to a higher stopping efficiency. The RFQ beamline and its upgrade will be presented.

HK 52.4 Do 15:00 HS 11

Material studies for the DarkMESA calorimeter — •Mirco Christmann[1], Patrick Achenbach[1], Sebastian Baunack[1], Paul Felix Burger[1], Achim Denig[1], Luca Doria[1], and Frank Maas[2] for the MAGIX-Collaboration — [1]Institut für Kernphysik Mainz — [2]Helmholtz-Institut Mainz

At the Institute for Nuclear Physics in Mainz the new electron accelerator MESA will go into operation within the next years. In the extracted beam operation (155 MeV, 150 μA) the P2 experiment will operate 10,000 hours. Therefore, the high-power beam dump of this experiment is ideally suited for a parasitic dark sector experiment.

Currently, DarkMESA is studied with a simulation based on MadGraph and Geant4. Theoretically, dark photons γ' are generated in the beam dump by a process analog to electromagnetic bremsstrahlung and decay invisibly to pairs of dark matter particles. Behind the beam dump, electrons scattered off by dark matter particles can be detected in a calorimeter.

The simulation was extended by an optical photon study, where the response of possible calorimeter materials – PbF_2, BGO, the lead glasses SF5, SF6 and SF57HTultra – was examined. In this contribution the simulation outcomes are compared with the results of first prototypes tested at MAMI with 6 to 14 MeV electrons.

In the first stage of DarkMESA we will use more than 1,000 PbF_2 crystals from the previous A4 experiment. Exclusion limits for the different stages of DarkMESA will be discussed and the current status of a prototype detector array including a veto system will be presented.

HK 52.5 Do 15:15 HS 11

Characterization of organo-metallic liquids for a novel PET detector — •Simon Peters[1], Konstantin Bolwin[2], Björn Gerke[2], Volker Hannen[1], Christian Huhmann[1], Klaus Schäfers[2], and Christian Weinheimer[1] — [1]Institut für Kernphysik, WWU Münster — [2]European Institute for Molecular Imaging, WWU Münster

Recently, a new type of PET detector has been proposed using a heavy organo-metallic liquid - TriMethyl Bismuth (TMBi) - as target material. TMBi is a transparent liquid with 82% by weight of Bismuth as the heaviest non-radioactive element. 511 keV photons from annihilation processes are effectively converted to photo-electrons in the material due to the high Z bismuth component. These photo-electrons produce both Cherenkov light and charges in the liquid. While the optical component enables a fast timing, a charge readout using a segmented anode can provide an accurate position reconstruction.
The charge measurement requires a high level of purification of the liquid to remove any electro-negative contaminations. In addition, as charge multiplication in the liquid is not an option, the readout of the pulses requires extremely low noise electronics. To be able to compare to existing results from literature, first test measurements were performed using Tetra-Methyl-Si as detection medium. The talk will present the setup of a test bench for purification and current / pulse detection and thereby characterization of the organo-metallic liquid under study. This work is supported by DFG via the Cells-in-Motion Cluster of Excellence.

HK 52.6 Do 15:30 HS 11

Applications of Neutron Depth Profiling at the N4DP Instrument at the Heinz Maier-Leibnitz Zentrum — •Markus Trunk[1], Lukas Werner[1], Bastian Märkisch[1], Ralph Gilles[2], Zsolt Revay[2], Morten Wetjen[3], Fabian Linsenmann[3], Hubert Gasteiger[3], and Roman Gernhäuser[1] — [1]TUM, Physik Department, Garching b. München — [2]TUM, Heinz Maier-Leibnitz Zentrum, Garching b. München — [3]TUM, Lehrstuhl für Technische Elektrochemie, Garching b. München

Neutron Depth Profiling (NDP) is a non-destructive, isotope-specific, high-resolution nuclear analytical technique, which is often used to probe lithium or boron concentration profiles in different host materials. The presented N4DP experiment is carried out at the PGAA facility of Heinz Maier-Leibnitz Zentrum, which provides a cold neutron flux up to 5E10 s-1cm-2. When a neutron is captured the investigated Li-6 nuclei undergo nuclear reactions and emit charged particles with well-defined energies and the energy loss of the charged particles traveling through the host material is related to the depth of origin at a resolution level up to a few ten nanometers. We investigated NDP on several applications such as heat-treated superalloys with boron additives and OLED prototypes with lithium. In this contribution lithium concentration profile measurements in different lithium-ion battery components are presented. Here NDP reveals new insights into the evolution of immobilized lithium in battery electrodes, which is one of the main causes of battery lifetime limitation.

HK 52.7 Do 15:45 HS 11

Investigation of non-depolarizing neutron guide coatings for neutron beta decay studies with PERC — •Alexander Hollering[1], Thorsten Lauer[3], Bastian Märkisch[1], and Ulrich Schmidt[2] — [1]TUM — [2]Universität Heidelberg — [3]Movatec GmbH

Neutron beta decay is a sensitive tool to search for non-V-A couplings beyond the Standard model in the charged weak interaction. The PERC instrument, which is currently under construction at the MLZ, Garching, aims to measure correlation parameters in neutron beta decay with an accuracy improved by one order of magnitude to a level of 10^{-4}. This also requires control of the neutron polarization on the same level. Inside the PERC instrument an 8 m long neutron guide is used as decay volume in a magnetic field of 1.5 Tesla and is fed by a highly polarized cold neutron beam. Supermirror neutron guides are usually made of hundreds of nanometer thin layers from nickel and titanium on a glass substrate. But the nickel is magnetized by the magnetic field which leads to depolarization of the neutron beam even for layers made of nickel alloy with vanadium added. In order to ensure a depolarization of the neutron beam on the level of 10^{-4} per bounce, completely non-magnetic coatings preferably made of diamagnetic materials are required. We present results on mirrors made from copper and titanium layers with excellent reflectivity. Despite copper is well known for its high mobility, which lead to degradation of the reflectivity caused by interdiffusion, our supermirrors are highly resistant to baking-out. We present an element analysis of the supermirrors via elastic recoil detection and reflectivity measurements.

HK 53: Instrumentation XII

Zeit: Donnerstag 14:00–16:00 Raum: HS 12

Gruppenbericht HK 53.1 Do 14:00 HS 12

Status of the CBM Time-of-Flight system — •Ingo Deppner and Norbert Herrmann — Physikalisches Institut, Uni Heidelberg

To provide particle identification (PID) of charged hadrons at the future high-rate Compressed Baryonic Matter (CBM) experiment the collaboration has developed a large-area Time-of-Flight (ToF) wall equipped with multi-gap resistive plate chambers (MRPC). The MRPC detectors were designed and tested in beam to maintain an efficiency of at least 95varying particle fluxes of up to a few kHz/cm^2. Prior to its destined operation at the Facility for Antiproton and Ion Research (FAIR) - starting in 2025 - this high-rate timing MRPC technology will be used for physics research at two scientific pillars of the FAIR Phase-0 program: the end-cap TOF upgrade of the STAR experiment at RHIC and the mTOF wall of the mCBM experiment at SIS18. At STAR, the fixed- target program of the Beam Energy Scan II (BES-II) will rely on 108 CBM MRPC detectors for forward PID at interaction rates of up to 2 kHz with 2.9 to 30.3 AGeV Au beams. At mCBM, high-performance benchmark runs of Λ production at top SIS18 energies (1.5/1.9 AGeV for Au/Ni beams) and CBM design interaction rates of 10 MHz will become feasible with a PID backbone consisting of 25 CBM MRPC detectors. Apart from the physics perspective, these pre-FAIR involvements will help gathering experience in operating the final CBM TOF wall with about 1500 MRPC detectors and 110,000 readout channels. The project is partially funded by BMBF 05P15VHFC1.

HK 53.2 Do 14:30 HS 12

Analysis of CBM - TOF module response with cosmic rays — •Dennis Sauter for the CBM-Collaboration — Physikalisches Institut, Universität Heidelberg, Deutschland

The future Compressed Baryonic Matter (CBM) experiment is planned to utilize MRPC detectors for its 120 m^2 large ToF wall. To reconstruct the majority of the produced particles at an interaction rate of up to 10 MHz, it is of utmost importance that detection efficiency reaches upper values close to 100of 50-60 ps. The MRPC prototypes 3a & 3b are planned to be used in the intermediate and low rate region of the wall with expected fluxes of a few kHz/cm^2. Utilizing cosmic muon radiation, these prototypes were extensively tested before exposing them to their designed rate, which will happen in the mCBM experiment in 2019 at GSI. With a test setup of 6 stacked MRPCs and through analysis with the CBM Tracker class it was possible to verify the required level of performance on both types. In addition, signals of particles that seemed to come from below the setup were found. This property of the tracker allowed for distinguishing between muons and their decay products, electrons.

HK 53.3 Do 14:45 HS 12

Commissioning and calibration of a precision high voltage divider for the electron cooler at CRYRING@ESR — •Daniel Winzen[1], Ilian Denesjuk[1], Volker Hannen[1], Wilfried Nörtershäuser[2], Hans-Werner Ortjohann[1], Oliver Rest[1], and Christian Weinheimer[1] — [1]WWU Münster — [2]TU Darmstadt

In high precision experiments at ion storage rings the velocity of the ions is a critical quantity. For measurements at CRYRING@ESR (GSI/FAIR) the electron cooler determines the ion velocity and momentum spread of the stored ions by superimposing the ion beam with a mono-energetic electron beam. Therefore, a precise knowledge of the acceleration voltage used to produce the electron beam is essential for the accuracy of the experiments. At the University of Münster we constructed a precision divider for voltages up to 35 kV with a similar design to the well-established and tested KATRIN dividers (K35 and K65) that were developed in Münster in cooperation with the PTB.
We will present calibration and stability measurements that characterize the performance of the high voltage divider. With a novel absolute calibration method the voltage dependency of the dividers scale factors could be measured to the ppm-level. As a consequence, it is possible to conduct ppm-precise voltage measurements over the whole 35 kV range of the divider. This work was supported by BMBF under contract number 05P15PMFAA, GSI F&E project MSWEIN1416 and HGS-HIRe for FAIR.

HK 53.4 Do 15:00 HS 12

Comissioning of the $\overline{\text{P}}$ANDA Cluster-Jet Target at COSY — •Benjamin Hetz, Daniel Bonaventura, Silke Grieser, Daniel Klostermann, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The internal cluster-jet target build up and already routinely in operation at the University of Münster will be the phase one target for the upcoming $\overline{\text{P}}$ANDA experiment at the antiproton storage ring HESR at FAIR. In June 2018 this target was transfered from Münster to the COSY accelerator at FZ Jülich and setup up in next to $\overline{\text{P}}$ANDA geometry. In August 2018 a first commissioning beam time has been performed with the desired $\overline{\text{P}}$ANDA at HESR target thickness of more than 10^{15} atoms/cm^2 and first data on a rich experimental program was gained. This includes, e.g., beam-target interaction, energy loss studies, Schottky measurements, beam heating investigations, emittance growth by the target, and the physical data quality was investigated using the WASA forward detection system by studying the π^0 production reaction in pp-collisions. Furthermore, the $\overline{\text{P}}$ANDA cluster-jet target has been used very successfully in additional beam times in combination with the HESR/COSY stochastic cooling and 2 MeV electron cooler, yielding important insights into the later HESR cooling performance with highest target thickness and high accelerator beam current. Results of this beam times and the upcoming experimental program of the $\overline{\text{P}}$ANDA cluster-jet target at COSY will be presented within this talk.

HK 53.5 Do 15:15 HS 12

Gas Flow Simulations for the Design of Jet Nozzles for Cluster-Jet Targets — •Philipp Brand, Daniel Bonaventura, Silke Grieser, Alfons Khoukaz, and Lukas Lessmann for the MAGIX-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The future MAGIX experiment (MESA Gas Internal target eXperiment) aims for high precision measurements of the electromagnetic form factors, the astrophysical S-factor and for the search of the dark photon. It will be located in the energy recovery arc of the electron accelerator MESA (Mainz Energy-recovering Superconducting Accelerator) which will deliver an 105 MeV electron beam with currents of up to 10 mA. To achieve luminosities of 10^{35} cm^{-2}s^{-1}, target thicknesses up to 10^{19} atoms/cm^2 are required which will be fulfilled directly behind the nozzle of a windowless cluster-jet target designed and built up at the University of Münster. Due to the high gas load this target works close to the transition from a gas jet to a cluster-jet target which makes the nozzle design crucial. For a complete understanding of the expansion process within the nozzle, computational fluid dynamics (CFD) is used to simulate the gas flow through different nozzle designs. The results of these simulations are presented and compared to measurements performed at MAMI (MAinz MIcrotron) with the MAGIX target. Finally, the consequences of the different nozzle designs for the cluster production are discussed.

HK 53.6 Do 15:30 HS 12

Collinear Laser Spectroscopy for High Voltage Metrology at 1 ppm relative precision — •Patrick Mueller[1], Joerg Kraemer[1], Kristian Koenig[1], Christopher Geppert[2], Phillip Imgram[1], Bernhard Maass[1], Johann Meisner[3], Ernst W. Otten[4], Stephan Passon[3], Tim Ratajczyk[1], Johannes Ullmann[1,5], and Wilfried Noertershaeuser[1] — [1]Inst. f. Kernphysik, Technische Universitaet Darmstadt — [2]Inst. f. Kernchemie, Johannes Gutenberg Universitaet Mainz — [3]Physikalisch-Technische Bundesanstalt, Braunschweig — [4]Inst. f. Physik, Johannes Gutenberg Universitaet Mainz — [5]Inst. f. Kernphysik, WWU Muenster

Electrostatic acceleration or deceleration is an integral part of many nuclear and atomic physics experiments. If the goal is to exactly define or measure a particle's kinetic energy, accurate high voltage measurements become inevitable. The best high-voltage dividers provide accuracy at the 1-ppm level by scaling down high voltages via resistor chains, however regular elaborate calibration and cross checking is needed. This process can be obviated by directly attributing voltage to frequency, exploiting the Doppler effect on accelerated ions. We report on improved measurements at the ALIVE experiment at TU Darmstadt for high voltage determination using a pump-and-probe

approach on accelerated Ca^+ ions using two lasers to address the Ca^+ ions before and after the acceleration. In the latest configuration a relative precision of 1 ppm was achieved. The absolute nature of the measurement allows the definition of a new high voltage standard and constitutes a reliable calibration apparatus for high voltage dividers.

HK 53.7 Do 15:45 HS 12

Investigations of the KATRIN interspectrometer Penning trap — •Mariia Fedkevych — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, Deutschland

The KArlsruhe TRItium Neutrino experiment (KATRIN) is aiming to probe the average electron (anti)neutrino mass with a sensitivity of 0.2 eV/c^2 (90 % C.L.). It uses a pair of electrostatic spectrometers of MAC-E filter type to analyze energies of electrons from tritium-β-decay. In the region between the spectrometers, a Penning trap is created by their retarding potentials combined with the magnetic field produced by a superconducting magnet. Electrons accumulating in this trap can lead to discharges which create additional background and may damage parts of the spectrometer and detector section of KATRIN. To counteract this problem, electron catchers were implemented in the beamline part between the two spectrometers to remove trapped electrons. The system was comissioned and showed its effectiveness for suppression of the Penning trap effects. Details of the measurements and experimental results will be presented. This work is supported under BMBF contract 05A17PM3.

HK 54: Poster

Zeit: Donnerstag 16:30–19:00 Raum: Foyer Nordbau

HK 54.1 Do 16:30 Foyer Nordbau

Search for exotic states in $e^+e^- \to \gamma\eta'\pi^+\pi^-$ above 4 GeV with the BESIII experiment — •Frederik Weidner, Johannes Bloms, Nils Hüsken, Johannes Kellers, Alfons Khoukaz, and Marcel Rump — Westfälische Wilhelms-Universität Münster, Münster, Germany

In the search for states in the charmonium energy region many particles have been found which could not be described by conventional $c\bar{c}$ states. Examples for these charmonium-like states are the X(3872) with quantum numbers $J^{PC} = 1^{++}$ or the Y(4260) with $J^{PC} = 1^{--}$. To obtain information on the nature of theses states, it is essential to determine their decay patterns which might give hints on their internal structure.
With the BESIII detector charmonium and charmonium-like states with $J^{PC} = 1^{--}$ can be investigated directly via the annihilation of an electron and a positron provided by BEPCII. Based on a previous BESIII analysis on $J/\psi \to \gamma\eta'\pi^+\pi^-$, the process $e^+e^- \to \gamma\eta'\pi^+\pi^-$ is studied. For this purpose 15 datasets in the energy region of 4.0 GeV $\leq \sqrt{s} \leq$ 4.6 GeV, each with an integrated luminosity of $L_{\text{int}} > 480\,\text{pb}^{-1}$, are used. In addition to the search for charmonium(-like) contributions, the subsystem $\eta'\pi^+\pi^-$ gives access to resonances in the light hadron sector. Here, different resonances like the X(1835) have been reported, whose quantum mechanical nature has not yet been determined.
The current status of the analysis will be presented.

HK 54.2 Do 16:30 Foyer Nordbau

Analysis of $e^+e^- \to (\gamma/\pi^+\pi^-)J/\psi\pi^+\pi^-$ at BESIII — •Johannes Bloms, Nils Hüsken, Johannes Kellers, Alfons Khoukaz, Marcel Rump, and Frederik Weidner — Westfälische Wilhelms-Universität Münster, Münster, Germany

The region of the charmonium and charmonium-like spectrum around 3.9 GeV/c^2 is a highly interesting one due to the observation of several unexpected states that do not fit the quark anti-quark assignment.
In 2006, the Belle Collaboration found a peak in the mass spectrum of $D\bar{D}$ mesons with $M = 3929 \pm 6\,\text{MeV}/c^2$ and $\Gamma = 29 \pm 10\,\text{MeV}$ called the $X(3930)$ with $J^{PC} = 2^{++}$. Hence, this state was assigned to the $\chi_{c2}(2P)$ charmonium state.
In 2008, the BaBar Collaboration observed a resonance in the $B \to J/\psi\omega K$ decay, which was later reported by Belle in the $\gamma\gamma \to \omega J/\psi$ process at $M = 3915^{\pm 3}_{\pm 2}\,\text{MeV}/c^2$ and $\Gamma = 17^{\pm 10}_{\pm 3}\,\text{MeV}$ and finally confirmed by BaBar with $J^{PC} = 0^{++}$.
However, recent studies have altered the previous situation. The scalar $X(3915)$ just might be the helicity-0 realisation of the tensor $X(3930)$. The latter one also might be the $s = 2$ partner of the $X(3872)$ which is assumed to be a $D\bar{D}^*$ bound state.
Since the $X(3915)$ was only observed in the $\omega J/\psi$ decay channel so far, other channels have to be searched for. The current status of the analysis will be discussed. This work has been supported by the Deutsche Forschungsgemeinschaft (DFG) through the Research Training Group "GRK 2149: Strong and Weak Interactions - from Hadrons to Dark Matter".

HK 54.3 Do 16:30 Foyer Nordbau

Extraction of $A_{sin(\phi)}^{LU}$ moments from the hard exclusive $\pi+$ channel off the unpolarized hydrogen target in a wide range of kinematics with CLAS at 5.5 GeV — •Stefan Diehl for the CLAS-Collaboration — University of Connecticut, Storrs, USA — Justus Liebig University Giessen, Giessen, Germany

For the first time, we have measured single beam spin asymmetries to extract $A_{sin(\phi)}^{LU}$ moments from the hard exclusive π^+ channel off the unpolarized hydrogen target in a wide range of kinematics from forward angles to backward angles in the center of mass frame. The measured moment in forward angles is known to be sensitive to generalized parton distributions (GPDs), while in backward angles, it is known to be sensitive to transition distribution amplitudes (TDAs). Our results clearly show that the sign of forward beam spin asymmetry measurements is positive whereas that of backward BSA measurements is negative, with the sign transition taking place around 90 degrees. By performing accurate measurements over a wide range of Q^2 and t, we can explore the transition from hadronic to partonic reaction mechanisms.

*The work is supported by DOE grant no: DE-FG02-04ER41309.

HK 54.4 Do 16:30 Foyer Nordbau

Proton-Xi interaction studied via the femtoscopy method in p-Pb collisions measured by ALICE — •Bernhard Hohlweger for the ALICE-Collaboration — TU Munich, Physics Department E62, ExcellenceCluster Universe Garching

Femtoscopic studies of Baryon-Baryon pairs opens a new era of studying two particle interactions at colliders. In particular, small collision systems prove to be particularly well suited to probe the short-ranged strong potentials. Experimental data are compared to local potentials with the newly developed Correlation Analysis Tool using the Schrödinger Equation (CATS). This analysis is based on the data measured by the ALICE Collaboration from p-Pb collisions at 5.02 TeV and the correlation function is obtained for pairs of protons and Ξs. For the first time, an attractive strong interaction is observed between the two particles is observed with a significance of more than 3σ. Lattice calculations by the HAL QCD to model the latter are validated and are used to explore the implications of including the newly found attractive p-Ξ interaction in the description of neutron stars.

HK 54.5 Do 16:30 Foyer Nordbau

Σ^0 Baryon Production in pp Collisions at $\sqrt{s} = 13$ TeV measured with the ALICE experiment — •Maximilian Korwieser, Andreas Mathis, and Laura Fabbietti for the ALICE-Collaboration — Technische Universität München, Physik Department E62, Excellence Cluster 'Universe', Garching

In the quest of understanding heavy neutron stars the equation of state for dense fermionic systems is investigated under the hypothesis of hyperons as additional degrees of freedom. A necessary condition to allow for a systematic exploration of this ansatz is an in depth understanding of the Hyperon-Nucleon interaction. In reality, however, for the majority of hyperons experimental constraints of the interaction are scarce. Complementing the canonical methods of studying these interactions via means of hypernuclei decays and scattering data, femtoscopy could allow to probe some interactions for the very first time.

As a first step, the production of the Σ^0 baryon at an unprecedented energy of $\sqrt{s} = 13$ TeV in minimum bias and high multiplicity triggered pp collisions is measured. The Σ^0 baryon is reconstructed via the decay $\Sigma^0 \to \Lambda\gamma$ with subsequent decays $\Lambda \to p\pi$ in coincidence with a di-electron pair stemming from photon conversions employing the unique

capability of the ALICE detector to measure low energy photons. The yield of the Σ^0 is compared to that of Λ baryons, which albeit sharing the quark content differ in isospin.

This research was supported by the DFG cluster of excellence 'Origin and Structure of the Universe' and the SFB 1258.

HK 54.6 Do 16:30 Foyer Nordbau

Measurements of Baryons Electro-magnetic From Factors at BESIII — •Samer Ahmed[1], Alaa Dbeyssi[1], Paul Larin[1], Frank Maas[1,2,3], Christoph Rosner[1], and Yadi Wang[1] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA Cluster of Excellence, Mainz, Germany

Electro-magnetic form factors are unique experimental tools not only in describing the internal structure of hadrons and testing QCD-inspired models but also in many areas of hadron and nuclear physics including charge-radii determination, parity-violating experiments, etc. They can be measured in space- and time-like regions via scattering and annihilation experiments, respectively. Form Factors in the time-like region are not as precisely measured as those measured in the space-like region, therefore different data samples being collected at Beijing Spectrometer III (BESIII) in the Beijing Electron Positron Collider II (BEPCII) are used for measuring time-like form factors which in turn leads to enhance the knowledge of hadrons structure. In this contribution, we report the recent results of measuring electromagnetic form factors of baryons at the BESIII experiment.

HK 54.7 Do 16:30 Foyer Nordbau

Investigating the decays $J/\psi \to \phi K^+K^-$ and $J/\psi \to \phi K^0_S K^0_S$ with the BESIII experiment — •Nils Hüsken, Johannes Bloms, Johannes Kellers, Alfons Khoukaz, Marcel Rump, and Frederik Weidner — Westfälische Wilhelms-Universität Münster, Münster, Deutschland

The decays of the lightest charmonium vector state, the J/ψ, into a vector and two pseudoscalar particles present an ideal opportunity to study scalar and tensor resonances through their decays into a pair of pseudoscalar mesons. While gluon-rich radiative decays are exploited in the search for light glueballs, decays involving massive vector mesons like the ω or the ϕ offer some insight into the quark content of the scalar and tensor resonances. Specifically, decays of the type $J/\psi \to \phi K\bar{K}$ strongly couple to those resonances containing large $s\bar{s}$ components. In a previous analysis based on 58×10^6 J/ψ decays gathered with BESII, the $f_0(980)$, $f_0(1710)$ and the $f_2'(1525)$, among other intermediate resonances, were found to strongly contribute to the $J/\psi \to \phi K^+K^-$ decay. Assuming isospin symmetry, it is expected that decays involving either K^+K^- or $K^0_S K^0_S$ pairs only differ by a scaling factor. Using the world's largest dataset of roughly 5.9×10^9 J/ψ decays this assumption is explored by investigation of the decays $J/\psi \to \phi K^+K^-$ and $J/\psi \to \phi K^0_S K^0_S$ in a partial wave analysis. Resonant contributions to the $J/\psi \to \phi K\bar{K}$ decay amplitude can be investigated with increased statistical precision, while the simultaneous consideration of the two different decay channels allows sensitivity to isospin violating contributions. The current status of the analysis will be discussed.

HK 54.8 Do 16:30 Foyer Nordbau

Radiation hard environmental monitoring sensors inside the PANDA calorimeter — •Yannik Bettner, Kai-Thomas Brinkmann, Christopher Hahn, Markus Moritz, and Hans-Georg Zaunick for the PANDA-Collaboration — Justus-Liebig Universität Gießen, 2.Physikalisches Institut

The future PANDA experiment at FAIR will investigate quantum chromodynamics with unprecedented precision. Its target calorimeter is composed of lead tungstate crystals operating at -25°C. Therefore, an important aspect is the monitoring of temperature, relative humidity and pressure by suitable sensors, in particular close to the front-end electronic to avoid water or even ice formation. The BME280 and the SHT21 sensors were investigated through measurements assessing their performance in the planned setup. Accuracies with respect to the above observables and radiation resistance will be presented. This work was supported by BMBF and HIC for FAIR.

HK 54.9 Do 16:30 Foyer Nordbau

Extracting the Chiral Anomaly from Primakoff Reactions in COMPASS Data — •Dominik Steffen for the COMPASS-Collaboration — Physik-Department E18, Technische Universität München

The COMPASS collaboration at CERN has measured pion-photon scattering reactions via the Primakoff effect. In these reactions, high-energetic pions scatter off quasi-real photons stemming from the Coulomb field of nuclei with high atomic number. The single-π^0 production $\pi^-\gamma^{(*)} \to \pi^-\pi^0$ shows a strong contribution of the $\rho(770)$ resonance in the invariant-mass spectrum of the $\pi^-\pi^0$ system. On the low-mass side of the $\rho(770)$ contribution, close to the kinematic threshold, a tail is present in the spectrum which is not driven by a resonance but by the chiral anomaly: the non-resonant production of a π^0 is only possible by the point-like coupling of the photon to three pions defined by the respective coupling constant $F_{3\pi}$ called chiral anomaly. Previous extractions of the chiral anomaly date back to the Serpukhov experiment in 1987, are restricted to the kinematic threshold region, and extracted the chiral anomaly to a 10%-level. COMPASS measured the invariant mass spectrum including the $\rho(770)$-resonance which allows for more precise extraction of $F_{3\pi}$. The contribution will present the status of the analysis.

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

HK 54.10 Do 16:30 Foyer Nordbau

Antideuteron annihilation with the ALICE detector material — •Anisa Dashi and Lucas Cordova Nyffenegger for the ALICE-Collaboration — Technical University Munich, Germany

Low energy antideuterons could be a unique probe for indirect search of dark matter. This measurement is limited by our understanding of the interaction of antideuteron with matter. There is no scattering data available with any material and therefore we propose to study the interaction of antideuterons with the detector material of the ALICE detector at the Large Hadron Collider.

In this poster, the first steps of the analysis are presented, starting from the identification of primary (anti-)protons and (anti-)deuterons produced in pp collisions at 13 TeV (both Minimum Bias and High Multiplicity) and pPb collisions at 5 TeV. The indications for antiparticle absorption in the ALICE detector material are discussed on the basis of antiparticle/particle ratios and simulations using the GEANT4 toolkit.

HK 54.11 Do 16:30 Foyer Nordbau

Study of the effect of strong resonance decays on the emitting source in baryon-baryon femtoscopy with EPOS — •Gerhard Huber for the ALICE-Collaboration — TUM Munich

The femtoscopy technique has been used, in heavy-ions and pp collisions, to investigate both the emission source and the interaction potential between particle pairs by measuring their correlation function. For such studies, the emitting source has been generally assumed to have a Gaussian profile With the achievement of high precision femtoscopic data in pp collisions RUN 2 with ALICE and the improved knowledge of the underlying interaction it is possible to study the effect of strong resonances and collective effects on the profile source. Transport models as EPOS are tuned to describe the full dynamics of pp collisions at ALICE energies and are able to provide the space-time emitting source of the produced particles including resonances decay and rescattering which lead to non-gaussian contributions. This source can hence be used in femtoscopic analysis tools, as CATS, to evaluate the theoretical correlation function and compare it to experimental data.

In this poster we will present a detailed analysis on the effects of strong resonance decays on the emitting source, obtained with EPOS model simulations for pp collisions in ALICE. We will show the comparison of the resulting correlation function for different particle pairs, proton-proton and proton-Λ, with recent ALICE data in pp collisions at $\sqrt{s} = 13$ TeV.

HK 54.12 Do 16:30 Foyer Nordbau

Radiative corrections on $\bar{p}p \to e^+e^-$ with the PANDA experiment at FAIR — •Manuel Zambrana[1,2], Alaa Dbeyssi[1], Frank Maas[1,2,3], Egle Tomasi-Gustafsson[4], Yury M. Bystritskiy[5], Vladimir A. Zykunov[5], Samer Ahmed[1,2], Luigi Capozza[1], Phillip Grasemann[1,2], Oliver Noll[1,2], David Rodríguez Piñeiro[1], Sahra Wolff[1,2], and Iris Zimmermann[1,2] — [1]Helmholtz-Institut Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany — [3]Prisma Cluster of Excellence, Mainz, Germany — [4]CEA, IRFU, SPhN, Saclay, France — [5]Joint Institute for Nuclear Research, Dubna, Russia

First order radiative corrections to $\bar{p}p \to e^+e^-$ have been calculated in

the proton point-like approximation, including both virtual and real corrections, and interference effects. Soft and hard photon emission regimes are covered in the calculation. In the soft photon regime, divergences from singular virtual diagrams are cancelled in pairs with the corresponding ones from real diagrams. On the other hand, the regularisation of infrared divergences of the bremsstrahlung cross section is achieved by the use of a small photon mass as a parameter, which makes the calculation suitable in both the soft and hard photon regime. The calculated cross section is the basis of an event generator to be used in the framework of the future PANDA experiment, where the expected precision in the measurement of the timelike electromagnetic form factors of the proton will demand a next-to-leading order differential cross section.

HK 54.13 Do 16:30 Foyer Nordbau

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

This contribution reports on the measurements of the $e^+e^- \to \bar{p}p$ cross section using the initial state radiation technique at the BESIII experiment in Beijing. Two independant analyses with detected and undetected initial state radiation photons have been perfomered. The two analyses are based on data sets, corresponding to an integrated luminosity of 7.4 fb^{-1}, collected at center of mass energies between 3.773 and 4.600 GeV. The results on the measured $e^+e^- \to \bar{p}p$ cross section and the proton form factors in the time-like region are presented.

HK 54.14 Do 16:30 Foyer Nordbau

Production of $\pi^0\eta$ pairs on nucleons and nuclei — •Vahe Sokhoyan for the A2-Collaboration — Universität Mainz, Institut für Kernphysik

The A2 Collaboration performs a manifold research program using real photons in the Crystal Ball/TAPS experiment at the MAMI accelerator facility in Mainz. The experiments are carried out with high-intensity unpolarized, linearly or circularly polarized photon beams, and unpolarized or polarized targets. The Crystal Ball/TAPS setup provides almost complete coverage in solid angle and is well suited for the detection of multi-particle final states. In order to probe the internal structure of the nucleon, the spectrum of baryon resonances is studied via measurements of unpolarized cross-sections and various polarization observables in single and double meson photoproduction.

The new data presented in this poster provide the world's best statistical accuracy in the energy range from threshold to $E_\gamma = 1.45\,\mathrm{GeV}$ for the $\gamma p \to p\pi^0\eta$ reaction. The results obtained for the unpolarized cross section and beam helicity asymmetry are compared with exisiting models. Moreover, the possible modifications of the $D_{33}(1700)$ resonance in the nuclear medium were studied using the production of $\pi^0\eta$ pairs on heavier targets (carbon, aluminum, lead) and the beam helicity asymmetry has been extracted for these targets for the first time.

HK 54.15 Do 16:30 Foyer Nordbau

In-medium properties of Λ in π^--induced reactions at 1.7 GeV/c — •Steffen Maurus for the HADES-Collaboration — Physik Department, TUM, Garching, Germany — Excellence Cluster "Universe", Garching, Germany

The existence of a two solar mass neutron star, gives strong boundaries to the equation of state (EOS) and models describing such dense objects. While more experiments offer data which reduce the allowed phase space, the appearance of hyperons in the nucleus of the neutron star is still a discussed topic. For all these EOS, the hyperon-nucleon interaction plays a crucial role. Of particular interest is the Λ hyperon, which should appear first because it is the lightest hyperon. In 2014, the HADES collaboration measured $\pi^- + A$ (A = C, W) reactions at an incident secondary pion beam momentum of 1.7 GeV/c. Since the pion-nucleon cross section is rather sizeable, hyperon production takes place at the surface of the nucleus. This is an ideal system, since the path length of the produced hyperons through the nuclear matter is quite large. In our experimental approach we choose the exclusive channel of $\pi^- + p \to \Lambda + K^0$, in both nuclear environment. Using the GiBUU-transport code, we can test different scenarios involving different couplings of Λ with the normal nuclear environment in combination with K^0. One of these scenarios also includes for the first time a repulsive Σ^0 potential, predicted by the χ effective theory. We will report on the ongoing analysis and demonstrate our sensitivity to the different scenarios of the in-medium propagation.

Supported by the Excellence Cluster "Universe" and SFB 1258

HK 54.16 Do 16:30 Foyer Nordbau

Monte Carlo Templates in the Measurement of Neutral Pions with the ALICE EMCal — •Marvin Hemmer for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

A hot and dense medium, the so-called quark-gluon plasma (QGP), is believed to be created in ultra-relativistic heavy-ion collisions. The dedicated heavy-ion experiment ALICE at the LHC is designed to study the properties of the QGP. Measurements in pp collisions function as a baseline for the measurements in Pb-Pb collisions and further provide insights into the particle production processes. In the ALICE experiment, neutral pions (π^0) can be measured via their two-photon decay channel, using one of the calorimeters EMCal, DCal and PHOS.

In this poster, a study of the background subtraction in the π^0 measurement in pp collisions at $\sqrt{s} = 13$ TeV with the EMCal using Monte Carlo templates will be presented.

Supported by BMBF and the Helmholtz Association.

HK 54.17 Do 16:30 Foyer Nordbau

Transverse momentum spectra of charged particles in pp collisions at $\sqrt{s} = 5.02$ TeV — •Youssef El Mard Bouziani for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at the LHC is designed to study the properties of the Quark-Gluon Plasma which is believed to be created in heavy-ion collisions. To distinguish medium effects from QCD vacuum effects a reference measurement of charge particle production in pp collisions is compared to the one in Pb-Pb collisions by means of the nuclear modification factor.

In previous measurements, charge particle production in pp collisions at $\sqrt{s} = 5.02$ TeV, recorded in 2015, was limited to a transverse momentum $p_T < 50$ GeV/c. With the much higher statistics of the 2017 data sets, a more precise analysis with higher p_T reach and finer p_T binning is possible.

In this poster, we present an analysis of the cross section of charge particle production in pp collisions at $\sqrt{s} = 5.02$ TeV based on these data sets.

Supported by BMBF and the Helmholtz Association.

HK 54.18 Do 16:30 Foyer Nordbau

Investigations on light (ant-)hypernuclei with ALICE at the LHC — •Janik Ditzel for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN copious production of light (anti-)(hyper-)nuclei has been measured in Pb–Pb collisions by the ALICE Collaboration. The excellent performance of the Inner Tracking System, the Time Projection Chamber and the Time-Of-Flight detector of the ALICE apparatus provide a clear identification and separation of primary produced light (anti-)nuclei from secondaries. ALICE is currently starting its upgrade of the detector setup to cope with the interaction rate of 50 kHz in Pb–Pb collisions. This will lead to an even larger sample of light (anti-)(hyper-)nuclei. One object to study is the hypertriton - a bound state of a proton, a neutron and a Λ hyperon. It is reconstructed by reconstructing its decay products, e.g. in the charged two-body decay channel ${}^3_\Lambda\mathrm{H} \to {}^3\mathrm{He} + \pi^-$. In order to predict the yields of the (anti-)hypertriton and also (double-)(anti-)(hyper-)hypernuclei of mass number A=4 and A=5, it is essential to study the acceptance x efficiency in Monte Carlo simulations. The investiagted decay channel channels are: ${}^5_\Lambda\mathrm{He} \to {}^4\mathrm{He} + \mathrm{p} + \pi^-$, ${}^5_\Lambda\mathrm{He} \to {}^3\mathrm{He} + \mathrm{d} + \pi^-$, ${}^4_\Lambda\mathrm{He} \to {}^3\mathrm{He} + \mathrm{p} + \pi^-$, ${}^4_\Lambda\mathrm{H} \to {}^4\mathrm{He} + \pi^-$, ${}^4_\Lambda\mathrm{H} \to \mathrm{t} + \mathrm{p} + \pi^-$ and ${}^4_{\Lambda\Lambda}\mathrm{H} \to {}^4_\Lambda\mathrm{He} + \pi^-$. We will present the status of the investigations of these (double-)(anti-)(hyper-)hypernuclei.

HK 54.19 Do 16:30 Foyer Nordbau

Predictions for particle production in Ag+Ag collisions at $E_{kin} = 1.67A$ GeV from a hadronic transport approach — •Natey Kübler — Institute for Theoretical Physics, Goethe University, Frankfurt am Main, Germany

The production of particles in heavy ion collisions is of great importance to inspect the properties and dynamics of hadronic matter. As part of the HADES experiment at GSI Ag+Ag collisions at beam en-

ergies of 1.67A GeV are going to be performed in spring 2019. In the light of these experimental studies this work provides a theoretical prediction of the expected results. The hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) is applied in order to predict the production of particles (protons, pions, kaons) and their respective distributions in phase space. In addition to the analysis of multiplicities and rapidity spectra, the mean transverse masses for different centrality classes are explored. In this context the hadronic spectra are confronted with earlier HADES results for Au+Au and C+C collisions in order to study the system size dependence. Furthermore, predictions for the invariant mass spectra of dielectron emission are provided.

HK 54.20 Do 16:30 Foyer Nordbau

Symmetry-plane correlations in flow analyses — •Marcel Lesch — Technical University of Munich, James-Franck-Str. 1, 85748 Garching, Germany

Multiparticle correlations build from azimuthal angles whose distributions were parameterized with the Fourier series expansion, depend generically on two distinct degrees of freedom: flow harmonics v_n and symmetry-planes Ψ_n. While analyses techniques for flow harmonics v_n have advanced over the past years, robust and unbiased techniques for analyzing symmetry-planes Ψ_n still need to be developed. In this poster we summarize the recent improvements in this direction.

HK 54.21 Do 16:30 Foyer Nordbau

A surface coalescence model for proton-nucleus collisions — •Ailec de la Caridad Bell Hechavarria — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

A theoretical surface coalescence approach was developed to describe the production of light clusters (nuclei) in nucleon-nucleus reactions at moderate energies. A semi-classical Wigner distribution is used to describe the coalescence phase space. Calculated differential production cross sections for $A \leq 4$ are compared to experimental data in p-Au collisions at a proton beam kinetic energy of 1.2 GeV. The model describes the data well for small emission angles and shows some differences to data for larger angles.

HK 54.22 Do 16:30 Foyer Nordbau

Monte Carlo studies of charged particle production in proton-proton collisions with ALICE — •Kristina Schmitt for the ALICE-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt

The ALICE experiment at CERN-LHC is dedicated to study the properties of the so-called Quark-Gluon Plasma by investigating high-energy pp, p-Pb and Pb-Pb collisions. To obtain detector independent results, corrections facilitating Monte Carlo generators such as PYTHIA are indispensable. For the corrections it is crucial that the generators accurately describe the particle collisions. Apart from theoretical concepts, phenomenological models and input parameters are used in the simulations. These input parameters cannot be determined theoretically and need to be tuned to experimental measurements.

In this poster, we present a systematic analysis of transverse momentum (p_T) distributions of charged particles for different center of mass energies generated with different tunes of the PYTHIA8 Monte Carlo generator. A comparison of PYTHIA8-tunes employing moments of the p_T distributions per charged multiplicity interval will be discussed with particular focus on mapping physical aspects of the collisions to certain Monte Carlo tune parameters.

Supported by BMBF and the Helmholtz Association

HK 54.23 Do 16:30 Foyer Nordbau

Search for the hypertriton via its three-body-decay — •Holger Huck for the HADES-Collaboration — Institut für Kernphysik, Goethe-Uni, Frankfurt, Deutschland

We use Au+Au heavy ion collisions at 1.23A GeV to search for ${}^{3}_{\Lambda}H$-hypernuclei via it's three-body-decay in d, p and π^-. After particle identification, we apply topological restrictions based on the weak decay to find a signal in the invariant mass spectrum. The uncorrelated combinatorical background is estimated with the mixed-event-method. Because of the similar Λ-decay in p and π^-, there is a source of correlated background which has to be taken into account. With the help of simulation we introduce an invariant mass cut on combined p and π^- to seperate the correlated background from free Λ-hyperon from the ${}^{3}_{\Lambda}H$-sample.

HK 54.24 Do 16:30 Foyer Nordbau

Inelastic $(e, e'\gamma)$ scattering from ^{12}C and ^{92}Zr nuclei — •Doris Jakubassa-Amundsen[1] and Vladimir Ponomarev[2] — [1]Mathematisches Institut, LMU Muenchen — [2]Institut fuer Kernphysik, TU Darmstadt

At the S-DALINAC there are electron scattering experiments in preparation which will concentrate on low-lying nuclear excitations and their subsequent radiative decay for beam energies around 70-100 MeV. By allowing for a clear separation from the background of high-spin states, such coincidence experiments are aimed at investigating nuclear structure properties of low-lying 2^+ states of spin-zero nuclei. Within the QPM and the DWBA theory, we provide theoretical predictions for the excitation of the 2^+_1 and 2^+_2 states of ^{92}Zr, but we also discuss the 2^+_1 excitation of ^{12}C which was pioneered in an early experiment in 1984. Particular emphasis will be laid on the 2^+-subshell excitations, on the photon angular distributions and on the role of bremsstrahlung as a competing process to nuclear excitation and decay.

HK 54.25 Do 16:30 Foyer Nordbau

Fast-Timing lifetime measurement of ^{150}Gd — •J. Wiederhold[1], N. Pietralla[1], V. Werner[1], W. Witt[1,2], E. Aciksöz[1], N. Marginean[3], D. G. Ghita[3], R. Marginean[3], C. R. Nita[3], R. Lica[3], N. Florea[3], S. Pascu[3], D. Bucurescu[3], D. M. Filipescu[3], C. Mihai[3], and R. Mihai[3] — [1]Institut für Kernphysik, TU-Darmstadt, Deutschland — [2]GSI, Darmstadt, Deutschland — [3]IFIN-HH, Bucharest, Rumänien

The region of the nuclear chart around the neutron number $N = 90$ is an example for a rapid change of structure as a function of nucleon number, i.e. shape-phase transition from spherical to quadrupole-deformed nuclei. Several observables, e.g. $\rho^2(E0; 0^+_{gs} \rightarrow 0^+_2)$ are promising signatures for a quantum phase transition. The aim of the experiment was to determine the mean lifetime of the first-excited 0^+ state of ^{150}Gd and other lifetimes in the ps - ns range.
Excited states of ^{150}Gd were populated using the ^{147}Sm(α,n)^{150}Gd fusion-evaporation reaction. The ions were produced at the IFIN-HH in Bucharest, Magurele, and accelerated with the 9 MV FN-Tandem accelerator to a beam energy of 17.5 MeV. De-excitation γ rays were detected with the RoSphere detector array in a configuration with 14 HPGe detectors and 11 $LaBr_3$:Ce detectors for fast-timing applications. This work was supported by the DFG under the grants SFB 634 and SFB 1245 and the BMBF under the grant 05P15RDFN1 within the collaboration 05P15 NuSTAR R&D and 05P15(18)RDFN9.

HK 54.26 Do 16:30 Foyer Nordbau

Analysis of excited low-spin states in ^{164}Dy via (p,p'γ) — •F. Kluwig, A. Bohn, V. Everwyn, M. Färber, S. G. Pickstone, S. Prill, M. Weinert, J. Wilhelmy, and A. Zilges — University of Cologne, Institute for Nuclear Physics

Many nuclear-level lifetimes of low-spin states in the rare-earth nucleus ^{164}Dy are still unknown. Therefore a (p,p'γ) experiment was performed at the combined detector setup SONIC@HORUS in Cologne. SONIC@HORUS consists of the γ-ray detector array HORUS equipped with 14 HPGe detectors and the particle detection array SONIC with up to 12 Si (PIPS) detectors (as singles or ΔE-E telescopes) [1]. At SONIC@HORUS the Doppler-shift attenuation method (DSAM) using the p-γ-coincidence technique is an established method to determine lifetimes of excited nuclear levels in the sub-picosecond range [2,3]. Using DSAM three lifetimes of nuclear-levels in ^{164}Dy were determined, two of them for the first time. Additionally, several branching ratios were extracted. In this contribution, the results of the lifetime measurement as well as the extracted branching ratios will be presented.
Supported by DFG (ZI 510/9-1). AB is supported by the Bonn-Cologne Graduate School of Physics and Astronomy.
[1] S. G. Pickstone *et al.*, NIM A **875** (2017) 104.
[2] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319.
[3] A. Hennig *et al.*, NIM A **794** (2015) 171.

HK 54.27 Do 16:30 Foyer Nordbau

Study of γ-spectroscopy of neutron-rich cerium isotopes after fission — •U. Ahmed[1], P. Koseoglou[1,2], V. Werner[1], N. Pietralla[1], J. Wiederhold[1], M. Thürauf[1], M. Jentschel[3], A. Blanc[3], G. de France[4], U. Köster[3], S. Leoni[5], P. Mutti[3], G. Simpson[6], T. Soldner[3], C. Ur[7,8], W. Urban[3,9], S. Ilieva[1], R. B. Cakirili[10], J. Jolie[11], T. Kröll[1], J.-M. Régis[11], and N. Saed-Samii[11] — [1]IKP - TU Darmstadt, Germany — [2]GSI, Germany — [3]ILL, France — [4]GANIL, France — [5]Universita di Milano, Italy —

[6]LPSC, Université Grenoble Alpes, France — [7]Universita di Padova, Italy — [8]ELI-NP, Romania — [9]University of Warsaw, Poland — [10]MPIK Heidelberg, Germany — [11]IKP Universität zu Köln, Germany

^{148}Ce and ^{150}Ce isotopes are located in an area of the nuclear chart known for a quantum shape phase transition from spherical to deformed nuclei [1]. The energies of the band-heads of the β- and γ-vibrations are valuable indicators for the shape of a nucleus.
At the Institute Laue-Langevin, neutron-rich cerium isotopes were produced by cold-neutron induced fission of ^{235}U. The prompt γ-rays were measured with the EXILL spectrometer [2], comprised of 8 HPGe clover detectors. The data were analysed using γ-spectroscopy coincidence techniques, e.g. including coincidence conditions with fission partners. These techniques were explored and applied to the search for the 0_2^+-states of ^{148}Ce and ^{150}Ce. Supported by BMBF under Grant No. 05P15RDFN1.
[1] R. F. Casten, Nature Physics 2, 811 (2006).
[2] M. Jentschel *et al.*, JINST 12, P11003 (2017).

HK 54.28 Do 16:30 Foyer Nordbau

Nucleon-Nucleon correlations in SMASH — •Damjan Mitrovic[1,2], Alba Soto Ontoso[2,3,4], and Jan Hammelmann[1,2] — [1]Frankfurt Institue for Advanced Studies, Frankfurt, Germany — [2]Goethe-Universität, Frankfurt, Germany — [3]Brookhaven National Laboratory, Upton, NY, USA — [4]Universidad de Granada, Granada, Spain

In this work, the effect of short range correlations at the nucleonic level are investigated within a hadronic transport approach, SMASH (Simulating Many Accelerated Strongly-interacting Hadrons). Most transport approaches in the literature model the initial nuclei by sampling random positions for the nucleons according to Woods-Saxon distribution, that is, neglecting short-range correlations. Our goal is to improve the traditional approach by implementing in SMASH the nuclear configurations computed my M. Alvioli et al. that include realistic nucleon-nucleon correlations. The impact of NN correlations is studied in the context of the initial state of a heavy ion collision. Further, the eccentricity and its fluctuations are investigated, which are highly relevant for the study of collective phenomena in heavy ion collisions.

HK 54.29 Do 16:30 Foyer Nordbau

Field Emission Electron Source and Diagnostics for the PUMA Ion Trap — •Jonas Fischer, Noritsugu Nakatsuka, and Alexandre Obertelli — TU Darmstadt, Darmstadt, Germany

The goal of the PUMA (antiProton Unstable Matter Annihilation) experiment is to investigate the density distribution of short-lived nuclei. This is to be achieved by the annihilation of antiprotons, after capture, with the outermost part of the nucleus' density distribution. To make this measurement possible one has to transport antiprotons to a radioactive ion beam facility. PUMA will be placed at the ELENA and ISOLDE facilities at CERN. For the storage of the $\bar{p}$ and the collision with the nuclei a cryogenic Penning trap is being built. Approximately one billion antiprotons will be stored in the trap and cooled by sympathetic electron cooling. In this work the design of a cryogenic field emission electron gun is detailed. Also the development of destructive and non-destructive diagnostics for antiproton cloud shape, charge and position is described.

HK 54.30 Do 16:30 Foyer Nordbau

Stability Simulations of the $\bar{p}$ Cloud in the PUMA Trap — •Alexander Schmidt, Alexandre Obertelli, Oliver Boine-Frankenheim, and Noritsugu Nakastuka — TU Darmstadt, Darmstadt, Germany

The PUMA (antiProton Unstable Matter Annihilation) project aims at the investigation of the nucleon density tails of short-lived nuclei by the means of nucleon-antiproton annihilations. These antiprotons will be trapped in a Penning trap at the ELENA facility of CERN and afterwards transported to ISOLDE for measurements. Due to the small amount of exotic nuclei with large neutron or proton excess that can be produced at ISOLDE, as many $\bar{p}$ as possible need to trapped to get sufficient statistics. Such large numbers of antiprotons in the trap volume imply repulsive internal space charge fields which need to be compensated. The present work aims at the simulation of the $\bar{p}$ cloud in the trap and the behaviour of the plasma during sympathetic cooling by electrons.

HK 54.31 Do 16:30 Foyer Nordbau

One-nucleon removal from ^{14}O at 100 MeV/nucleon with a thin hydrogen target — •Thomas Pohl, Yelei Sun, and Alexandre Obertelli — TU Darmstadt, Darmstadt, Germany

One-nucleon removal reactions at intermediate energies are an important tool for nuclear structure studies, but the reaction mechanism is still not fully understood. One unexplained phenomenon is the asymmetric parallel momentum distribution (PMD) of the residual nucleus observed in some occasions [1-3]. Recently, theoretical calculations with the distorted-wave impulse approximation (DWIA) have predicted a large asymmetric PMD for *(p,pN)* reactions of ^{14}O [4]. The asymmetric shape of the PMD is found to be due to the phase volume effect and the attractive potential of the residues and the outgoing nucleons. Quantitative comparison with experimental data is essential to verify the predicted effects and establish a basis for further spectroscopic factor studies at medium energy facilities. Therefore we performed an experiment with ^{14}O beam at 100 MeV/nucleon impinging on a 2-mm thick solid hydrogen target at RIBF at RIKEN. The momentum of the knockout residues were measured by the SAMURAI spectrometer. On the proposed poster, details of the experiment and the current status of the analysis will be presented.

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[3] F. Flavigny *et al.*, Phys. Rev. Lett. 108, 252501 (2012).
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HK 54.32 Do 16:30 Foyer Nordbau

Plasma screening effects in laser-generated plasmas — •David Elsing, Adriana Pálffy, and Yuanbin Wu — Max-Planck-Institut für Kernphysik, Heidelberg

In hot and dense astrophysical plasmas, the reaction rate of nuclear reactions is modified by the plasma screening. Direct measurements of this effect in the laboratory, which would be vital for our understanding of nuclear processes occuring in stellar nucleosynthesis, remain until today very challenging. Upcoming petawatt laser facilities, such as the Extreme Light Infrastructure, could render such measurements possible, allowing the comparison of several theoretical models to experimental data [1].

Here we investigate theoretically four plasma screening models with focus on the quantum mechanical model [2] which we extend to low temperatures and laboratory conditions. The reactions considered are ^{13}C$(\alpha,\mathrm{n})^{16}$O, which is important in advanced stellar phases and in the s-process, as well as ^{7}Li$(\mathrm{d},\alpha)\alpha$, which is relevant in the big bang nucleosynthesis. Our results show a rather large discrepancy between the investigated models at low temperatures and high densities.
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HK 54.33 Do 16:30 Foyer Nordbau

Simple Geant4 atmosphere model for cosmic shower simulations and comparison to other simulation frameworks. — •Sven Peter, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physikalisches Institut, JLU Gießen, Deutschland

Earth is hit by high energy cosmic rays emitted by various sources. This radiation includes protons and light nuclei with energies up to 10^{20} eV. Reactions of these particles with nuclei in the atmosphere lead to the formation of a particle shower consisting of hadrons and electromagnetic particles. Being known as one of the components of these showers, muons are used for testing scintillation detectors. In order to investigate some properties of cosmic showers, a simple atmosphere model was implemented in Geant4. The distribution of particle species, energy spectrum and shower geometry were examined varying primary particle energies and entry angles. A comparison of the results to results of other frameworks and measured data is presented.

HK 54.34 Do 16:30 Foyer Nordbau

Observations of charge sign dependent modulation of galactic cosmic rays during four successive solar cycles — •Bernd Heber, Marlon Koeberle, Patrick Kuehl, and Johannes Marquardt — Christian-Albrechts-Universität, 24118 Kiel, Germany

The intensity of galactic cosmic rays (GCRs) is modulated as they traverse the turbulent magnetic field embedded in the solar wind. These particles are scattered by irregularities in the interplanetary magnetic field and undergo convection and adiabatic deceleration in the expanding solar wind. The large-scale heliospheric magnetic field leads to gradient and curvature drifts leading to charge sign dependent variations. In this contribution we investigate the time period from 1980

to 2017, including two and one solar minima during the A $<$ 0 and A $>$ 0 solar magnetic epoch as well as four solar magnetic field polarity reversals. Observations are taken from instruments aboard IMP-8, ISEE-3, Ulysses as well as from PAMELA and AMS-02. While the latter two separate between particle and its corresponding anti-particle the instruments utilized in this study prioir to PAMELA cannot. In order to compare these measurements with each other we utilize here the electron plus positron flux. Since the proton to antiproton ratio is smaller than 10^{-3} the contribution of antiprotons is neglected. The measurements by the Kiel Electron Telescope aboard Ulysses are altered by the variation along the orbit of the spacecraft that needs to be taken into account.

HK 54.35 Do 16:30 Foyer Nordbau

Neutron monitor measurements on the German research vessel Polarstern — •Bernd Heber[1], Dennis Galsdorf[1], Konstantin Herbst[1], Michael Walter[2], Du Toit Strauss[3], and Carolin Schwerdt[3] — [1]Christian-Albrechts-Universität, 24118 Kiel, Germany — [2]Deutsches Elektronen-Synchrotron DESY, D-15738 Zeuthen — [3]Center for Space Research, North-West University, Potchefstroom 2520, South Africa

Neutron Monitors (NM) and Muon Telescopes (MT) are ground-based devices to measure the variation of galactic cosmic ray intensities. Since their measurements are influenced by the variable Earth magnetic field and the atmospheric conditions close to its position a detailed knowledge of the instrument sensitivity with geomagnetic latitude (rigidity) and atmospheric pressure is essential. The rigidity dependence is determined experimentally by utilizing several so called latitude scans. The Polarstern is currently one of the most sophisticated polar research vessels in the world that spends almost 310 days a year at sea. Between November and March it usually sails to and around the waters of the Antarctic, while the northern summer months are spent in Arctic waters. In other words the vessel scans twice a year the rigidity range below the atmospheric threshold and above 10 GV. One Mini NM, constructed by the North West University campus Potchefstroom, and one MT, constructed by DESY Zeuthen, are measuring the variation of galactic cosmic rays with respect to the position of the vessel. In this presentation the measurements of the NM over the last years are presented.

HK 54.36 Do 16:30 Foyer Nordbau

Strahldiagnose mit bewegten Minikameras in der Vakuumkammer eines Magneten — •Adem Ates, Heiko Niebuhr und Ulrich Ratzinger — Institut für Angewandte Physik, Goethe Universität, Frankfurt am Main

Am Teststand des Figure-8 Projektes am IAP an der Goethe Universität Frankfurt wird die Injektion von Protonenstrahlen zwischen zwei Toroidmagneten sowie der gleichzeitige Transport von Protonen entlang der beiden Toroidsegmente untersucht. Hauptaugenmerk bei diesem Beitrag liegt in der Entwicklung eines optischen Detektionssystems für das Figure-8 Projekt. Dazu wird ein eingebettetes optisches System entwickelt, welches das ionenstrahlinduzierte Restgasleuchten aufnimmt. Dieses besteht aus einer CMOS Einplatinenkamera und einem Einplatinencomputer. Die Kameras werden in den Vakuumrezipienten des Magneten auf einer Schiene integriert. Der Beitrag zeigt erste Aufnahmen von einem Ionenstrahl entlang der Strahlbahn, der durch ein 30° Toroidsegment mit einem Kreisbogen von 680mm transportiert wird. Die Kalibrierung der Kameras ermöglicht es, den Strahlschwerpunkt und die Halbachsen des transversalen Strahlprofils in realen Koordinaten zu rekonstruieren.

HK 54.37 Do 16:30 Foyer Nordbau

Upgrade des Darmstadt High Intensity Photon Setup am S-DALINAC — •M. Schilling, V. Werner, O. Papst und N. Pietralla — IKP, TU Darmstadt

Für hochpräzise Kernresonanzfluoreszenzexperimente (KRF) am Darmstadt High Intensity Photon Setup (DHIPS) ist der Untergrund momentan ein limitierender Faktor. Eine der Quellen des nichtresonanten Untergrundes ist Streuung von γ-Strahlung an Luft. Erfahrungen vom γ^3-Aufbau an der High Intensity γ-ray Source (HIγS) haben gezeigt, dass ein evakuiertes Strahlrohr den nicht-resonanten Untergrund um mindestens eine Größenordnung reduzieren kann [1].

Des Weiteren ist die genaue Kenntnis der Endpunktsenergie bei KRF-Experimenten mit Bremstrahlung, wichtig um eine exakte Kalibrierung des Photonenflusses zu ermöglichen. Aus diesem Grund wird eine Online-Messung für den Endpunkt des Bremsstrahlungsspektrums aufgebaut, damit dieser während des gesamten Experiments überwacht werden kann. Das Strahlprofil wird durch den photoneninduzierte Aufbruch des Deuterons vermessen und schließlich für die genaue Analyse des Photonenflusses benutzt.

Durch diese Maßnahmen ist das Potenzial vorhanden, die Qualität und die Präzision der Experimente an DHIPS zu steigern. Der Status und die ersten Ergebnisse des Upgrades von DHIPS werden vorgestellt.

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

* gefördert durch die DFG im Rahmen des SFB 1245

HK 54.38 Do 16:30 Foyer Nordbau

Verbesserung der Energie- und Zeitauflösung des QCLAM-Spektrometers am S-DALINAC — •A. D'Alessio, J. Birkhan, P. von Neumann-Cosel, N. Pietralla, M. Singer und V. Werner — Institut für Kernphysik, TU Darmstadt

Im erfolgten Upgrade des Superconducting-DArmstadt-LINear-ACcelerator (S-DALINAC) wurde dieser mit einer dritten Rezirkulationsstrahlführung ausgestattet. Im Zuge dieser Umbauarbeiten wurde ebenfalls ein Strahlscraper in der Strahlführung installiert. Hierdurch hat sich die Energieauflösung verbessert. Es wurden Energieauflösungen von $< 5 \cdot 10^{-4}$ gemessen. In dieser Konfiguration ist das QCLAM-Magnet-Spektrometer das limitierende Element in der Energieauflösung bei zukünftigen Koinzidenzexperimenten mit großer Akzeptanz. Aus diesem Grund wird das Detektorsystem des Spektrometers überarbeitet.
Durch Umstellung des Gasgemisches, welches für die Vieldraht-Driftkammern des Detektorsystem genutzt wird, erreicht man eine geringere Diffusion der Elektronenlawine innerhalb des Gases und somit eine bessere Zeitauflösung der Driftzeiten. Nach ausführlichen Tests der momentan genutzten Vieldrahtdriftkammern hat sich gezeigt, dass Nachbesserungsbedarf in mehreren Punkten besteht. Dies kann nicht ohne weiteres durch Reparaturen oder einfache Änderungen des Aufbaus geschehen. Ein neues Design der Driftkammern wird in diesem Beitrag vorgestellt.
Gefördert wird diese Arbeit durch das Graduiertenlolleg GRK 2128 „AccelencE “und den Sonderfoschungsbereich SFB 1245.

HK 54.39 Do 16:30 Foyer Nordbau

Test eines Flüssig-Heliumtargets für Elektronenstreuexperimente — •M. Hilcker, T. Klaus, N. Pietralla, M. Singer, G. Steinhilber und P. von Neumann-Cosel — Institut für Kernphysik, TU Darmstadt

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

Im Rahmen des Sonderforschungsbereich 1245 „Nuclei: From Fundamental Interaction to Structure and Stars“ ist ein Elektronenstreuexperiment bei niedrigem Impulsübertrag zur Untersuchung des ersten angeregten 0^+ Zustandes in ^{4}He geplant, da bisherige Experimente [1] stark von aktuellen „ab initio“ Rechnungen im Rahmen der chiralen EFT [2] abweichen. Um eine ausreichend gute Statistik der Messdaten in annehmbarer Messzeit erhalten zu können, ist die Verwendung von suprafluidem Helium als Targetmaterial notwendig. Ein geeigneter Aufbau inklusive Heliumkryostat und einer dazu passenden Streukammer, werden vorgestellt und erste Ergebnisse des bereits durchgeführten Testexperiments gezeigt.
[1] T. Walcher, Phys. Lett. B **31**, 442 (1970).
[2] S. Bacca, N. Barnea, W. Leidemann, and G. Orlandini, Phys. Rev. Lett. **110**, 042503 (2013).
Gefördert durch die DFG im Rahmen des SFB 1245.

HK 54.40 Do 16:30 Foyer Nordbau

Towards a nuclear clock: Neutralization of $^{229(m)}$Th ions in carbon foils — •Ines Amersdorffer, Benedict Seiferle, Lars von der Wense, and Peter G. Thirolf — LMU Munich, Garching, Germany.

It has been proposed that a nuclear clock could potentially outperform today's most precise atomic clocks, using a nuclear transition instead of an atomic shell transition. ^{229}Th possesses an isomeric state (^{229m}Th) with an extraordinary low energy which makes it the only candidate for a nuclear clock. However, precise knowledge of the nuclear transition energy is required. For a measurement of this energy via the internal conversion decay which only occurs in neutral ^{229m}Th, thorium ions are neutralized by charge exchange in a carbon foil. In the presented measurements, the particles exiting the carbon foil are analyzed. The

results can be used to perform a background-free measurement of the nuclear transition energy.

This work was supported by DFG Grant No. Th956/3-2, by the EU's Horizon 2020 research and innovation program under grant agreement 664732 "nuClock".

HK 54.41 Do 16:30 Foyer Nordbau

Spatial Resolution-Induced Restraints for $\gamma\gamma/\gamma$ Experiments with AGATA — •P. Napiralla[1,2], D. Brugnara[4], H. Egger[3], A. Goasduff[4], P. R. John[1], N. Pietralla[1], and J. J. Valiente-Dobón[4] — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]AG Numerik und Wissenschaftliches Rechnen, TU Darmstadt, Darmstadt, Germany — [4]INFN LNL, Legnaro, Italy

The competitive double γ-decay ($\gamma\gamma/\gamma$) is a strongly suppressed second order decay process in nuclear physics. Its first observation in the nucleus ^{137}Ba [1] was performed using five $LaBr_3$:Ce scintillation detectors in a star-shaped configuration which severely limits the measurement of angular correlations between emitted γ rays. Using the Advanced GAmma Tracking Array AGATA, a detailed resolution of angular correlations could be possible. However, due the limited time resolution of AGATA's high-purity germanium detectors, the experimental analysis has to fully rely on γ-ray tracking methods.
Based on a *Geant4* simulation, a technical feasibility study of $\gamma\gamma/\gamma$ experiments with AGATA using ^{137}Ba as an example case is presented. The impact of AGATA's metrological restraints is emphasized.
This work was supported by the German BMBF under grant Nos. 05P15RDFN1 and 05P15(18)RDFN9, HGS-HIRe and HIC for FAIR.
[1] C.Walz *et al.*, Nature 526 (2015) 406-409.

HK 54.42 Do 16:30 Foyer Nordbau

A photoelectric-effect-based field calibration system for the Time Projection Chamber at the CBELSA/TAPS experiment — •Dimitri Schaab, Fabian Metzger, Markus Ball, Reinhard Beck, and Bernhard Ketzer for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

The performance of a Time Projection Chamber (TPC) relies on a very good knowledge of the electric field inside the sensitive volume. This is crucial since deviations from a perfectly homogeneous drift field deteriorate the spatial resolution of the detector if they remain uncorrected. Reasons for these deviations are, on the one hand, static imperfections of the detector structure and, on the other hand, dynamic changes of the space charge inside the sensitive volume which mainly originate from fluctuations of the event rate.
For the CBELSA-TPC, a calibration system based on the one of the T2K experiment is being set up. With the help of a UV-laser, electrons are released via the photoelectric effect at well-known positions on the cathode. By the electric field, these electrons are guided towards the readout plane and show the integrated spatial distortions.
The UV laser light is introduced into the TPC from the anode side through fibre bundles. Care was taken to achieve a uniform illumination of the cathode surface.
The poster will present the optical setup and a small TPC, which has been designed and built in order to test the calibration system.

HK 54.43 Do 16:30 Foyer Nordbau

Entwicklung eines neuen (e,e'x)-Datenaufnahmesystems für das QCLAM-Spektrometer am S-DALINAC * — •M. Singer, A. D'Alessio, P. von Neumann-Cosel und M. Spall — Institut für Kernphysik, TU Darmstadt

Am supraleitenden Elektronenbeschleuniger S-DALINAC wurde für das hochauflösende QCLAM-Magnetspektrometer ein neues Datenaufnahmesystem für (e,e'x)-Elektronenstreuexperimente entwickelt. Das Detektorsystem des Spektrometers besteht aus drei Driftkammern zur Elektronbahnbestimmung und einem Triggerdetektor. Die Driftkammersignale werden durch ein VME-basiertes System ausgelesen und mit in einem dazu in Koinzidenz geschalteten Datenaufnahmesystem für LaBr- und Neutronendetektoren verbunden. Gezeigt wird das Konzept der Datenaufnahme, sowie das speziell darauf zugeschnittene Online-Monitoring-Programm QCLAMon. Die Funktionsfähigkeit und mögliche Erweiterungen des Systems werden anhand von (e,e')- und (e,e'γ)-Messergebnissen aus einer aktuellen Strahlzeit diskutiert.

* Gefördert durch die DFG im Rahmen des SFB 1245.

HK 54.44 Do 16:30 Foyer Nordbau

Monte-Carlo-Studien zum Prototypen des Endcap Disc DIRC für PANDA — Simon Bodenschatz, Lisa Brück, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, •Jan Hofmann, Sophie Kegel, Ilknur Köseoğlu, Jhonathan Pereira de Lira, Mustafa Schmidt und Marc Strickert für die PANDA-Kollaboration — Justus Liebig-Universität Gießen, II.Physikalisches Institut, Gießen

Im Rahmen der Entwicklung des Endcap Disc DIRC Detektors für das PANDA Experiment wurde ein DIRC-Prototyp bei einer Teststrahlzeit im Sommer 2018 getestet. Zur Verbesserung der Winkelauflösung soll die chromatische Dispersion der detektierten Photonen durch verschiedene optische Filter eingeschränkt werden. Das Leistungsvermögen des Prototyps wurde mit Monte-Carlo-Simulationen getestet und untersucht, wie verschiedene Konfigurationen aus optischen Filtern und MCP-PMTs dieses beeinflusst. Dabei wurden Impuls, Auftreffwinkel und Position des Teilchenstrahls zum Radiator variiert und der Einfluss auf die performance-kritischen Größen - Photonenausbeute, Winkelauflösung und Separation Power - untersucht.

HK 54.45 Do 16:30 Foyer Nordbau

Reflectivity and storage properties of ultra-nanocrystalline diamond films for ultracold neutrons — •Andreas Frei[1], Peter Geltenbort[2], Christopher Geppert[3], Christian Gorges[3], Petra Müschenborn[1], Hadwig Sternschulte[4], Stefan Wenisch[1], Stephan Wlokka[1], and Nicolas Wöhrl[5] — [1]Heinz Maier-Leibnitz-Zentrum, Technische Universität München — [2]Institut Laue-Langevin, Grenoble — [3]Institut für Kernchemie, Universität Mainz — [4]Fakultät für Geistes- und Naturwissenschaften, Hochschule Augsburg — [5]Fakultät für Physik, Universität Duisburg-Essen

Ultra-cold neutrons (UCN) have kinetic energies of < 300 neV and are used for high precision experiments. UCN have to be transported in guides under specular reflection on the walls to such experiments over long distances with low losses.

Diamond is an excellent reflector for UCN due to the high atom density in combination with a large bound coherent scattering length and low loss cross sections. Ultra-nanocrystalline diamond (UNCD) films with a very low surface roughness independent of the film thickness can be grown on various 3D shaped substrates by chemical vapour deposition. Therefore they are promising candidates for UCN reflecting layers.

In this work we present studies of the UCN reflection and storage properties of UNCD thin films grown on planar 6" Si substrates. The influence of the UNCD film morphology and composition on the reflectity and storage properties will be discussed.

HK 54.46 Do 16:30 Foyer Nordbau

CALIFA detector test using the ^{208}Pb(p,2p) reaction in direct kinematics — •Anna-Lena Hartig, Thorsten Kröll, Alexander Ignatov, Han-Bum Rhee, and Christian Sürder for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

The 4π-calorimeter CALIFA is one of the major detectors of the R3B-experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt. CALIFA consists of 2464 CsI(Tl) crystals and 96 Phoswich detectors providing high efficiency, good energy resolution of 5 % for γ-rays at 662 keV and a large dynamic range, enabling a simultaneous measurement of γ-rays of $E > 100$ keV and light charged particles of up to $E < 700$ MeV. Besides the assembling of a CALIFA detector unit, this contribution will show first results of a test experiment with 192 CALIFA detectors at the Bronowice Cyclotron Center in November 2017 in Kraków where the ^{280}Pb(p,2p) reaction was studied in direct kinematics with a proton beam of 200 MeV.

Supported by BMBF Project (05P15RDFN1,05P19RDFN1) and HIC for FAIR.

HK 54.47 Do 16:30 Foyer Nordbau

Investigation of the response of the CALIFA demonstrator — •Han-Bum Rhee, Anna-Lena Hartig, Thorsten Kröll, and Christian Sürder for the R3B-Collaboration — Institut für Kern-Physik, Darmstadt, Germany

CALIFA is a calorimeter and spectrometer that aims to detect γ-rays and light charged particles. It is a part of the R3B experiment at GSI and the future FAIR facility. CALIFA is divided into a cylindrical barrel and a forward end-cap. The CALIFA barrel consist of CsI(Tl) scintillating crystals, which are individually read out with Avalanche Photodiodes(APDs). The functional units for the CALIFA demonstrator are called PETALs containing 64 crystals each. The PETALs are built using the same construction procedures, materials and elements

as for CALIFA.
In this work, I have tested a PETAL in the laboratory of the institute of nuclear physics(IKP), TU Darmstadt. The basic properties of the detection unit, the event reconstruction and particle identification have been checked. In addition the measurement programs have been simulated to be compared to the data. R3BRoot, which is an analysis and simulation toolkit of the R3B experiment, was used. Several measurements were done, for which different sources were used: an AmBe source(γ-rays, fast neutrons), thermalized neutrons (high-energy γ rays via capture process) and muons from cosmic rays.

This work is supported by German BMBF(05P15DFN1,05P19RDFN1), HIC for FAIR and GSI-TU Darmstadt cooperation contract.

HK 54.48 Do 16:30 Foyer Nordbau

The first Barrel Slice for the Electromagnetic Calorimeter of the $\overline{\text{P}}$ANDA experiment — •Markus Moritz, Hans-Georg Zaunick, and Kai-Thomas Brinkmann for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

The electromagnetic target calorimeter (EMC) of the future $\overline{\text{P}}$ANDA detector has the challenging aim to detect high energy photons with excellent energy resolution from 15 GeV down to a few tens of MeV. To reach this goal, improved $PbW0_4$ scintillator crystals, cooled down to $-25°$C have been chosen. They provide a fast decay time for highest count rates, short radiation length for compactness, improved light yield for lowest thresholds and excellent radiation hardness. The target calorimeter itself is divided into a barrel and two endcaps. The individual crystal will be read out with two precisely matched large area avalanche photo sensors (APD). In the very inner part of the forward endcap, vacuum phototetrodes will be used instead. In this poster the construction and assembly status of the first slice of the barrel will be presented. This includes for example the assembly of detector subunits, mechanical support structure, the cooling system, optical monitoring system and front end electronics. This project is supported by the BMBF, GSI and HIC for FAIR.

HK 54.49 Do 16:30 Foyer Nordbau

$^{12}C^{3+}$ fine structure transitions measured with a detection system for forward emitted XUV photons at the ESR — •Daniel Winzen[1], Michael Bussmann[2], Axel Buss[1], Christian Egelkamp[1], Lewin Eidam[3], Volker Hannen[1], Zhongkui Huang[4], Daniel Kiefer[3], Sebastian Klammes[3], Thomas Kühl[5,6,7], Markus Loeser[2], Xinwen Ma[4], Wilfried Nörtershäuser[3], Hans-Werner Ortjohann[1], Rodolfo Sánchez[3,5], Mathias Siebold[2], Thomas Stöhlker[5,6,8], Johannes Ullmann[3,6,8], Jonas Vollbrecht[1], Thomas Walther[3], Hanbing Wang[4], Christian Weinheimer[1], and Danyal Winters[5] — [1]WWU Münster — [2]HZDR Dresden — [3]TU Darmstadt — [4]IMP Lanzhou — [5]GSI Darmstadt — [6]HI Jena — [7]JGU Mainz — [8]FSU Jena

The Institut für Kernphysik in Münster developed an XUV-photon detection system for laser spectroscopy measurements at the ESR (GSI/FAIR). In a test beam time for laser cooling with $^{12}C^{3+}$-ions at $\beta \approx 0.47$, the $^2S_{1/2} - {}^2P_{1/2}$ and the $^2S_{1/2} - {}^2P_{3/2}$ transitions were investigated to commission the system. The detector features a movable cathode plate which is brought into the vicinity of the beam to collect forward emitted Doppler shifted photons ($\lambda_{\text{lab}} \approx 93$ nm). These photons produce mostly low energetic (<3 eV) secondary electrons which are electromagnetically guided onto an MCP detector. The working principle of the detector as well as the results of the beam time will be presented. This work is supported by BMBF under contract number 05P15PMFAA. D. Winzen thanks HGS-Hire for FAIR for funding his scholarship.

HK 54.50 Do 16:30 Foyer Nordbau

Untersuchung systematischer Effekte für das P2-Experiment — •Sebastian Baunack[1], Dominik Becker[1], Kathrin Imai[1], Frank Maas[1,2,3], David Rodriguez Pineiro[2], Rahima Krini[1], Malte Wilfert[1] und Boxing Gou[2] für die P2-Kollaboration — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]PRISMA Cluster of Excellence, Mainz

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

Die erreichbare Präzision hängt sowohl von der zu erreichenden statistischen Unsicherheit in der Messung der paritätsverletzenden Asymmetrie als auch von zahlreichen systematischen Effekten ab. Im Beitrag werden verschiedene Quellen systematischer Unsicherheiten untersucht und eine Abschätzung ihrer Beiträge zur Gesamtunsicherheit vorgestellt.

HK 54.51 Do 16:30 Foyer Nordbau

Implementation of an automated position and tension determination of wires in MWPCs — •Murat Esen for the CBM-Collaboration — Institut für Kernphysik, Uni Frankfurt

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) will be dedicated to the exploration of the QCD phase-diagram in the region of high netbaryon densities. As part of the experimental setup a Transition Radiation Detector (TRD) will deliver tracking and particle identification information. Each layer of the TRD is composed of several Multi-Wire Proportional Chambers (MWPC). In order to guarantee the desired performance a constant gas gain and thus a constant electromagnetic field is required. Therefore it must be ensured that the values for tension and position of all wires fulfill a certain accuracy. Otherwise, an inhomogeneous electric field would develop in the chambers and the gas gain and thus the measured data would deteriorate. Since more than 200 chambers have to be built and each is equipped with up to 400 wires, a manual check of the tension and position of each wire could hardly be carried out. For this reason the so-called Wire-Test-Device (WTD), which was originally developed for the construction of the ALICE-TRD, was adapted and further improved. The purpose of this device is to carry out the tension and position measurement automatically. Its working principle, especially the newly written program code of its software, will be presented in this poster.

HK 54.52 Do 16:30 Foyer Nordbau

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

Time Projection Chambers (TPC) are used both for tracking of charged particles and the search for rare events. The requirements for these two fields of applications are rather different. A high drift velocity, low diffusion and small distortions of the drifting electrons are mandatory for tracking, especially at high rates. Distortions are primarily induced by ions drifting back from the avalanche multiplication region into the drift region. This ion backflow could be completely eliminated by exploiting a different concept for signal amplification based on excitation instead of ionization, i.e. electroluminescence. The excited noble gas atoms form dimers, which emit photons with a gas-specific wavelength, which is typically in the deep UV region. This concept is widely used in rare-event TPCs. We plan to adapt it to develop a zero-ion-backflow tracking TPC for future applications in high-rate experiments. This requires the addition of a quench gas in order to achieve higher drift velocities and limit the diffusion. The quencher, however, also reduces the light yield. The goal is to find a gas mixture, which is suitable for tracking and amplification by electroluminescence. GARFIELD++ simulations provide some guidance, but the final validation has to come from experiment. The poster will present simulation results and a demonstrator setup, which are currently being assembled. This work was supported by BMBF.

HK 54.53 Do 16:30 Foyer Nordbau

Investigation of ion backflow and energy resolution in four GEM systems with Ar-CO2 for the Upgrade of the ALICE TPC — •Christoph Weidlich for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) of the ALICE experiment will be upgraded during the LHC long shutdown 2 (2019-2021). The upgrade includes a replacement of the MWPC-based readout chambers by stacks of Gas Electron Multipliers (GEMs). Two key parameters of the GEMs are ion backflow (IBF) and energy resolution. These parameters are anti-correlated and an ideal working point where both parameters are as low as possible has to be achieved. The phase-space of these parameters has already been measured in detail in the baseline gas mixture Ne-CO2-N2 (90-10-5).

During run1 and run2 operation the MWPCs showed instabilities with the Ne-based gas mixture which were not present in an Ar-based mixture. Such instabilities are not expected with a GEM-based readout. However, for completeness IBF and energy resolution were in-

vestigated in Ar-CO2 (90-10). Here we present the results of these measurements.

Supported by BMBF and the Helmholtz Association.

HK 54.54 Do 16:30 Foyer Nordbau

Entwicklung, Aufbau und Optimierung eines Droplet-Targets für kryogene Gase — •Christina Westphälinger, Daniel Bonaventura, Laura Habers, Catharina Hargens und Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

Droplet-Targets bieten für eine Vielzahl von Beschleunigerexperimenten in der Hadronen-, Leptonen- und Laserphysik wie beispielsweise PANDA, MAGIX@MESA oder CryoFlash eine interessante Alternative zu den bisher bestehenden Gas- und Cluster-Jet Targets. Hierbei sind die Interaktionspunkte wegen der festen Droplet-Frequenz und kleinen lokalen Ausdehnung der Streuzentren individuell rekonstruierbar. Gleichzeitig ist eine hohe Dichte und damit verbunden eine hohe Ereigniswahrscheinlichkeit vorhanden. Dazu wird mittels mikrometerfeiner Düsen und i.d.R. kryogen verflüssigten Gasen ein laminarer Flüssigkeitsstrahl aus z.B. Argon oder Wasserstoff erzeugt, der aufgrund des Rayleigh-Kriteriums bei einer festen Oszillationsfrequenz und entsprechenden Temperatur- und Druckparametern im Vakuum zu Tröpfchen aufbricht und einen kontinuierlichen, periodischen Tröfpchenstrahl liefert. Die Einstellung der exakten Parameter zur Erzeugung eines über Wochen langzeitstabilen Droplet-Strahls, sowie die Erstellung einer geeigneten Düse bieten dabei die größten Herausforderungen, weshalb hierzu an der Universität Münster systematische Studien begonnen wurden. Der aktuelle Stand des Targetaufbaus sowie der Dropleterzeugung werden im Folgenden aufgezeigt und diskutiert.

HK 54.55 Do 16:30 Foyer Nordbau

Front-end signal path of the P2 experiment at MESA — •Rahima Krini[1], Sebastian Baunack[1], Dominik Becker[1], Michael Gericke[2], Frank Maas[1,3,4], and David Rodriguez Pineiro[3] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]University of Manitoba, Canada — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA Cluster of Excellence, Mainz

The MESA accelerator is planned to be built in the next years in the Institute for Nuclear Physics in Mainz. In this research area, the parity-violating asymmetry in the elastic electron-proton scattering was never measured with the precision that the P2 experiment is aiming for. Therefore, many technical challenges have to be solved.

For measuring asymmetries in the order of $\mathcal{O}(10^{-9})$ the front-end signal path at the P2 experiment has to be well thought out. The helicity of the polarized electron beam will be flipped with a reversal rate of f=2 kHz. The bandwidth of the signal path and the sampling rate of the ADC need to be adjusted accordingly. A joint read-out electronics for the P2 experiment in Mainz and for the Moeller experiment at the Jefferson Laboratory is under development by collaborators of the University of Manitoba. The I-U preamplifier prototype with a bandwidth of 1 MHz is already designed and first tests can be performed.

HK 54.56 Do 16:30 Foyer Nordbau

A Detection System for Laser Spectroscopy Experiments at CRYRING@ESR — •A. Buss[1], Z. Andelkovic[2], V. Hannen[1], C. Huhmann[1], K. Mohr[3], W. Nörtershäuser[3], H. Ortjohann[1], R. Sánchez[2], T. Tüshaus[1], and C. Weinheimer[1] — [1]Institut für Kernphysik, WWU Münster — [2]GSI, Darmstadt — [3]Institut für Kernphysik, TU Darmstadt

In order to enable laser spectroscopy experiments at CRYRING, a new general purpose fluorescence detector has been developed at the University of Münster. The design allows detection from ultraviolet to the near infrared regime. Among others, the transition $3^2S_{1/2} \rightarrow 3^2P_{1/2}$ at 280 nm of Mg^+ is of special interest as it enables tests for polarization conservation of the stored ion beams at CRYRING. The detector consists of an elliptical mirror chamber and a set of three interchangable PMTs. The geometry has been optimized in Geant4 simulation for enhanced detection of fluorescence photons, originating in one focus point of the ellipse. After installation in spring 2018, a test beamtime with D^+ ions was conducted to check the detector's performance. Though these ions were completely ionized, and thus no observable transition existed, excitations of residual gas produced a detactable signal. Experimental background rates from laser stray light and residual gas excitation were measured and allowed to extract the bunch structure of the stored ion beam. Results from the PMT calibration and from the test beam time will be presented.

This project is funded by BMBF, contract number: 05P15PMFAA.

HK 54.57 Do 16:30 Foyer Nordbau

Weiterentwicklung eines automatisierten Messverfahrens zur Qualifikation der Fokussierelemente für den PANDA Endcap Disc DIRC — •Sophie Kegel, Simon Bodenschatz, Lisa Brück, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, Jan Niclas Hofmann, Ilknur Köseoğlu, Jhonathan Pereira de Lira, Mustafa Schmidt und Marc Strickert für die PANDA-Kollaboration — Justus Liebig-Universität Gießen, II.Physikalisches Institut, Gießen

Mit Hilfe des Endcap Disc DIRCs sollen im PANDA Experiment Pionen und Kaonen anhand ihres Cherenkov-Winkels identifiziert werden. Zweck der FELs (Focusing ELements) ist es dabei, die Winkelinformation der Cherenkov-Photonen in eine Ortsinformation umzuwandeln, um diese auswerten zu können. Da die Qualität der Fokussierung durch die FELs die Auflösung beeinflusst, wurde ein Messstand entwickelt, mit dem die Vermessung und Qualitätssicherung der FELs weitgehend automatisiert erfolgen kann.

HK 54.58 Do 16:30 Foyer Nordbau

The new Neutron Depth Profiling Instrument N4DP at the MLZ — •Lukas Werner[1], Markus Trunk[1], Roman Gernhäuser[1], Ralph Gilles[2], Bastian Märkisch[1], and Zsolt Revay[2] — [1]Technische Universität München, Physikdepartment — [2]Technische Universität München, Heinz-Maier-Leibnitz Zentrum

In neutron depth profiling (NDP), an applied nuclear physics technique, neutrons are captured by nuclei such as ^{6}Li or ^{10}B. The resulting compound nucleus then decays into two charged particles (an alpha and triton particle in the case of Lithium). Due to conservation of four-momentum, these particles are emitted back to back, at fixed energies. If the two charged particles are produced within a sample they will lose energy while propagating out of it. In NDP, this energy loss is correlated to the depth where this reaction takes place. At the Heinz-Maier-Leibnitz Zentrum in Garching a new instrument with a high neutron flux of up to 5^{10} n/sec cm^2 and a depth resolution down to 5 nm is currently being set up for a long series of measurements in very different fields of physics.

HK 54.59 Do 16:30 Foyer Nordbau

Construction of a new Cluster-Jet Target for the CryoFlash Experiment — •Christian Mannweiler, Lukas Lessmann, Daniel Bonaventura, Silke Grieser, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster 48149 Münster, Germany

The Cryoflash-Experiment employs the ARCTURUS high power laser system of the University of Düsseldorf and a cluster-jet target designed and constructed by the University of Münster to study laser-plasma interactions. These experiments investigate the acceleration of particles, especially protons, for use in compact tabletop accelerators as well as the generation of ultrashort intense X-ray pulses for pump-probe experiments. The clusters are created by pressing cooled gas through a Laval nozzle, resulting in a continuous jet of small particles with approximately solid density, each the size of tens of nanometres, thus combining the strengths of both gas- as well as foil-targets. Previous experiments with a first cluster-jet target have already demonstrated a remarkable stability concerning the spectra of obtained accelerated protons. The newly developed target, its design optimised using the experience gained from the previous target, will enable greater Proton fluxes and energies. Furthermore, it will become possible to characterise clusters created with liquid hydrogen with the help of Mie-scattering techniques. The design as well as first test- and experimental results will be presented and discussed.

HK 54.60 Do 16:30 Foyer Nordbau

Das $\overline{\text{P}}$ANDA Cluster-Jet Target an COSY mit einem optischen Monitorsystem für Clusterstrahldichten — •Daniel Klostermann, Benjamin Hetz, Daniel Bonaventura, Silke Grieser und Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48161 Münster

Das interne Cluster-Jet Target für das zukünftige $\overline{\text{P}}$ANDA Experiment wurde im Sommer 2018 am COSY Beschleuniger in Jülich installiert, nachdem es bereits Jahre zuverlässig in Münster betrieben wurde. In annähernd $\overline{\text{P}}$ANDA-Geometrie, sowie mit den finalen Vakuum- und Strahlüberwachungssystemen wurden die ersten Messungen erfolgreich durchgeführt und bereits die anvisierten HESR-Targetdichten von mehr als $10^{15} \frac{\text{Atome}}{\text{cm}^2}$ erzielt. Eine wichtige Rolle bei der Überwachung der Targetstrahldichte spielt ein optisches Monitorsystem des

finalen Cluster-Jet Targets, welches an der WWU Münster entwickelt und getestet worden ist. Hierbei wird der Clusterstrahl von einem Laser beleuchtet und die Intensität des Streulichts kann in direkten Zusammenhang zur Targetdichte gebracht werden, was eine zerstörungsfreie Überwachung der Clusterstrahldichte ohne Beeinflussung des Experiments ermöglicht. Zudem können durch das optische Monitorsystem die Targeteigenschaften mit hoher Zeitauflösung überwacht werden. Hiermit lassen sich Aussagen über die Stabilität des Cluster-Jet Targets treffen. Vorgestellt werden der $\overline{\text{P}}$ANDA-Aufbau an COSY und Kennzahlen der letzten COSY-Strahlzeit des $\overline{\text{P}}$ANDA-Targets, sowie die zerstörungsfreie Dichtebestimmung der Targetdichte mithilfe des optischen Monitorsystems.

HK 54.61 Do 16:30 Foyer Nordbau

Sensor Quality Assurance for the CBM Silicon Tracking System — •Iaroslav Panasenko — Physikalisches Institut, Universität Tübingen, Germany — Institute for Nuclear Research, Kiev, Ukraine

The CBM experiment at FAIR will investigate the properties of nucler matter at extreme conditions created in ultrarelativistic heavy-ion collisions. Its core detector — the Silicon Tracking System (STS) — will determine the momentum of charged particles from beam-target interactions. The high track multiplicity (up to 700 within the detector aperture) as well as stringent requirements to the momentum resolution ($\sim$2% at $p \geq 1GeV/c$) require a system with high channel granularity and low material budget.

The STS will be constructed of about 900 double-sided silicon microstrip sensors with a total area of $\sim 4\,\text{m}^2$. CBM microstrip sensors have 1024 readout strips per side with $58\,\mu m$ pitch, thus, resulting in about 1.8 million channels. The fraction of the defective strips per sensor has to be less than 1.5 % to guarantee the expected STS performance. The mission of quality assurance (QA) is to ensure that the manufactured sensors correspond to the CBM specifications. For this purpose, dedicated equipment including a custom-built probe station has been set up in the clean room at the Tübingen University. Advanced QA methods were developed and successfully applied for the CBM microstrip sensors. Results of the characterization of the prototype microstrip sensors CBM06 will be presented.

Work supported by BMBF under grant 05P12VTFCE.

HK 54.62 Do 16:30 Foyer Nordbau

Radiation damage and recovery studies with lead tungstate scintillators of the $\overline{\text{P}}$ANDA Target Calorimeter — •Pavel Orsich[1], Kai-Thomas Brinkmann[1], Valera Dormenev[1], Rainer-Willi Novotny[1], Hans-Georg Zaunick[1], Till Kuske[1], Vitaly Mechinski[2], and Mikhail Korzhik[2] for the PANDA-Collaboration — [1]2nd Physics Institute JLU, Giessen, Germany — [2]Institute for Nucleans Problems BSU, Minsk, Belarus

The $\overline{\text{P}}$ANDA detector is a new detector system which will be installed at the international FAIR accelerator facility (Darmstadt, Germany) with a wide research program. One of the major detector components will be the Electromagnetic Target Calorimeter (EMC) based on second generation lead tungstate scintillation crystals (PWO-II). The operating temperature of the PANDA EMC was chosen as -25^o C.

The consequence of radiation damage in PWO is the degradation of optical transmittance. This leads to light collection losses and results in the degradation of energy resolution of the EMC in general. In particular, the impact is critical at low temperatures, whose spontaneous recovery processes are suppressed or frozen. To minimize radiation induced damages during operation, a LED based stimulated recovery is foreseen.

A experimental setup to study stimulated recovery was developed. Test results of radiation damage annealing via stimulated recovery will be shown.

This project is supported by BMBF and HIC for FAIR.

HK 54.63 Do 16:30 Foyer Nordbau

Performance of a monolithic scintillator studied under realistic conditions in a Compton Camera system — •Giovanni Paolo Vinci, Tim Binder, Silvia Liprandi, Maria Kawula, Katia Parodi, and Peter G. Thirolf — Ludwig-Maximilans-Universität München

The Compton Camera (CC) prototype under commissioning in Garching aims at providing an online beam range verification tool using the prompt γ rays emitted by excited nuclei during the irradiation of tissue with a particle beam. Currently, we are working with 50x50x30 mm^3 monolithic $LaBr_3$:Ce or $CeBr_3$ scintillators as CC absorber component, read out by multianode photomultipliers. These configurations show excellent energy, spatial and timing resolutions.

In realistic conditions, however, the Compton electrons, generated in the scatterer, consisting of 6 layers of 0.5 mm thick double-sided Silicon strip detectors (DSSSD), may reach the scintillator, since the thickness of the DSSSD array is not enough to stop them. So far, the determination of the photon interaction position in the absorber crystal was studied only with individual collimated γ sources. Yet, it remains to be explored how the resolution is affected by either an electron and the Compton scattered photon or two photons impinging simultaneously onto the crystal. This work will present a study of these two scenarios using simultaneous irradiation by a collimated ^{204}Tl electron source and collimated ^{137}Cs or ^{60}Co photon sources.

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

HK 54.64 Do 16:30 Foyer Nordbau

A Monitoring System for the CALIFA Calorimeter — Roman Gernhäuser, Benjamin Heiss, •Philipp Klenze, and Lukas Ponnath for the R3B-Collaboration — Physik Department, Technische Universität München

Using more than 2600 scintillator crystals, the CALIFA calorimeter is a key component of the R^{3}B experiment.

Time stamped events of independent detector units are a state of the art way to collect large event rates from high granularity detection systems. In CALIFA we combine a local time stamping with a widely used *White Rabbit* protocol implemented in the precision time distribution system at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt.

Large buffers of event data are collected asynchronously from different subsystems and especially for online monitoring have to be sorted and combined to physics events in real time.

We will present an event builder concept which allows to monitor and compensate regular drifts between different clock domains. This is being used during FAIR the phase-0 campaign for the first time to provide online QA for the full system. We will especially discuss the interplay of rate capability and error recovery essential for scalable system operations.

HK 54.65 Do 16:30 Foyer Nordbau

A test stand for the characterization of a GEM-TPC with cosmic muons — •Wael alkakhi, dimitri schaab, jonathan ottnad, markus ball, philipp bielefeldt, and bernhard ketzer for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen und Kernphysik, Bonn, Germany

We are setting up a cosmic-ray triggering and tracking telescope for the characterization of a compact GEM(Gas Electron Multiplier)-TPC (Time Projection Chamber).Such a GEM-TPC is currently being developed for a future upgrade of the CBELSA/TAPS experiment at the ELSA facility in Bonn.The setup consists of a trigger hodoscope made up of two planes of four scintillator panels, each read out on both sides by photomultiplier tubes, and four $10 \times 10\,\text{cm}^2$ GEM detectors with 2D strip readout on a movable platform.Applying a programmable trigger matrix to the hodoscopes signals,we make a coarse selection of cosmic tracks through the TPC. The GEM detectors deliver two space points on each side of the TPC and thus provide an precise external track reference for TPC resolution studies. The poster will describe the setup, the characterization of the trigger hodoscope, and the characterization of the GEM detectors, and the readout of the GEM detectors.

HK 54.66 Do 16:30 Foyer Nordbau

Performance of the BGO-OD experiment at ELSA* — •Björn-Eric Reitz for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

Since many years meson photoproduction has been used to explore the excitation structure of the nucleon and the degrees of freedom involved. With the pentaquark baryon candidates and the XYZ mesons recently discovered in the charmed quark sector, the question arises whether similar structures are present in the lighter strange quark sector as well. To investigate this issue experimentally, it is crucial to have access to a region of low momentum exchange with the baryonic final states.

The BGO-OD experiment at the ELSA accelerator facility of the University of Bonn is ideally suited for such experiments. It allows photoproduction of forward going kaons with ground or excited state hyperons remaining with little momentum transfer. Non-strange reaction channels can be explored detecting forward going protons, e.g. in η' photoproduction. The experiment is comprised of a forward magnetic

spectrometer combined with a central crystal calorimeter.
This poster will present an overview of the general detector performance together with preliminary results of various analyses.

*Supported by DFG (PN 50165297).

HK 54.67 Do 16:30 Foyer Nordbau

Status of the LED based gain monitoring system for CALIFA CALorimeter for In flight detection of γ rays and high energy charged pArticles — •Christian Sürder, Anna-Lena Hartig, Alexander Ignatov, Thorsten Kröll, Noël Merkel, and Han-Bum Rhee for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

CALIFA is part of the R^3B setup of the future FAIR facility. The quality of the scintillator crystal is important for the setup perfomance. To check for the crystal's light output uniformity a scanner was developed, using a collimated ^{137}Cs source. The scanners features and future improvements will be presented. To be able to monitor changes of the crystal quality during experiments, a LED based gain monitoring system was developed. It produces a reliable signal to monitor the crystal quality over time. The peak position can be chosen via the light pulse intensity, produced by the LED. The LED system was attached to 64 CsI+APD detector units and was tested within the CALIFA demonstrator. The current development status and the further improvements will be presented. This work is supported by the German BMBF (05P15RDFN1 and 05P19RDFN1), GSI-TU Darmstadt cooperation contract and HIC for FAIR.

HK 54.68 Do 16:30 Foyer Nordbau

Testing prototype Micron X5 silicon-strip detectors for the R3B setup — •Sonja Storck[1], Ina Syndikus[1,2], Dominic Rossi[1], and Thomas Aumann[1,2] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

With the R3B (Reactions with Relativistic Radioactive Beams) setup at GSI in Darmstadt, it is possible to perform kinematically complete measurements with relativistic radioactive beams. In order to identify the incoming and outgoing particles, various detector systems are necessary. Among other systems, silicon-strip detectors employing the resistive charge division are used to measure the positions and the energy loss of charged particles before and after the target.

A new prototype of a double-sided silicon-strip detector, Micron X5, was tested in beam during a beam time at GSI in 2018 with ^{40}Ar and ^{107}Ag beams. The detectors have 32 strips on each side which are arranged perpendicularly to each other to give an x and y position in the same detector. The strips have a resistive surface and are read out at the ends of each strip. The detectors were tested regarding the energy and position resolution.

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

HK 54.69 Do 16:30 Foyer Nordbau

Studying discharge propagations with an optically read-out GEM — •Berkin Ulukutlu and Piotr Gasik — TU München, Physik Department E62, Excellence Cluster 'Universe', Garching

Gas Electron Multiplier (GEM) has become a commonly employed technology for modern high-rate particle and nuclear physics experiments (e.g. upgraded ALICE TPC). A key parameter for their long-term sustainability is stability against electrical discharges. Typically, these electrical breakdown events occur within the holes on the GEM foil, but they may also propagate into the gap between subsequent GEM foils resulting in secondary discharges. It is crucial to mitigate secondary discharges since they can result in irreparable damage to the detector. Accordingly, many successful methods have been developed to increase their stability against discharges. However, the propagation of discharges is still not fully understood.

In this study, an optically readout GEM detector incorporating a sCMOS camera was built as a new tool to investigate the formation of secondary discharges. We used optical imaging to capture the time evolution of the light from discharges. Studying the glow in instances leading and not leading to a secondary discharge, we pursue to determine the underlying mechanisms for discharge propagation.

HK 54.70 Do 16:30 Foyer Nordbau

Charge density as a driving factor for discharges in THGEM-based detectors — •Lukas Lautner, Berkin Ulukutlu, and Piotr Gasik — TU München, Physik Department E62, Excellence Cluster 'Universe', Garching

Thick Gas Electron Multipliers (THGEMs) are robust, high gain gaseous detectors with a structure resembling a GEM with expanded dimensions. Electrical discharges during operation of THGEM-based detectors may result in detection dead time, efficiency loss and damage to hardware and electronics. Although there are measures to minimize the discharge probability, discharges cannot be completely avoided. These discharges are triggered by charge densities close to the Raether limit (10^6-10^7 electrons) in single THGEM holes. Discharge probability curves for THGEMs in different Ar- & Ne-based gas mixtures have been measured. A comparison with GEANT4 simulations allowed to extract the critical charge density leading to the formation of a spark in a THGEM hole. It occurs that this number depends on the gas mixture and is a driving factor for discharge formation in THGEM-based detectors.
This research was supported by BMBF, HGF and the DFG cluster of excellence 'Origin and Structure of the Universe'.

HK 54.71 Do 16:30 Foyer Nordbau

"MCA Recorder", a platform independent, open graphical MCA controller software — •Benedikt Bieringer — Institut für Kernphysik, WWU Münster, Germany

Multichannel Analyzers are broadly used in diverse scientific and educational contexts. Most times, proprietary libraries and software are needed to interact with commercial MCA devices. In this work, a new controller software with low-level device interaction is introduced that is free of calls to proprietary libraries and written in platform independent Python code. It features a clean GUI, allows live fits on Gaussian distributions and ships with open source code. Currently supported devices are the "Ortec EasyMCA 8k" (requires license from manufacturer), "CAEN N957" and "Ortec 926 MCB".

HK 54.72 Do 16:30 Foyer Nordbau

URANOS - a voxel engine Neutron Transport Monte Carlo Simulation — •Markus Köhli[1,2], Martin Schrön[3], Klaus Desch[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg, Heidelberg, Deutschland — [2]Physikalisches Institut, Universität Bonn, Bonn, Deutschland — [3]Dep. Monitoring and Exploration Technologies, Helmholtz Centre for Environmental Research GmbH - UFZ, Leipzig, Deutschland

URANOS (Ultra RApid Neutron-Only Simulation) is a newly developed 3D neutron transport Monte Carlo for the thermal to fast regime. Emerging from a problem solver for detector development in collaboration with environmental physics the project aims towards providing a fast computational workflow and an intuitive graphical user interface (GUI) for small to medium sized projects. It features a ray-casting algorithm based on a voxel engine. The simulation domain is defined layerwise, whereas the geometry is extruded from a pixel matrix of materials, identified by specific numbers. Therefore, input files are solely a stack of pictures, all other settings, including the configuration of predefined sources, can be adjusted by the GUI. The scattering kernel features the treatment of elastic and inelastic collisions, absorption and absorption-like processes like evaporation. In order to simulate multilayer boron detectors it also models the charged particle transport following the conversion by computing the energy loss in the boron and its consecutive layer. The electron track is then projected onto a readout unit by longitudinal and transversal diffusion.

HK 54.73 Do 16:30 Foyer Nordbau

Low-cost Readout Electronics based on Arduino Microcontrollers — •Markus Köhli[1,2], Jannis Weimar[1], Fabian Schmidt[2], Jochen Kaminski[2], Klaus Desch[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg, Heidelberg, Deutschland — [2]Physikalisches Institut, Universität Bonn, Bonn, Deutschland

With the Arduino open source electronics platform microcontrollers have become a comparably easy-to-use tool for rapid prototyping and implementing creative solutions. Yet, running at 16 MHz, the capabilities can be extended to data taking and signal analysis at decent rates. Such devices in combination with dedicated frontend electronics can offer low cost alternatives for student projects and independently operating small scale instrumentation. We present two projects, which cover as well the readout of helium-3 and boron-10 proportional counters as of scintillators or wavelength shifting fibers with Silicon Photomultipliers. The nCatcher board transforms an Aruino nano to a proportional counter readout with pulse shape analysis - time over threshold measurement and a 10-bit analog to digital converter for pulse heights. This makes the device suitable for low to medium rate environments,

where a good signal to noise ratio is a crucial. With the SiPMTrigger we have realized a small-scale design for triggering or vetoing in combination with a photon counter. It consists of a custom mixed signal frontend board featuring signal amplification, discrimination and a coincidence unit for rates up to 200 kHz.

HK 54.74 Do 16:30 Foyer Nordbau

Ausrichtung und Bestimmung der Auflösung der Spurrekonstruktionsdetektoren des NA64-Experiments — •Nabeel Ahmed, Michael Hösgen und Bernhard Ketzer für die NA64-Kollaboration — Helmholtz-Institut für Strahlen- und Kernphysik der Universität Bonn

Das NA64-Experiment ist ein Experiment am CERN, das nach möglichen Teilchen der Dunklen Materie sucht, indem hochenergetische Elektronen in einem hermetischen Kalorimeter gestoppt werden und nach Ereignissen mit fehlender Energie gesucht wird. Die notwendige möglichst genaue Messung wird durch eine präzise Rekonstruktion der Teilchenspur vor und nach einem Dipolmagnet erreicht. Es werden zehn Spurrekonstruktionsdetektoren verwendet, sechs Micromegas und vier GEM-Detektoren mit jeweils zwei Projektionen. Zunächst wird die Position der Detektoren im Raum durch eine optische Messung mit einem Laser bestimmt und die Feinausrichtung erfolgt mit Hilfe von rekonstruierten Teilchenspuren. In einem iterativen Verfahren werden die Residuen aller Detektorebenen bestimmt und die Positionen entsprechend justiert. Das Verfahren wird beendet, falls sich die Güte der angepassten Spur nicht mehr ändert. Dabei werden die Auflösungen der Detektoren zunächst genähert. Die tatsächlichen Detektorauflösungen werden nach erfolgter Ausrichtung mit verschiedenen erwartungstreuen Methoden bestimmt, bei denen die zu untersuchende Ebene nicht zur Rekonstruktion herangezogen wird. Das Poster illustriert das iterative Verfahren zur Ausrichtung und die Ergebnisse zu den Auflösungen der GEM- und Micromegas-Detektoren von NA64.

HK 54.75 Do 16:30 Foyer Nordbau

Determination of the photon interaction position in a monolithic scintillator applied in a Compton Camera — •Maria Kawula[1], Silvia Liprandi[1], Tim Binder[1,2], Rita Viegas Rego[1,3], Ben Hoyle[1], Katia Parodi[1], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität, Munich, Germany — [2]KETEK GmbH, Munich, Germany — [3]University of Coimbra, Portugal

The LMU Compton Camera is being developed to detect prompt gamma rays. The camera consists of a scatterer (6 layers of double-sided Si-strip detectors) and a monolithic $LaBr_3$(Ce) scintillator as an absorber, read out by a multianode photomultiplier. To determine the photon interaction position in the scintillator the "Categorical Average Pattern" (CAP) algorithm [1] is used. This algorithm is based on the comparison of every recorded photon event with a reference library of 2D light amplitude distributions obtained by scanning the scintillator front surface with tightly collimated ^{60}Co and ^{137}Cs sources respectively in 10404 positions (400 photopeak events per position are acquired). A second method based on Convolutional Neural Networks (CNN) is under development. The reference library acquired for the CAP algorithm is used as training data. The architecture of the network as well as a quantitative comparison of CAP and CNN in terms of computational time, memory consumption and obtained spatial resolution will be presented. This work is supported by the DFG Cluster of Excellence Munich Centre of Advanced Photonics (MAP).

HK 54.76 Do 16:30 Foyer Nordbau

Development of a MiniTAPS Trigger Board for the CBELSA/TAPS Experiment — •Janis Hoff, Christian Honisch, and Annika Thiel for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik der Universität Bonn

The structure of hadrons is investigated by the CBELSA/TAPS experiment using electromagnetic probes. The MiniTAPS calorimeter is one of the central parts of the detector system. The detector covers the forward angle between 1° and 12° and is ideally suited to detect photons with energies between 10 MeV and 2.0 GeV. The detector consists of 216 BaF_2 crystals which are read out via photomultiplier tubes. Due to its fast timing the detector can contribute to the first level trigger. For this purpose, the crystals are grouped into four sectors and the number of sectors hit in one event is provided for the trigger decision. The current trigger electronics will be replaced, which will in future allow for a more sophisticated trigger decision algorithm. The discriminator signals of all crystals will be connected to one FPGA. A commercially available VME module will be utilized and extended with high-density level-translation input cards.
This poster shows how the high input density of 10.8 differential pairs per cm is implemented in the prototype and presents the results of the analysis researching the benefits of a full cluster encoder compared to the currently used algorithm.

HK 55: Mitgliederversammlung

Zeit: Donnerstag 19:00–21:00 Raum: HS 15

Mitgliederversammlung

HK 56: Hauptvorträge V

Zeit: Freitag 11:30–12:40 Raum: Plenarsaal

Hauptvortrag HK 56.1 Fr 11:30 Plenarsaal

Exotic, heavy element abundances in metal-poor dwarf galaxy stars — •Camilla Juul Hansen — MPIA Heidelberg

Explosions of various kinds create about half of all the heavy (Z>30) elements in the Universe. These heavy elements are locked up in low-mass stars, and the combinations of heavy material vary vastly from star to star, especially in the early Universe. Hence, we can use their chemical patterns as indirect evidence of the nature and physics of the long gone explosions possibly from the first stars. The first generation of low-mass stars typically resides in the Milky Way (MW) halo either as single halo field stars or engulfed dwarf galaxies. Sagittarius (Sgr) is a massive dwarf galaxy in the MW halo. Previous studies were restricted mainly to a few, metal-rich ([Fe/H]˜-1) stars that suggested a top-light IMF. Here I present the first high-resolution, very metal-poor stellar sample in Sgr spanning metallicities from [Fe/H]=-1 to -3. We have derived abundances of 13 elements namely C, Ca, Co, Fe, Sr, Ba, La, Ce, Nd, Eu, Dy, Pb, and Th, where abundances of Sr, Pb, and Th are presented here for the first time. The high level of Ca indicates that more massive supernovae (SNe) must have existed and polluted the early ISM of Sgr before it lost its gas. This is in contrast with a top-light IMF with no massive star pollution. Our most metal-poor star ([Fe/H]˜-3) indicates a pure r-process pollution. Based on star-to-star scatter and abundance patterns, a mixture of AGB stars and massive SNe (15-25Mo) are necessary to explain these. Hence, stars stripped from Sgr and similar dwarf galaxies could indeed be building blocks of the MW halo.

Hauptvortrag HK 56.2 Fr 12:05 Plenarsaal

Nuclear astrophysics with gas targets — •Konrad Schmidt — Institute of Nuclear and Particle Physics, TU Dresden, Germany

Nuclear astrophysics experiments will benefit from the development of next generation gas-target setups. The advantages of a localized, dense and pure target are discussed in detail by taking the example of the Jet Experiments in Nuclear Structure and Astrophysics (JENSA) windowless gas-jet target. JENSA enables the direct measurement of previously inaccessible reactions with radioactive ion beams provided by the rare isotope re-accelerator ReA3 at the National Superconducting Cyclotron Laboratory (NSCL) on the campus of Michigan State University (MSU), USA. The gas jet will be the main target for the Recoil Separator for Capture Reactions (SECAR) at the Facility for Rare Isotope Beams (FRIB). JENSA provides an unprecedentedly high number density of $\sim 10^{19}$ atoms/cm^2 and enables the direct measurement of various hydrogen and helium-induced astrophysical reactions.

HK 57: Hadron Structure and Spectroscopy VIII

Zeit: Freitag 14:00–15:45 Raum: HS 13

Gruppenbericht HK 57.1 Fr 14:00 HS 13

Partial Wave Analysis with PAWIAN — •Bertram Kopf — Institut für Experimentalphysik I, Ruhr-Universität Bochum

PAWIAN (**Pa**rtial **W**ave **I**nteractive **An**alysis Software) is a powerful and user-friendly software package with the ability to perform spin parity analyses with data obtained from different hadron spectroscopy experiments. After a brief summary of the features of PAWIAN, an exemplary coupled channel analysis with various $\bar{p}p$-annihilation and $\pi\pi$-scattering data performed with this package will be presented. In this context important aspects on the extraction of resonance properties by considering analyticity and unitarity conditions will be discussed.

HK 57.2 Fr 14:30 HS 13

Search for the Y(2175) in photo-production at GlueX — •Abdennacer Hamdi[1,2], Klaus Götzen[1], Frank Nerling[1,2], and Klaus Peters[1,2] — [1]Institut für Kernphysik, J. W. Goethe-Universitat, Max-von-Laue-Str. 1, 60438 Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

Quantum Chromodynamics is the theory that describes how hadrons are built from quarks and gluons via the strong interaction. Many predictions have been observed, but many others are still pending and under experimental investigation. Of particular interest is how gluonic excitations give rise to exotic states. One class of such states are hybrid mesons that are predicted by theoretical models and Lattice Quantum Chromodynamics calculations. The Y(2175), as observed in electron-positron experiments, is discussed to be the strangeonium partner of the Y(4260), and thus a candidate for e.g. a hybrid meson or tetraquark state. We present the status and plans to search for this state in photoproduction at the GlueX experiment in Jefferson Lab's Hall D, which started physics data taking in 2016. This work is supported by HGS-HIRe.

HK 57.3 Fr 14:45 HS 13

Partial Wave Analysis of $\bar{p}p \to \phi\phi$ at $\overline{\text{P}}$ANDA — •Iman Keshk for the PANDA-Collaboration — Ruhr-Universität Bochum

The $\overline{\text{P}}$ANDA experiment at FAIR in Darmstadt (Germany), which is currently under construction, will provide excellent opportunities to search for exotic states in anitproton-proton annihilations. Lattice QCD calculations predict the tensor glueball at a mass of $2.4\,\text{GeV}/c^2$, while various experiments observed tensor resonances in the same mass region in the $\phi\phi$ system. The reaction $\bar{p}p \to \phi\phi$ offers a gluonrich environment and will be studied with $\overline{\text{P}}$ANDA by performing an energy scan from about $2.25\,\text{GeV}/c^2$ up to $2.7\,\text{GeV}/c^2$. Contributing resonances in the $\phi\phi$ system can then be identified by means of a mass independent partial wave analysis. For the identification of resonances produced in this formation process the extraction of phase motions is a strong indication for their presence. Monte Carlo studies performed to address the feasibility to identify contributing resonances utilizing the partial wave analysis software PAWIAN will be discussed.

HK 57.4 Fr 15:00 HS 13

Applying Model Comparison Techniques to Hadron Spectroscopy — •Florian Kaspar[1], Fabian Krinner[1], Boris Grube[1], Stephan Paul[1], Dmitri Ryabchikov[1], Sebastian Uhl[2], and Stefan Wallner[1] — [1]Physik-Department E18, Technische Universität München — [2]formerly: Physik-Department E18, Technische Universität München

Hadron spectroscopy is one of many examples in physics which require complex statistical modeling. Large data sets reveal ever more structures of the underlying physical processes and their backgrounds. This drives the development of more advanced models, simultaneously making it difficult to gauge improvements in data description and inference quality. There is a variety of different criteria available to compare the performance of statistical models. We discuss the utility and validity of some of these criteria for the analysis of hadron spectroscopy data. Where possible we verify them on simulated data and compare the implications of their underlying assumptions.

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 Universtiät und der Technischen Universität München.

HK 57.5 Fr 15:15 HS 13

Incorporating Spin into Rescattering Effects via Partial Wave Projections - The $a_1(1420)$ — •Mathias Wagner, Mikhail Mikhasenko, and Bernhard Ketzer for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, 53115 Bonn, Germany

In the recent past several new particle candidates were found which do not fit into the simple constituent quark models for mesons and baryons. Different concepts were introduced in order to find an explanation for these exotic states. One of them is a rescattering effect. Here, triangle diagrams can produce resonance-like signals, both in the intensity and the relative phase of the corresponding partial wave.

For example, the $a_1(1420)$ signal observed by the COMPASS experiment, in the $J^{PC} = 1^{++}$ partial wave decaying to $f_0(980)\pi$, can be well described with a simplified $K^*\bar{K} \to f_0\pi$ rescattering model neglecting the spin of the intermediate K^*. Including the spin of intermediate particles will modify the amplitude.

Exploiting the isobar model we can describe the rescattering as a dispersive integral over a partial wave projection of the $K\bar{K}\pi$ final state onto the 3π final state, using a general πK P-wave amplitude instead of the Breit-Wigner parametrization for K^*. This method allows us to include the spin of the K^* appearing as an intermediate $K\pi$-resonance via Wigner-D-matrices, using rotational properties of the helicity amplitudes. Our approach built from analyticity and Lorentz-invariance is considered as an alternative to the method of Feynman diagrams, which is based on an effective Lagrangian. *Supported by BMBF.*

HK 57.6 Fr 15:30 HS 13

$K^+\ \Sigma^-$ Photoproduction at the BGO-OD Experiment — •Johannes Gross — Physikalisches Institut der Universität Bonn

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

This unique combination is ideal for investigating low momentum transfer processes due to the acceptance and high momentum resolution at forward angles. In addition, the reconstruction capabilities of mixed charged final states is ideal for the investigation of strangeness photoproduction as part of an extensive experimental program. Preliminary results for $K^+\ \Sigma^-$ photoproduction will be presented.

These first data were acquired using a novel analysis technique, where K^+ are identified in the BGO calorimeter via their time-delayed weak decay. This is complemented by the high momentum resolution and extreme forward acceptance of K^+ detection in the forward spectrometer.

Supported by DFG (PN 50165297)

HK 58: Heavy-Ion Collisions and QCD Phases X

Zeit: Freitag 14:00–16:00 Raum: HS 15

Gruppenbericht HK 58.1 Fr 14:00 HS 15

SMASH: A New Hadronic Transport Approach — •Anna Schäfer[1,2] and Hannah Elfner[3,1,2] — [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]GSI Helmholtzzentrum für Schwerionenforschung GmbH, D-64291 Darmstadt, Germany

Transport approaches are very successfully applied for the microscopic description of matter in and out of equilibrium. Hadronic transport approaches are particularly useful to describe low-energy heavy ion collisions as well as the late, dilute stages of high-energy collisions. In this talk, an overview of SMASH (Simulating Many Accelerated Strongly-interacting Hadrons), a novel and open-source hadronic transport approach is presented. First, the underlying concepts and assumptions are introduced before their functionality is verified in a number of test setups. Among those are comparisons to an analytic solution of the Boltzmann equation and to experimentally known cross section data. Finally, SMASH results for transport coefficients, electromagnetic probes, particle spectra and elliptic flow are presented and, where applicable, confronted with experimental data. It is further demonstrated that while the results agree well with those of existing transport codes, SMASH also provides new opportunities to investigate the properties of strongly interacting matter.

HK 58.2 Fr 14:30 HS 15

Recent net-baryon fluctuation results from ALICE in view of the effect of detection efficiency losses — •Mesut Arslandok for the ALICE-Collaboration — Physikalisches Institut Heidelberg

In a thermal system, fluctuations of particle yields are directly encoded in the equation of state of the system under the study. By measuring event-by-event fluctuations over an ensemble of events via cumulants or moments of particle multiplicity distributions, one can study the freeze-out conditions in heavy-ion collisions and clarify their relation to the QCD phase transition. Higher order cumulants of fluctuations of conserved quantities like electric charge and baryon number are related to thermodynamic susceptibilities, which can be calculated in the Grand Canonical Ensemble formulation of thermodynamics such as Lattice QCD or statistical models. Cumulants beyond the second order are more sensitive to the underlying physics however experimentally more challenging. In particular the effect of finite detection efficiency losses drastically influences the measurements. In this contribution, recent experimental results on event-by-event analysis of net- baryon number fluctuation measurements in Pb-Pb collisions recorded by the ALICE Collaboration at the CERN LHC will be presented. The cumulants of net-proton, used as a proxy to net-baryon, results up to third order will be discussed in view of the effect of detection efficiency losses.

Supported by BMBF and SFB 1225 ISOQUANT.

HK 58.3 Fr 14:45 HS 15

Higher order Symmetric Cumulants — •Cindy Mordasini — Technical University of Munich, James-Franck-Str. 1, 85748 Garching, Germany

The measurements of correlations between the fluctuations of amplitudes of different flow harmonics in heavy-ion collisions have been shown to have a better sensitivity to the properties of the Quark-Gluon Plasma than the flow harmonics computed individually. These results were obtained using a new method based on the computation of the multiparticle cumulants for two different harmonics: the Symmetric Cumulants.

This talk presents the generalization of the Symmetric Cumulants for the case of three or more different harmonics. It will be shown explicitly how this new observable is sensitive only to the genuine three-harmonic correlations, and therefore how it provides a new and independent constraint on the properties of the Quark-Gluon Plasma. Predictions of these new observables made with the iEBE-VISHNU model will be shown.

HK 58.4 Fr 15:00 HS 15

Net-Λ fluctuations in Pb-Pb collisions at ALICE at the LHC — •Alice Ohlson for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

The fluctuations of conserved charges – such as electric charge, strangeness, and baryon number – in ultrarelativistic heavy-ion collisions provide insight into the properties of the quark-gluon plasma and the QCD phase diagram. They can be related to the higher moments of the multiplicity distributions of identified particles such as pions, kaons, and protons. The Λ baryon carries both strangeness and baryon number and is thus of particular interest. We present the first measurement of net-Λ fluctuations in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with the ALICE detector. The results are obtained with the Identity Method, which is applied in a novel way to account for the combinatoric background in the invariant mass distribution. The second moments of the net-Λ multiplicity distribution as a function of centrality and pseudorapidity acceptance are compared with the net-proton and net-kaon results measured by ALICE, as well as with model calculations.

Supported by BMBF and the Alexander von Humboldt Foundation.

HK 58.5 Fr 15:15 HS 15

Influence of the neutron skin effect on the isospin density in heavy ion collisions — •Jan Hammelmann[1,2], Alba Soto Ontoso[4], Hannah Elfner[1,2,3], and Damjan Mitrovic[1,2] — [1]Institut für Theoretische Physik, Goethe Universität Frankfurt — [2]FIAS Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenvorschung — [4]Brookhaven National Laboratory

A key ingredient in any theoretical description of heavy ion collisions is the spatial distribution of the nucleons inside the nuclei. Traditionally, both protons and neutrons have been distributed in an identical way via the Woods-Saxon distribution in the nucleus. However it has been experimentally measured that this assumption is not correct: there are more neutrons distributed on the outer layers of the nucleus than protons, the so-called neutron skin effect. By initializing heavy nuclei like Au or Pb with a neutron skin within the transport model SMASH, we study the influence of this novel feature on the zeroth component of the baryonic isospin current j^μ for different impact parameters and $\sqrt{s}$. The aim of this study is to make predictions for the isobar systems Zr and Ru run at RHIC in 2018.

HK 58.6 Fr 15:30 HS 15

Non-Bessel-Gaussianity of Flow Distribution — •Seyed Farid Taghavi — Technical University of Munich, James-Franck-Str. 1, 85748 Garching, Germany

There is a strong evidence that the produced matter in the heavy ion collision exhibits non-trivial collective behavior. Moreover, we know that the initial energy density produced after the collision depends on both the collision geometry and the quantum fluctuations of the nucleons inside the nucleus. According to this picture, the footprint of the collision geometry and quantum fluctuations can be observed in the final particle momentum distribution after the collective evolution of the initial state. This picture is mostly examined by studying the cumulants of momentum distributions in the experiment. In the present talk, we connect observed cumulants to the momentum distribution systematically. The final particle momentum distribution is approximately considered as Bessel-Gaussian distribution while the cumulants of the distribution show non-Bessel-Gaussianity. Here, we introduce an expansion (Gram-Charlier A series) around Bessel-Gaussian distribution and connect the non-Bessel-Gaussianity to the observed cumulant fine-splitting. Also we disentangle the effect of the collision geometry from quantum fluctuations in the cumulants. Using this approach, we introduce new estimators for average ellipticity. Also we show how one can restrict the phase space of the observed cumulants into specific allowed regions.

HK 58.7 Fr 15:45 HS 15

Λ^0 and K^0_S Production in Au+Au Collisions at 1.23A GeV in HADES — •Simon Spies for the HADES-Collaboration — Goethe-Universität Frankfurt

We use a high statistic data sample of 7.3×10^9 recorded Au(1.23A GeV)+Au events to investigate Λ^0 baryon and K^0_S meson production below their free nucleon nucleon threshold. These hadrons are being reconstructed using their weak decay topologies that are being recognized with the help of an artificial neural network. We calculate kinematic distributions in transverse and logitudinal direction

of these hadrons and put them in context with phenomenological models.

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

HK 59: Structure and Dynamics of Nuclei XI

Zeit: Freitag 14:00–16:00 Raum: HS 14

Gruppenbericht HK 59.1 Fr 14:00 HS 14

High-Precision Nuclear Structure Studies for Neutrinoless Double-Beta ($0\nu\beta\beta$) Decay — •U. Gayer[1], J. Kleemann[1], T. Beck[1], S. Finch[2], J. Isaak[1], FNU Krishichayan[2], B. Löher[1], H. Pai[3], O. Papst[1], N. Pietralla[1], P. C. Ries[1], D. Savran[4], W. Tornow[2], M. Weinert[5], and V. Werner[1] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]SINP, Kolkata, India — [4]GSI, Darmstadt — [5]IKP, Universität zu Köln

Apart from the unknown neutrino mass, the uncertainty of predicted decay rates for the $0\nu\beta\beta$-process is dominated by input from nuclear structure theory [1]. Our experimental campaign aimed at improving the data on electromagnetic observables of the $0\nu\beta\beta$-decay candidates ^{82}Kr/^{82}Se and ^{150}Nd/^{150}Sm to test theoretical models. We focused on γ-decay branches of the nuclear scissors mode (ScM), which can be determined in high-precision nuclear resonance fluorescence experiments using the γ^3 setup at the High-Intensity γ-Ray Source (HIγS). Due to the isovector character of the ScM and its relation to deformation, its decay probes isovector parameters and the description of shape coexistence in nuclear models such as the Interacting Boson Model-2 [2–4]. This contribution will summarize the experimental method, present the results, and discuss the impact on predicted $0\nu\beta\beta$ decay rates.

Supported by DFG research grant SFB 1245

[1] J. Engel, J. Menéndez, Rep. Prog. Phys. **80** (2017) 046301
[2] J. Beller *et al.*, Phys. Rev. Lett. **111** (2013) 172501
[3] T. Beck *et al.*, Phys. Rev. Lett. **118** (2017) 212502
[4] F. Iachello, A. Arima, Cambridge University Press (1987)

HK 59.2 Fr 14:30 HS 14

Decay Characteristics of the Scissors Mode of the $0\nu\beta\beta$-Decay Partner Isotopes ^{150}Nd and ^{150}Sm* — •J. Kleemann[1], T. Beck[1], U. Gayer[1], N. Pietralla[1], V. Werner[1], S. Finch[2], FNU Krishichayan[2], B. Löher[1], H. Pai[1,3], O. Papst[1], W. Tornow[2], and M. Weinert[4] — [1]IKP, TU Darmstadt — [2]TUNL, Duke University, Durham NC, USA — [3]SINP, Kolkata, India — [4]IKP, Universität zu Köln

To investigate the decay characteristics of the scissors mode of the hypothesized neutrinoless double beta ($0\nu\beta\beta$) decay mother nucleus ^{150}Nd and its daughter ^{150}Sm, two nuclear resonance fluorescence experiments were conducted at the γ^3-setup [1] at the High Intensity γ-ray Source (HIγS) of the Triangle Universities Nuclear Laboratory in Durham, NC, USA. By using HIγS' intense, nearly monochromatic, linearly polarized γ-ray beam, dipole states were selectively excited and their parities determined through the azimuthal distribution of their ground-state decay intensities. Our new data on the scissors mode's decay characteristics, especially its branching ratios to the 0_2^+ states, allows constraining nuclear structure model calculations involved in an extraction of the neutrino mass from a $0\nu\beta\beta$-decay rate. In particular, a determination of the Majorana parameters of the Interacting Boson Model-2 (IBM-2) is rendered possible [2]. Preliminary results and IBM-2 calculations will be presented and discussed.

*Supported by the DFG through the research grant SFB 1245.

[1] B. Löher *et al.* Nucl. Instr. Meth. Phys. Res. A **723**, 136 (2013)
[2] J. Beller *et al.* Phys. Rev. Lett. **111**, 172501 (2013)

HK 59.3 Fr 14:45 HS 14

Untersuchung der Quadrupolkollektivität der Scherenmode von ^{152}Sm — •K. Ide[1], T. Beck[1], S. Finch[2], U. Gayer[1], J. Kleemann[1], FNU Krishichayan[2], B. Löher[1], O. Papst[1], N. Pietralla[1], D. Savran[3], W. Tornow[2], M. Weinert[4] und V. Werner[1] — [1]IKP, TU Darmstadt — [2]TUNL, Duke University, Durham NC, USA — [3]GSI, Darmstadt — [4]IKP, Universität zu Köln

Die Scherenmode ist eine isovektorielle Kernanregung, deren Zerfall unter Aussendung elektrischer Quadrupolstrahlung kürzlich erstmalig beobachtet wurde [1]. Im Interacting Boson Model II (IBM-2) sind isovektorielle $E2$-Übergänge sensitiv auf die effektiven Bosonenladungen des $E2$-Übergangsoperators und können, gemeinsam mit der üblicherweise bekannten isoskalaren Anregungsstärke des 2_1^+-Zustands, für die Festlegung dieser Modellparameter verwendet werden.

Im vorgestellten Experiment wurde nach isovektoriellen $E2$-Zerfällen der Scherenmode des Kerns ^{152}Sm geforscht. An der High-Intensity γ-Ray Source wurde eine Kernresonanzfluoreszenzmessung mit einer mittleren Photonenstrahlenergie von 2.99(5) MeV durchgeführt.

Es konnte ein isovektorieller $E2$-Übergang der Scherenmode beobachtet werden. Durch eine Anpassung der IBM-2 Parameter an die neuen experimentellen Befunde von ^{152}Sm können die effektiven Bosonenladungen des $E2$-Übergangsoperators bestimmt werden.

[1] T.Beck *et al.*, Phys. Rev. Lett. **118** (2017) 212502

Gefördert durch die DFG im Rahmen des SFB 1245

HK 59.4 Fr 15:00 HS 14

Projectile Coulomb Excitation of Radioactive ^{140}Nd at HIE-ISOLDE — •R. Kern[1], R. Stegmann[1], G. Rainovski[2], N. Pietralla[1], L. Gaffney[3], A. Blazhev[4], K. Gladnishki[2], J. Jolie[4], V. Karayonchev[4], T. Kröll[1], P. Reiter[4], P.-A. Söderström[1], M. Scheck[5], P. Spagnoletti[5], A. Vogt[4], N. Warr[4], A. Welker[3], V. Werner[1], J. Wiederhold[1], and R. Zidarova[2] — [1]Technische Universität Darmstadt — [2]University of Sofia — [3]CERN — [4]Universität zu Köln — [5]University of the West of Scotland

Projectile Coulomb excitation (CoulEx) is a powerful tool for investigating valence-shell excitations of unstable nuclei. The full-symmetry 2_1^+ state and the so-called mixed-symmetry $2_{1,\mathrm{ms}}^+$ state are the two fundamental quadrupole-collective valence-shell excitations of near-spherical nuclei. They can be understood as a mixture of the collective 2^+ proton and 2^+ neutron excitations. Near-spherical even-even $N = 80$ isotones with $50 < Z < 58$ exhibit an isolated $2_{1,\mathrm{ms}}^+$ state, due to a mechanism called shell-stabilization. This situation changes at ^{138}Ce, where at the $\pi(g_{7/2})$ sub-shell closure at $Z = 58$ the lack of shell-stabilization causes the fragmentation of the $2_{1,\mathrm{ms}}^+$ state. It is of great interest, whether the shell stabilization reoccurs in the $N = 80$ isotones for $Z > 58$, i.e. ^{140}Nd ($Z = 60$). To answer this question, a CoulEx experiment was performed to identify the $2_{1,\mathrm{ms}}^+$ state of ^{140}Nd at the radioactive ion beam facility ISOLDE at CERN using MINIBALL. Preliminary results from the experiment will be shown.

Supported by the BMBF under Grant No. 05P15(/18)RDCIA.

HK 59.5 Fr 15:15 HS 14

$E2$ strength of the scissors mode and F-vector quadrupole charges over a shape-phase transition* — •T. Beck[1], N. Cooper[2,3], U. Gayer[1], FNU Krishichayan[4], O. Papst[1], N. Pietralla[1], D. Savran[5], W. Tornow[4], and V. Werner[1] — [1]IKP, TU Darmstadt — [2]Yale University, New Haven, CT, USA — [3]University of Notre Dame, Notre Dame, IN, USA — [4]Duke University, Durham, NC, USA — [5]GSI, Darmstadt

The properties of the nuclear scissors mode provide an essential insight into the nature of the restoring forces between the proton and neutron subsystems. Especially the behavior at the quantum phase transition (QPT) from spherical to quadrupole-deformed nuclear shape is of interest due to the quadrupole-collective origin of the scissors mode. Recently, the first measurement [1] of an F-vector $E2$ transition in axially deformed nuclei yielded direct information on the magnitude of the quadrupole boson charges for deformed nuclei in the framework of the Interacting Boson Model-2 [2]. New data on ^{154}Gd and ^{162,164}Dy corroborate and extend the work on the evolution of F-scalar and F-vector quadrupole boson charges over the QPT. The obtained results will be presented in detail and discussed in terms of the underlying nuclear physics. An outlook to future research will be given.

[1] T. Beck *et al.*, Phys. Rev. Lett. **118**, 212502 (2017).
[2] T. Otsuka and J.N. Ginocchio, Phys. Rev. Lett. **54**, 777 (1985).

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HK 59.6 Fr 15:30 HS 14

Nuclear photon strength functions: a model-independent approach via $(\vec{\gamma}, \gamma'\gamma'')$ reactions — •J. Isaak[1], T. Beck[1],

M. Bhike[2], I. Brandherm[1], U. Gayer[1], F. Krishichayan[2], B. Löher[1,3], N. Pietralla[1], D. Savran[3], M. Scheck[4], W. Tornow[2], V. Werner[1], and A. Zilges[5] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]GSI, Darmstadt — [4]UWS, Paisley, UK — [5]University of Cologne

Photon strength functions (PSFs) serve as an essential input for nuclear astrophysical model calculations and play an important role in the calculation of capture and photo-disintegration reaction rates as well as in the description of the nucleosynthesis of heavy nuclei. Different experimental methods have been used in the past to study PSFs. In this contribution, a model-independent approach is presented for the extraction of the PSF in $(\vec{\gamma}, \gamma'\gamma'')$ reactions using quasi-monochromatic photon beams. The measurements were performed with the γ^3 setup [1] at the High Intensity γ-ray Source at Duke University, Durham, USA [2]. The experimental method and results are presented and compared to statistical model calculations [3].

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[1] B. Löher *et al.*, NIMA 723 (2013) 136.
[2] H. R. Weller *et al.*, PPNP 62 (2009) 257.
[3] J. Isaak *et al.*, PLB 788 (2019) 225.

HK 59.7 Fr 15:45 HS 14

From Hans alpha-neutron coincidences to the superheavy boson — Genevieve Mouze[1] and •Jean-Francois Comanducci[2] — [1]Universite de Nice, 06108 Nice cedex 2, France — [2]LE- AIEA, 4 Quai Antoine Premier, 98000 Monaco

The study, by Hongyin Han et al., of the coincidences between the alpha-particles and neutrons emitted by 252Cf has led to the discovery that a heavy boson, of lifetime 0.17 yoctosecond and mass at least 160.9 GeV/c2 plays a crucial role in the fission reaction. These authors reported that up to 3.25 neutrons are in coincidence with alphas of 15.9 MeV on average. This suggests that the harmonic oscillator, made of the 82-proton and 126- neutron phases of the 208Pb core can reach its four-phonon level, and de-excite by two D.G.D.R. of 26 MeV. But in our study of 258Fm we have shown that the two phases have moved away, so that the 50Ar cluster can interact with the bare 82-proton phase and form a 132Sn-126Sn pair. This interaction triggers the intervention of a superheavy boson field and the creation of a W+ , W- boson pair, since changes have occurred in the quark flavours.

HK 60: Nuclear Astrophysics V

Zeit: Freitag 14:00–15:30 Raum: HS 16

Gruppenbericht HK 60.1 Fr 14:00 HS 16

Radiative charged-particle induced reaction studies for the nucleosynthesis of heavy isotopes — •P. Scholz, F. Heim, M. Körschgen, J. Mayer, M. Müller, and A. Zilges — Institute for Nuclear Physics, University of Cologne

Nuclear reaction cross sections are one of the main ingredients for the understanding of nucleosynthesis processes in stellar environments. For isotopes synthesized in the p- or r process [1,2], reaction rates on exotic nuclei are often calculated in the scope of the Hauser-Feshbach statistical model [3]. The accuracy of these reaction rates crucially depend on the uncertainties of nuclear-physics input-parameters like γ-ray strength functions, optical-model potentials, and level densities. The way to improve the reliability of statistical model calculations is to extend the available database for charged-particle induced reaction cross sections at low energies as well as using these data to study the underlying nuclear physics properties.

This talk will summarize the different projects of our group, measuring proton and α-particle induced reactions in different mass regions and studying the γ-ray strength functions and α+nucleus optical-model potential.

Supported by the DFG (ZI 510/8-1) and the "ULDETIS" project within the UoC Excellence Initiative institutional strategy.

[1] M. Arnould and S. Goriely, Phys. Rep. **384** (2003) 1.
[2] M. Arnould *et al.*, Phys. Rep. **450** (2007) 97.
[3] W. Hauser and H. Feshbach, Phys. Rev. **87**, 366 (1952).

HK 60.2 Fr 14:30 HS 16

NICE -Neutron Induced Charged particle Emission — •Kafa Khasawneh[1], Benjamin Bruckner[1], Philipp Erbacher[1], Stefan Fiebiger[1], Roman Gernhäuser[2], Kathrin Göbel[1], Deniz Kurtulgil[1], Christoph Langer[1], René Reifarth[1], Benedikt Thomas[1], Meiko Volknandt[1], and Mario Weigand[1] — [1]Goethe University Frankfurt — [2]Technical University Munich

Neutron-induced nuclear reactions with the charged particle in the exit channel play an essential role in the s-process nucleosynthesis, but are also important for medical and nuclear reactor technologies. Despite this importance, cross-section data for such reactions are still scarce because of the short range of charged particles (μ m), which hampers their detection. Only very thin samples in the range of micrometers can therefore be used. New approaches are required in particular for the time-of-flight technique to overcome the low reaction rates.

A new detector setup (NICE-detector) based on an organic plastic scintillator was proposed and tested at the Goethe University Frankfurt. One of the test cases was the capture cross-section of ^{209}Bi at different astrophysically important energies. In this talk, the performance of the adapted detector setup as well as the results of calculated cross-section values will be presented. This project is supported by the DFG project NICE (RE 3461/3-1).

HK 60.3 Fr 14:45 HS 16

Towards background-free studies of capture reactions in a heavy-ion storage ring — •L. Varga, J. Glorius, Yu. A. Litvinov, Z. Slavkovska, and Y. M. Xing — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

In 2016, the first measurement of the 124Xe(p,γ)125Cs reaction was performed at the Experimental Storage Ring (ESR) at GSI. Using Double Sided Silicon Strip Detectors (DSSSD) the 125Cs reaction products have been successfully detected [1]. In order to increase the sensitivity of this method, the signal-to-background ratio has to be improved. In addition to the spatial distribution of the measured ion-hits, using the energy information of the Si detector the particle identification technique for highly charged ions can be optimized.

In this talk, a clear assignment of each events to a p- and n-side strip pair of the DSSSD is introduced. Then, the intrinsic calibration of the detector is presented by performing gain-matching for all individual segments. At last, the deposited energy of the detected ions is reconstructed considering the inter-strip effects for each side of the Si detector. MonteCarlo simulations show, by combining the energy resolution and an additional slit system at ESR, background-free measurements of the p-capture products can be accomplished. This method could provide an unrivaled opportunity for precision (p,g) reaction studies in the Gamow-window using stored and cooled, highly charged, radioactive ions.

[1] J.Glorius et. al., J. Phys: Conf Ser 875(2017)092015

HK 60.4 Fr 15:00 HS 16

Preparation for the measurement of the bound-state beta-decay of bare ^{205}Tl ions at the ESR — •Ragandeep S. Sidhu, Rui Jiu Chen, and Yuri A. Litvinov — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

In bound-state beta-decay [1,2], a neutron inside a nucleus transforms into a proton, an anti-neutrino (produced in a free state), and an electron which is created in a bound atomic state. The determination of the bound-state beta-decay rate of fully-ionized ^{205}Tl is needed to determine the matrix element for the electron capture decay of the 2.3 keV excited state in ^{205}Pb to the ground state of ^{205}Tl [3]. The latter is important for the determination of the neutrino-capture probability on ^{205}Tl and, in turn, within the LOREX project the solar pp neutrino flux for over 4.3 Ma. The Experimental Storage Ring (ESR) at GSI, Darmstadt provides an unrivaled opportunity to allow for the corresponding decay studies. The report on the preparations for the bound-state beta-decay for bare ^{205}Tl ions will be given. [1] R. Daudel, M. Jean and M. Lecoin, J. Phys. Radium 8, 238 (1947). [2] J. N. Bahcall, Phys. Rev. 124, 495 (1961). [3] M.K. Pevicevic et al., Nucl. Instr. and Meth. A 621, 282 (2010).

HK 60.5 Fr 15:15 HS 16

The Measurement of Long Lived Alpha Decay for Cosmochronometry — •Heinrich Wilsenach[1], Kai Zuber[1], Ulli Köster[2], and Mihály Braun[3] — [1]Institut für Kern- und Teilchenphysik TU-Dresden, Dresden, Germany — [2]Institut Laue Langevin, Grenoble, France — [3]Institute for Nuclear Research of the Hungarian Academy of Sciences, Debrecen, Hungary

Due to the mechanism of alpha decay, it has the largest span of half-lives of any decay. The large range of half-lives allows alpha decay to be used as a tool to probe many different fields of physics. A field of recent interest is dating the formation of the Solar System using isotopic ratios. This dating technique relies on isotopes with half-lives in the range of megayears. One of the weaknesses of this technique is the reliability of the half-lives. Measuring this quantity is challenging as the material does not usually exist in nature. This means that the isotopes of interest will have to be made accurately in quantities that give a sufficiently detectable signal. To produce these rare materials the ISOLDE facility at CERN was used. A ultrapure beam of the isotope of interest was implanted into aluminium foil. The foils were then measured with an ultra-low background ionisation chamber. The chamber was specially designed and built to measure low signal rates and has a background in the region of interest of around 0.27 counts per day per MeV. The design and operation of this alpha detector will be discussed, as well as some preliminary results of the new implantation technique.

HK 61: Fundamental Symmetries and Astroparticle Physics

Zeit: Freitag 14:00–15:45 Raum: HS 18

Gruppenbericht HK 61.1 Fr 14:00 HS 18

Probing charged lepton flavor violation with the Mu2e experiment — •Stefan E. Müller and Anna Ferrari for the Mu2e-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, currently under construction at the Fermi National Accelerator Laboratory near Chicago, will search for the neutrinoless conversion of muons to electrons in the field of an aluminum nucleus. In the Standard Model, this process, which violates charged lepton flavor, is highly suppressed and therefore undetectable. However, scenarios for physics beyond the Standard Model predict small but observable rates. The Mu2e experiment aims at a sensitivity four orders of magnitude better than existing experiments. This is achieved by a rigorous control of all backgrounds that could mimic the monoenergetic conversion electron.

At HZDR, we use the ELBE radiation facility to study radiation hardness and performance of components for the Mu2e calorimeter and contribute with Monte Carlo simulations to the understanding of the optimal configuration for the detector that will monitor the rate of stopped muons in the aluminum target. Additional simulations are performed for both the pion production target and the muon stopping target.

In the presentation, the design and status of the Mu2e experiment will be presented, and results from the ELBE beamtimes and the simulation studies will be given.

Gruppenbericht HK 61.2 Fr 14:30 HS 18

CONUS: Towards the detection of coherent elastic neutrino nucleus scattering — •Janina Hakenmüller for the CONUS-Collaboration — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

The CONUS experiment is located at the nuclear power plant of Brokdorf, Germany, at 17 m distance from the reactor core. Four high-purity point contact Germanium detectors with a noise threshold in the range of 300 eV have been deployed in an elaborate shield and are used to look for the elusive coherent elastic neutrino nucleus scattering. The experiment has been set up in 2018. The analysis of the first data set based on 1 month of reactor off time and 6 months of reactor on time will be presented.

Before the setup of the experiment, the location, especially the potential neutron-induced background, has been characterized thoroughly. It will be shown in the talk that inside the detector chamber no reactor thermal power correlated background is expected.

An outlook on planned upgrades and feasible physics goals with the CONUS setup will be given.

HK 61.3 Fr 15:00 HS 18

Light sterile neutrino search with KATRIN — •Fotios Megas for the KATRIN-Collaboration — Technische Universität München, München, Deutschland — Max-Planck-Institut für Physik, München, Deutschland

The KATRIN experiment aims to measure the effective electron antineutrino mass, with an unprecedented sensitivity of 0.2 eV/c^2. Being sensitive in this mass range means that KATRIN can also be used to resolve another puzzling phenomenon:

Anomalies observed in short baseline and reactor experiments may be resolved by the existence of light sterile neutrinos. KATRIN has the potential to shed light onto these anomalies.

This talk will present the sensitivity of KATRIN to light sterile neutrinos. Focus will be put on the effect of background, systematic uncertainties and different measurement schemes. Finally, the analysis method will be applied to the first tritium data acquired in summer 2018, as a test study.

HK 61.4 Fr 15:15 HS 18

Simulation of Cosmic-Ray Antimatter Fluxes — •Laura Serksnyte, Laura Fabbietti, Martin J. Losekamm, Stephan Paul, and Thomas Pöschl — Technische Universität München, München, Deutschland

Measuring antimatter in space probes various astrophysical processes. The abundancies and energy spectra of antiparticles reveal details of 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. Especially the search for cosmic antideuterons and antihelium may reveal exotic production processes—such as dark-matter annihilation—as the background production rate through inelastic scattering of cosmic-ray protons is very low. However, these particles are strongly influenced by the magnetic fields of the Sun and Earth, modifying the expected particle flux for experiments near Earth. We discuss the production of secondary antiions in Earth's atmosphere as an additional background production mechanism. We simulate the propagation and interaction of the particles in Earth's proximity to extract the location-dependent antiparticle flux and to evaluate the suitability of different locations in space for experiments that search for low-energy cosmic-ray anti-ions.

HK 61.5 Fr 15:30 HS 18

Fluorescence measurements of optical active materials in response to liquid argon scintillation — •Ekaterina Rukhadze[1,2], Patrick Krause[1], Laszlo Papp[1], Stefan Schönert[1], and Mario Schwarz[1] — [1]Technische Universität München, Garching, Germany — [2]Institute of Experimental and Applied Physics, CTU in Prague, Prague, Czech Republic

The next generation of large volume liquid argon (LAr) detectors requires an understanding and optimization of the collection of light created by scintillation. Since most photodetectors are not sensitive for the emission wavelength of LAr, wavelength sifter (WLS) materials are needed. Measurements of the fluorescence yield of WLS materials in LAr should be performed in order to characterize the light collection of these detectors. For this purpose a new triggered LAr light source and detection system has been developed. An overview of the setup as well as first measurements using different WLS will be presented. This work is supported in part by the German Federal Ministry for Education and Research (BMBF) Verbundforschung 05A17W02, the German Research Foundation (DFG) via the SFB1258, the European Structural and Investment Fund, grant cz.02.2.69/0.0/0.0/16_027/0008465 and the Ministry of Industry and Trade of the Czech Republic via the FV30231.

HK 62: Instrumentation XIII

Zeit: Freitag 14:00–15:45 Raum: HS 11

Gruppenbericht HK 62.1 Fr 14:00 HS 11

Readiness of R3B setup for FAIR Phase-0 — •Dominic Rossi for the R3B-Collaboration — Technische Universität Darmstadt, Darmstadt, Germany

The R^3B experimental setup is designed to enable kinematically complete measurements of various types of nuclear reactions involving exotic secondary beams at relativistic energies up to the GeV/nucleon range. Currently located at GSI, the setup will be in use for several approved physics runs within the FAIR Phase-0 program.

The experimental setup and scope will be presented briefly, followed by the current status of the various detector subsystems, including for instance the superconducting dipole magnet GLAD, the neutron time-of-flight detector NeuLAND and the photon detector CALIFA. Preliminary results from on-line detector tests will be presented, illustrating the readiness of the experiment for the upcoming physics program.

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

HK 62.2 Fr 14:30 HS 11

200μm Scintillating Fiber Detector with SiPM Readout — •Ashton Falduto[1], Junki Tanaka[1], and Thomas Aumann[1,2] for the R3B-Collaboration — [1]TU Darmstadt — [2]GSI Helmholtzzentrum

Being able to track charged particles using scintillation light detection near magnetic fields is currently challenging due to magnetic field influences on the often used photomultiplier tubes. However, with the development of a new Silicon Photomultiplier (SiPM) Fiber detector, it is now possible to detect these particles using a unique combination of SiPM, Preamplifing Discriminators (PADI) and an FPGA-based Time-to-Digital Converters (TDC). The detector is built from over two thousand 200μm round plastic scintillator fibers arranged in a unique pattern. The position is determined when light is detected by one of these scintillating fibers and a "hit" or "no hit" signal is produced. In this presentation, I will explain how the detector was constructed and how the electronics work together. I will show where the detector is located during experimental runs. And finally, I will discuss the performance of the detector during an on-line experiment.
This work is supported by the BMBF project 05P15RDFN1 and the GSI-TU Darmstadt cooperation.

HK 62.3 Fr 14:45 HS 11

Comparison of Different Coatings for Scintillating-Plastic Fibers — •Verena Eiblmeier, Laura Fabbietti, Martin J. Losekamm, Stephan Paul, and Thomas Pöschl — Technical University, Garching, Germany

Plastic scintillators have a long tradition as radiation detectors in high-energy and medical physics. Due to their low weights and cost, large segmented volumes can be built up from them. To suppress optical crosstalk between the different segments, the surface of the scintillator must be made impermeable to light. We tested different surface coatings on short scintillating-plastic fibers and compare their mechanical and optical properties. To compare the light output of the different fibers, we coupled them to silicon photomultipliers and irradiated them with a pion and proton beam at Paul Scherrer Insitute. We performed different measurements to compare the magnitude and the uniformity of the light yield along the scintillating fiber.

HK 62.4 Fr 15:00 HS 11

Zeitauflösung eines elektromagnetischen Blei-Wolframat-Kalorimeters mit Siliziumphotomultiplier-Auslese — •Lukas Nies, Kai-Thomas Brinkmann, Markus Moritz, René Schubert und Hans-Georg Zaunick — II. Physikalisches Institut, Gießen, Deutschland

Da moderne Messaufgaben immer leistungsfähigere Detektoren erfordern, wurde mit der Entwicklung des Siliziumphotomultipliers (SiPM) in den letzten Jahren eine Alternative zur traditionellen Photomultiplier-Röhre (PMT) geschaffen. Aufgrund der kleineren Größe, der geringen Betriebsspannung und der Insensitivität gegen Magnetfelder ist die SiPM der PMT in vielen Anwendungen überlegen. In dieser Arbeit wird die Entwicklung eines Detektors vorgestellt, welcher aus Blei-Wolframat (PWO) Kristallen und SiPM-basierten Auslesemodulen besteht. Das einzelne Auslesemodul besteht aus einer SiPM-Trägerplatine, welche neun SiPMs parallel betreibt und eine gesamte photosensitive Fläche von 81 mm^2 besitzt. Auf der Rückseite der Trägerplatine ist ein modularer Hochfrequenz-Verstärker aufgesteckt, der die Rohsignale der SiPMs wahlweise mit einer einfachen oder einer doppelten Verstärkerstufe verstärkt. Um die Leistung dieses Detektorkonzeptes zu testen, wurden neben Tests der einzelnen Komponenten auch kosmische Myonen gemessen und die Signale mit einem 100 MHz SADC digitalisiert. Über eine optimierte offline Merkmalextraktion wurden die Zeitauflösung zwischen zwei Detektoren bestimmt und das Spektrum der Energiedeposition der Myonen im Szintillatormaterial aufgenommen.

HK 62.5 Fr 15:15 HS 11

Collection efficiency performance of recently developed Microchannel-Plate Photomultipliers — •Daniel Miehling, Merlin Böhm, Albert Lehmann, Markus Pfaffinger, and Samuel Stelter for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

Two Cherenkov detectors for hadron identification will be used for the PANDA experiment at the new FAIR facility. For both of these DIRC detectors the focal plane will be located inside a magnetic field of >1 T. Microchannel-Plate Photomultipliers (MCP-PMTs) are the chosen sensors for the detection of the Cherenkov photons. Typically the probability that an electron from the photo cathode is actually detected at the anodes is in the order of 60% for MCP-PMTs. This is called the collection efficiency (CE). PHOTONIS has built a new HiCE sensor which should reach 90% CE or even more. This is achieved with a special treatment of the microchannel-plates. In the Erlangen setup a measurement of the CE of different MCP-PMTs, older PHOTONIS and Hamamatsu and the new HiCE PHOTONIS tube, was performed. There are some challenging requirements for the measurement, namely a light source whose intensity is tunable over several orders of magnitude and a suitable setup for measuring very low currents in the range of picoampere. This talk will present the current setup and the latest obtained results. The focus will be on the comparison of various tubes with different lifetime enhancement methods applied like a protection film in the tube or ALD-coated (atomic layer deposition) MCPs.

- Funded by BMBF and GSI -

HK 62.6 Fr 15:30 HS 11

The eyes of XENONnT: Qualification tests of 494 photomultiplier tubes — •Oliver Wack and Luisa Hoetzsch for the XENON Collaboration — MPIK, Heidelberg, Germany

The next phase of the XENON dark matter direct detection experiments will be the XENONnT detector. Utilizing in total 8.4 tonnes of xenon in a dual-phase liquid xenon time projection chamber, its aim is to increase the sensitivity for direct dark matter detection by one order of magnitude to probe new regions of the parameter space.

The scintillation light induced within the detector volume by particle interactions will be detected with 494 photomultiplier tubes (PMTs). The Hamamatsu R11410 tube has been chosen for its high quantum efficiency and low intrinsic radioactivity to maximize the detector's sensitivity. Applying the knowledge gained during testing and operation of the previous detector, XENON1T, the characteristics and performance of the PMTs for XENONnT have been studied and tested extensively. The general testing procedures and the results of the testing campaign will be presented in this talk.

HK 63: Instrumentation XIV

Zeit: Freitag 14:00–15:45 Raum: HS 12

Gruppenbericht HK 63.1 Fr 14:00 HS 12

The ALICE TPC – past, present and future — •Jens Wiechula for the ALICE-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE time projection chamber (TPC) has been in operation for a decade. During the Run 1 and Run 2 data taking phase (2009-2018) it showed excellent performance, culminating in the Pb–Pb run in Dec. 2018. During the LHC long shutdown 2, which started directly after the Pb–Pb run, the MWPCs of the TPC will be replaced by a GEM-based readout system. This will allow for making full use of the 50 kHz Pb–Pb interaction rate which the LHC will deliver in Run 3 and Run 4.

Performance and challenges during the Run 1 and Run 2 data taking periods will be summarized. Also, the present status and the further planning of the upgrade program will be discussed.

Supported by BMBF and the Helmholtz Association.

HK 63.2 Fr 14:30 HS 12

The development of a TPC-based focal plane detector for the MAGIX spectrometers — •Sabato Stefano Caiazza for the MAGIX-Collaboration — Institute for Nuclear Physics, JGU Mainz

MAGIX is a versatile experiment which will be installed on the 105 MeV energy recovering beam line of the new MESA accelerator under construction at the Institute for Nuclear Physics in Mainz. The design of the experiment is based on two large spectrometers pivoting around the scattering chamber. The key components of those spectrometers are the detector which will track the scattered particles as they cross the spectrometers' focal planes. To achieve a high position resolution with electrons whose energy is lower than 100 MeV, we decided to rely on a pair of TPCs using which we can reduce the amount of passive material before the tracker to the amount necessary to separate the vacuum of the spectrometers from the counting gas of the detector sensitive volume. In this contribution we will present the most recent developments of those detectors and the plans for their future deployment

HK 63.3 Fr 14:45 HS 12

Space-charge distortions in the ALICE TPC — •Ernst Hellbär — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. With the advent of high luminosity data in LHC Run 2 (2015–2018), unexpectedly large local distortions of the drift paths of ionization electrons are observed at the edges of specific readout chambers. These distortions are caused by ions which originate at the readout chambers, leading to local space-charge accumulation in the drift volume of the TPC. Extensive studies have been performed to understand the exact origin of the space charge and the mechanism responsible for it. Along with this effort, a way to significantly mitigate the distortions has been found to achieve the best performance possible of the TPC in the latest heavy-ion run at the end of 2018.

Supported by BMBF and the Helmholtz Association.

HK 63.4 Fr 15:00 HS 12

Performance of a twin position-sensitive Frisch-grid ionization chamber for photofission experiments* — •M. Peck[1], U. Bonnes[1], J. Enders[1], A. Göök[2], J. Hehner[3], A. Oberstedt[4], and S. Oberstedt[2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]European Commission, Joint Research Centre, Geel, Belgium — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [4]ELI-NP, Măgurele, Romania

Twin Frisch-grid ionization chambers (FGIC) [1] for the study of fission-fragment properties have been established as reliable detectors. Fission-fragment mass and energy distributions are determined using the double kinetic energy technique, the polar angle of the collinear fission fragments is determined from the drift time of electrons created by decelerating fission fragments in the counting gas. By exchanging the anode plates in the standard chamber on both sides by an array of grid- and strip-anodes, which are read out by means of resistive charge division [2], a position sensitivity is achieved that allows the azimuthal fragment emission angle to be determined, too [3]. The performance of a twin position-sensitive FGIC for future photofission experiments at ELI-NP has been studied using the well-known ^{252}Cf(sf) decay. First results will be presented. *Supported by BMBF (05P2018RDEN9) and by the state of Hesse (LOEWE research cluster Nuclear Photonics).

[1] C. Budtz-Jørgensen et al., NIM A 258, 209 (1987).
[2] A. Pullia et al., IEEE Trans. Nucl. Sci. 49, 3269-3277 (2002).
[3] A. Göök et al., NIM A 830, 366-374 (2016).

HK 63.5 Fr 15:15 HS 12

Electron Detection Efficiency of the CBM-TRD Prototypes in Testbeams at DESY — •Adrian Meyer-Ahrens for the CBM-Collaboration — Institut für Kernphysik, Münster, Germany

The Transition Radiation Detector (TRD) is a part of the Compressed Baryonic Matter (CBM) experiment at FAIR. As electron identification is one of the TRD's main tasks, its electron detection efficiency is an important system property to be determined. For this and other testing purposes testbeam measurements with an electron beam at DESY were taken with current CBM-TRD prototypes in september of 2017. In this talk analysis results leading to the determination of the electron detection efficiency of the used prototypes will be presented. Since the detector prototypes and readout electronics were not yet tested in a large scale setup like the one used at DESY a focus of the analysis was also a general QA of the system. This work is supported by BMBF.

HK 63.6 Fr 15:30 HS 12

CBM-TRD high-rate detector tests at the CERN-GIF — •Philipp Kähler for the CBM-Collaboration — Institut für Kernphysik, Münster, Germany

The Compressed Baryonic Matter (CBM) experiment will be one of the research pillars of FAIR (Darmstadt, Germany), which is currently under construction. High-intensity heavy-ion beams delivered by the SIS100 accelerator (FAIR Phase 1) will be used to explore the QCD phase diagram at high net-baryon densities. At the planned interaction rates, the CBM experiment has to meet the challenge of very high hit rates in the detectors. This talk will focus on high-rate tests of the MWPCs for the CBM-TRD, which have been conducted at the CERN Gamma Irradiation Facility (GIF) in October 2018 using the near-to-final, self-triggered CBM-DAQ system. The detection efficiency for muons from CERN-SPS has been measured with respect to the detector load, applied using the 14 TBq ^{137}Cs GIF source. First efficiency results will be shown as well as measurements on the high-voltage field of the MWPCs in load situations. This work is supported by BMBF-grant 05P16PMFC1.