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

Peter Reiter
Universität zu Köln
Institut für Kernphysik
Zülpicher Straße 77
50937 Köln
preiter@ikp.uni-koeln.de

Overview of Invited Talks and Sessions

(Lecture halls AM 00.011, AM 00.014, AM 00.017, AM 00.021, PHIL A 301, PHIL B 302, PHIL C 301, PHIL A 401, PHIL A 602, PHIL B 604, PHIL C 601, and MED 00.915; Poster Redoutensaal)

Plenary Talk of the Hadronic and Nuclear Physics Division

PV IX	Wed	9:00– 9:45	AudiMax	**Status and perspectives for science at FAIR (Facility for Antiproton and Ion Research)** — •Thomas Nilsson

Invited Talks

HK 1.1	Mon	14:45–15:15	MED 00.915	**ALICE Run 3 Physics Highlights** — •Igor Altsybeev
HK 1.2	Mon	15:15–15:45	MED 00.915	**Ab initio studies on muon capture and rare decays** — •Lotta Jokiniemi
HK 10.1	Tue	11:00–11:30	MED 00.915	**Baryon scattering amplitudes from lattice QCD** — •John Bulava
HK 10.2	Tue	11:30–12:00	MED 00.915	**Exploring Triaxial Deformation in Neutron-rich Nuclei** — •Kathrin Wimmer, Byul Moon, Wolfram Korten
HK 10.3	Tue	12:00–12:30	MED 00.915	**Jet Targets for Nuclear and Hadron Physics Experiments** — •Alfons Khoukaz
HK 10.4	Tue	12:30–13:00	MED 00.915	**Probing neutrinos with the KATRIN and LEGEND experiments** — •Susanne Mertens
HK 19.1	Wed	11:00–11:30	MED 00.915	**Nucleosynthesis of heavy elements in explosive astrophysical environments** — •Daniel Siegel
HK 19.2	Wed	11:30–12:00	MED 00.915	**Recent results from laser spectroscopy with CRIS at ISOLDE: nuclear structure studies and beyond** — •Jessica Warbinek
HK 19.3	Wed	12:00–12:30	MED 00.915	**QCD at FAIR: Strong QCD Across Communities** — •Johan Messchendorp, Frank Nerling
HK 19.4	Wed	12:30–13:00	MED 00.915	**New Directions in Micropattern Gaseous Detector Technologies** — •Philip Hauer
HK 28.1	Thu	11:00–11:30	MED 00.915	**Toward the Island of Stability** — •Khuyagbaatar Jadambaa
HK 28.2	Thu	11:30–12:00	MED 00.915	**From stars to underground labs: Nuclear astrophysics measurements at Felsenkeller** — •Eliana Masha
HK 28.3	Thu	12:00–12:30	MED 00.915	**Hunting exotic mesons in the light-quark sector at GlueX** — •Farah Afzal
HK 28.4	Thu	12:30–13:00	MED 00.915	**Dispersive analyses of Primakoff reactions with kaons** — •Bastian Kubis
HK 47.1	Fri	9:00– 9:30	MED 00.915	**Supernova signatures on Earth and beyond** — •Jenny Feige
HK 47.2	Fri	9:30–10:00	MED 00.915	**ALICE 3 - The next-generation heavy-ion experiment at the LHC** — •Lars Döpper
HK 47.3	Fri	10:00–10:30	MED 00.915	**Towards Physics Operation of the CBM Experiment at FAIR** — •Adrian Rodríguez Rodríguez
HK 48.1	Fri	11:00–11:30	MED 00.915	**Probing confinement and string-breaking with quantum simulations** — •Torsten Zache
HK 48.2	Fri	11:30–12:00	MED 00.915	**Exploring stochastic aspects of nuclear gamma decays with photonuclear reactions** — •Johann Isaak
HK 48.3	Fri	12:00–12:30	MED 00.915	**Precision QCD with ePIC at the Electron-Ion Collider** — •Tyler Kutz

Sessions

HK 1.1–1.2	Mon	14:45–15:45	MED 00.915	**Invited Talks**
HK 2.1–2.7	Mon	16:15–18:30	PHIL C 301	**Hadron Structure and Spectroscopy I**
HK 3.1–3.7	Mon	16:15–18:15	PHIL A 401	**Hadron Structure and Spectroscopy II**
HK 4.1–4.7	Mon	16:15–18:30	AM 00.011	**Structure and Dynamics of Nuclei I**
HK 5.1–5.7	Mon	16:15–18:30	AM 00.021	**Structure and Dynamics of Nuclei II**
HK 6.1–6.7	Mon	16:15–18:15	PHIL C 601	**Heavy-Ion Collisions and QCD Phases I**
HK 7.1–7.7	Mon	16:15–18:15	PHIL A 602	**Nuclear Astrophysics I**
HK 8.1–8.7	Mon	16:15–18:15	PHIL A 301	**Instrumentation I**
HK 9.1–9.7	Mon	16:15–18:15	PHIL B 302	**Instrumentation II**
HK 10.1–10.4	Tue	11:00–13:00	MED 00.915	**Invited Talks**
HK 11.1–11.7	Tue	16:15–18:30	PHIL C 301	**Hadron Structure and Spectroscopy III**
HK 12.1–12.7	Tue	16:15–18:30	PHIL A 401	**Hadron Structure and Spectroscopy IV**
HK 13.1–13.8	Tue	16:15–18:45	AM 00.011	**Structure and Dynamics of Nuclei III**
HK 14.1–14.9	Tue	16:15–18:45	AM 00.021	**Structure and Dynamics of Nuclei IV**
HK 15.1–15.10	Tue	16:15–18:45	PHIL C 601	**Heavy-Ion Collisions and QCD Phases II**
HK 16.1–16.7	Tue	16:15–18:30	PHIL A 602	**Nuclear Astrophysics II**
HK 17.1–17.7	Tue	16:15–18:15	PHIL A 301	**Instrumentation III**
HK 18.1–18.8	Tue	16:15–18:15	PHIL B 302	**Instrumentation IV**
HK 19.1–19.4	Wed	11:00–13:00	MED 00.915	**Invited Talks**
HK 20.1–20.6	Wed	13:45–15:45	AM 00.014	**Focus Session: QCD@FAIR**
HK 21.1–21.7	Wed	13:45–15:45	AM 00.011	**Structure and Dynamics of Nuclei V**
HK 22.1–22.6	Wed	13:45–15:45	AM 00.021	**Structure and Dynamics of Nuclei VI**
HK 23.1–23.7	Wed	13:45–15:45	PHIL C 301	**Heavy-Ion Collisions and QCD Phases III**
HK 24.1–24.7	Wed	13:45–15:45	PHIL A 401	**Heavy-Ion Collisions and QCD Phases IV**
HK 25.1–25.6	Wed	13:45–15:30	PHIL A 602	**Nuclear Astrophysics III**
HK 26.1–26.7	Wed	13:45–15:30	PHIL A 301	**Instrumentation V**
HK 27.1–27.32	Wed	16:15–18:30	Redoutensaal	**Poster Session**
HK 28.1–28.4	Thu	11:00–13:00	MED 00.915	**Invited Talks**
HK 29.1–29.6	Thu	13:45–15:30	PHIL C 301	**Hadron Structure and Spectroscopy V**
HK 30.1–30.6	Thu	13:45–15:45	PHIL A 401	**Hadron Structure and Spectroscopy VI**
HK 31.1–31.6	Thu	13:45–15:45	AM 00.011	**Structure and Dynamics of Nuclei VII**
HK 32.1–32.7	Thu	13:45–15:45	PHIL C 601	**Heavy-Ion Collisions and QCD Phases V**
HK 33.1–33.8	Thu	13:45–15:45	PHIL A 602	**Nuclear Astrophysics IV**
HK 34.1–34.3	Thu	13:45–15:00	AM 00.021	**Fundamental Symmetries I**
HK 35.1–35.7	Thu	13:45–15:45	PHIL A 301	**Instrumentation VI**
HK 36.1–36.7	Thu	13:45–15:45	PHIL B 302	**Instrumentation VII**
HK 37.1–37.6	Thu	16:15–18:00	PHIL C 301	**Hadron Structure and Spectroscopy VII**
HK 38.1–38.6	Thu	16:15–18:00	PHIL A 401	**Hadron Structure and Spectroscopy VIII**
HK 39.1–39.7	Thu	16:15–18:00	AM 00.011	**Structure and Dynamics of Nuclei VIII**
HK 40.1–40.7	Thu	16:15–18:00	PHIL C 601	**Heavy-Ion Collisions and QCD Phases VI**
HK 41.1–41.6	Thu	16:15–18:00	PHIL A 602	**Heavy-Ion Collisions and QCD Phases VII**
HK 42.1–42.3	Thu	16:15–17:30	AM 00.021	**Fundamental Symmetries II**
HK 43.1–43.3	Thu	16:15–17:00	PHIL B 604	**Computing and Outreach**
HK 44.1–44.7	Thu	16:15–18:00	PHIL A 301	**Instrumentation VIII**
HK 45.1–45.6	Thu	16:15–17:45	PHIL B 302	**Instrumentation IX**
HK 46	Thu	18:00–19:30	AM 00.017	**Members' Assembly**
HK 47.1–47.3	Fri	9:00–10:30	MED 00.915	**Invited Talks**
HK 48.1–48.3	Fri	11:00–12:30	MED 00.915	**Invited Talks**

Members' Assembly of the Hadronic and Nuclear Physics Division

Thursday 18:00–19:30 AM 00.017

- Approval of the minutes and the agenda
- Report from HK division chair
- Report from KHuK
- Aob

HK 1: Invited Talks

Time: Monday 14:45–15:45 Location: MED 00.915

Invited Talk HK 1.1 Mon 14:45 MED 00.915
ALICE Run 3 Physics Highlights — •Igor Altsybeev for the ALICE Germany-Collaboration — Technische Universität München, Garching bei München, Germany

The ALICE experiment at the LHC is designed to study the properties of the quark-gluon plasma (QGP) formed in relativistic heavy-ion collisions. The QGP is a hot, dense state of QCD matter in which quarks and gluons are no longer confined within hadrons and can propagate over distances larger than the hadronic scale.

During Run 3 of the LHC (2022–2026), ALICE has collected data across a variety of collision systems, including pp, Pb-Pb, as well as – for the first time – light-ion systems such as pO, OO and Ne-Ne. Compared to Runs 1 and 2, the experiment operates at significantly higher interaction rates, made possible by major detector upgrades that enable continuous readout rather than a trigger-based data acquisition.

In this talk, an overview of recent physics results from ALICE will be presented, with a particular emphasis on the high-statistics data collected during Run 3.

Invited Talk HK 1.2 Mon 15:15 MED 00.915
Ab initio studies on muon capture and rare decays — •Lotta Jokiniemi — Technische Universität Darmstadt, Darmstadt, Germany — ExtreMe Matter Institute EMMI, Darmstadt, Germany

Neutrinoless double-beta decay, in which a nucleus decays by two simultaneous beta decays without emitting neutrinos, is a sensitive probe for new physics. The decay would be the first signal of lepton number violation, since only two beta particles without antiparticles are created. It would also prove that neutrinos have Majorana nature and shed light on their unknown masses. However, interpreting the experiments requires reliable nuclear-theory predictions.

Muon capture is a nuclear-weak process in which a negatively charged muon, initially in an atomic bound state, is captured by the atomic nucleus, resulting in atomic number reduction by one and emission of a muon neutrino. Thanks to the high momentum transfer involved in the process, it can be used to probe the weak currents at the momentum regime relevant for the neutrinoless double-beta decay.

I will discuss recent advances in the theory predictions for neutrinoless double-beta decay. Then, I will talk about ab initio studies on muon capture in light nuclei, focusing in particular on the ab initio no-core shell model. These systematically improvable calculations are based on nuclear interactions derived from chiral effective field theory. The computed rates are found to be in good agreement with available experimental counterparts, motivating future experimental and theoretical explorations in light nuclei.
* Funded by the LOEWE Top Professorship LOEWE/4a/519/05.00.002(0014)98.

HK 2: Hadron Structure and Spectroscopy I

Time: Monday 16:15–18:30 Location: PHIL C 301

Group Report HK 2.1 Mon 16:15 PHIL C 301
Accessing transition Generalized Parton Distributions with the $N \to N^*$ DVCS and DVMP processes — •Stefan Diehl for the CLAS-Collaboration — II. Physikalisches Institut, JLU Gießen, Gießen, Germany — University of Connecticut, Storrs, CT, USA

The understanding of the internal structure of baryon resonances is of essential important for many fields of nuclear physics. It is known, that Generalized Parton Distributions (GPDs) are a well established tool for characterizing the QCD structure of the ground-state nucleon based on 3D tomographic images of the quark/gluon structure. Transition GPDs extend these concepts to $N \to N^*$ transitions and can be used to characterize the 3D structure and mechanical properties of baryon resonances. They can be probed for example in high-momentum transfer exclusive electroproduction processes with resonance transitions $eN^* \to eMN^*$, such as deeply virtual Compton scattering (M = γ) or meson production (M = π, K ...). Based on the high-intensity, 10.6 GeV electron beam at JLAB and the large acceptance CLAS12 spectrometer, it becomes possible to study these processes in a large kinematic range. The talk will present results of the deeply virtual $ep \to e\Delta^{++}\pi^-$ process, providing a first measurement sensitive to transition GPDs and discuss the feasibility of the study of further $N \to N^*$ DVMP processes with CLAS12. Furthermore, first results for beam spin asymmetries of the $N \to N^*$ DVCS process ($ep \to eN^{*+}\gamma$) will be presented and compared to transition GPD based theory predictions. *The work is partly supported by Deutsche Forschungsgemeinschaft (Project No. 508107918).

Group Report HK 2.2 Mon 16:45 PHIL C 301
Measurement of the proton charge radius at AMBER — •Martin Hoffmann for the AMBER-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The AMBER collaboration plans to perform a new precision measurement of the proton electric form factor at low values of the negative squared four-momentum transfer by elastic scattering of high-energy muons off protons. This experiment features a high-intensity 100 GeV muon beam at the M2 beam line of CERN's Super Proton Synchrotron, leading to reduced and different systematic uncertainties compared to low-energy lepton-proton elastic scattering experiments. A high-pressure hydrogen-filled Time Projection Chamber serves as an active target and measures the energy transferred to the recoil proton. The muon trajectories and momenta are reconstructed by high-precision vertex detectors surrounding this chamber and a magnetic spectrometer. In this way, the measurement is over-constrained to cleanly select elastic scattering events.

The completely new free-streaming data acquisition was successfully tested under realistic conditions in 2025. First detectors of each type were installed in the setup and included in this new readout scheme. This talk will present first insights from this measurement and an overview of further developments towards the main experiment, which will be in the commissioning phase during the conference.

Supported by BMFTR.

HK 2.3 Mon 17:15 PHIL C 301
The PRIMA Experiment@MAMI: Simulation work for the pion acceptance determination — •Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Majunata[1], Frank Maas[1,2,3], Antoine Martinet[1], Oliver Noll[1,2], Paul Schöner[1], Christoph Rosner[1], Pierre Vijayan[1], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, German — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

The significant discrepancy among data-driven models for the pion electromagnetic transition form factor (TFF)$F_{\pi^0\gamma^*\gamma^*}$ must be resolved, as this factor provides a main contribution to the hadronic light-by-light scattering (HLbL) process, which is essential for calculating the hadronic correction to the muon anomalous magnetic moment (a_μ^{QCD}). The PRIMA Experiment is measuring $F_{\pi^0\gamma^*\gamma^*}$ in the low momentum transfer (Q^2) region at the MAMI accelerator in Mainz, utilizing an Electromagnetic Calorimeter (EMC) and an Electron Veto Detector.
Determining the pion acceptance of the calorimeter is essential for this experiment. Consequently, simulation studies are being performed. This talk presents the current work-in-progress and the initial results regarding the pion acceptance.

HK 2.4 Mon 17:30 PHIL C 301
Feasibility studies of hyperon transition form factors with CBM at FAIR — •Shreya Roy for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH Planckstraße 1 64291 Darmstadt

Electromagnetic transition form factors (eTFFs) probe the internal structure of baryons. In the timelike region ($q^2 > 0$), they are accessible, for example via Dalitz decays $Y^* \to Y\, e^+e^-$. Previous results from

HADES exist for light baryons (e.g. $\Delta(1232)$, $N^*(1520)$) that tested vector–meson dominance and revealed meson–cloud effects. To take the studies to the next level, the feasibility of extending this program to the strange sector with the Compressed Baryonic Matter (CBM) experiment at FAIR, Darmstadt, has been investigated. This contribution will cover details of the analysis strategy for exclusive Λ reconstruction in the $pp \to pK^+\Lambda$ channel using CBM tracking, PID, and kinematic fitting in the simulation. We then extend the study to the Dalitz channel $pp \to pK^+\Lambda(1520)$ with $\Lambda(1520) \to \Lambda\, e^+e^-$ to assess the sensitivity to timelike eTFFs and the possible kaon-cloud dynamics. Background simulation is under investigation. The obtained invariant-mass resolution, acceptance×efficiency, expected signal rates at CBM luminosities, form-factor sensitivity, and the accessible baryon radius will be presented.

HK 2.5 Mon 17:45 PHIL C 301

Beam rastering system for P2 collaboration at MESA — •Sumedh Kulkarni and Tyler Kutz for the P2-Collaboration — KPH, Johannes Gutenberg University of Mainz

The P2 collaboration at the MESA facility aims for a high precision measurement of the parity violating asymmetry in the elastic scattering of polarized electrons off of unpolarized protons. The expected asymmetry is on the order of 40 parts per billion (ppb), with a precision goal of better than 1 ppb. Thus, the experiment requires very high event rates to achieve the necessary statistical precision. Achieving such rates demands an intense, continuous electron beam incident on a thick target. P2 will carry out the measurement with a 150 μA electron beam on a 60 cm liquid hydrogen target. The resulting large power deposition can damage or destabilize the target without proper precautions. One way to mitigate this risk is to raster the electron beam with fast steering magnets, in order to distribute the power over a larger area of the target. For this, P2 will develop a rastering system that uses two electromagnetic dipoles to steer the electron beam by the desired angle. We used computer simulation to optimize ferrite yoke geometries and to determine the coil specifications for the required magnetic field strength. From these simulations, the most suitable yoke design and coil specifications were chosen. Here we present results of these simulations and further construction steps of the rastering system for the P2 experiment at MESA.

HK 2.6 Mon 18:00 PHIL C 301

Sieve optimization for calibration of the MAGIX spectrometers — •Alen Gajer for the MAGIX-Collaboration — KPH, JGU, Mainz, Germany

The MAGIX experiment, currently under development at the MESA accelerator in Mainz, will enable a broad range of precision measurements using electron scattering on fixed targets. The core component are two high-resolution magnetic spectrometers that separate scattered particles according to their momentum and detect them at the focal plane.

To extract scattering variables at the target, accurate reconstruction of the particle trajectories from focal-plane measurements is required. This is achieved through spectrometer optics, using a matrix formalism method that relates measured and target variables. Determining the corresponding transport tensor components demands a dedicated calibration run with a sieve collimator placed in front of the spectrometers entrance.

Since the performance of the calibration directly depends on the sieve geometry, designing it is a nontrivial task. We present a simulation-based optimization approach, which evaluates the sieve pattern based on the quality of the reconstruction.

HK 2.7 Mon 18:15 PHIL C 301

Investigation of initial Antiproton Polarization — •Vincent Verhoeven for the P371-Collaboration — Ruhr-University Bochum — GSI

The preparation of a polarized antiproton beam, useful for experiments aiming at exploring new physics topics, remains a challenge. No simple and efficient polarization method has yet been established. The CERN P371 experiment aims to investigate whether antiprotons produced in a high-energy proton beam collision with an unpolarized solid target are initially polarized. The polarization can be determined by measuring the asymmetry of elastic $\bar{p}p$-scattering with a known analyzing power in the Coulomb-Nuclear Interference region. The experiment was carried out in July and August 2025 using the T11 beam line of the Proton Synchroton in the East Area. As a track reconstruction is required even to determine the number of antiprotons in the beam, the data analysis is challenging and currently ongoing.

HK 3: Hadron Structure and Spectroscopy II

Time: Monday 16:15–18:15 Location: PHIL A 401

Group Report HK 3.1 Mon 16:15 PHIL A 401

Light-Meson Spectroscopy at COMPASS — •Stefan Wallner for the COMPASS-Collaboration — Max Planck Institute for Physics, Garching, Germany

We studied the excitation spectrum of non-strange and strange light mesons with unparalleled precision using the world's largest sample of diffractive scattering of 190 GeV/c negative pions and kaons recorded at the COMPASS experiment at CERN. We performed partial-wave analyses of data on various final states to identify the produced light-meson resonances and to measure their properties, including spin, parity, mass, and width.

We report on recent results for the $\omega\pi^-\pi^0$, $\eta\pi^-\pi^-\pi^+$, and $K^0_S K^-$ final states, which map out a wide range of the non-strange light-meson spectrum. We present measurements of excited a_J and π_J states at high masses, a partly unexplored regime. We also discuss the exotic $\pi_1(1600)$, the lightest hybrid meson, which we found in various decay channels in these final states. Finally, we present the most comprehensive measurement to date of the strange-meson spectrum in the $K^-\pi^-\pi^+$ final state. There, we found the first candidate for an exotic strange meson with $J^P = 0^-$.

HK 3.2 Mon 16:45 PHIL A 401

Pseudoscalar meson-pair production beyond the resonance region at COMPASS — •Henri Pekeler for the COMPASS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany

The COMPASS experiment at CERN's SPS provides a uniquely large data set to study the light-meson spectrum in diffractive production reactions of 190 GeV/c beam pions with protons. Among the many different final states accessible, $\eta\pi^-$ and $\eta'\pi^-$ are clean channels to investigate the lightest hybrid-meson candidate, the $\pi_1(1600)$. One challenge in identifying meson resonances is the separation of resonant and non-resonant processes.

To better constrain the non-resonant production mechanism of these final states, we analyze the high-mass region, i.e. $4\,\mathrm{GeV/c^2} < m_{\eta^{(\prime)}\pi^-} < 6\,\mathrm{GeV/c^2}$, using the double-Regge exchange model by Shimada er al., [Nucl. Phys. B 142 (1978)]. The model describes the dependence of the amplitude of a given double-Regge exchange on the invariant variables in terms of Regge trajectories. In addition, form factors are introduced at every vertex to parameterize the t-dependence of the coupling. For the first time, we perform an event-based likelihood fit to the COMPASS data set and show that the high-mass data can be described by only 13 parameters.

Supported by BMFTR.

HK 3.3 Mon 17:00 PHIL A 401

Studying Light-Meson Resonances in $\tau^- \to \pi^+\pi^-\pi^-\nu_\tau$ Decays at Belle (II) — •Godo Kurten, Hans-Günther Moser, Stephan Paul, Claudia Perez-Orive, Stefan Wallner, and Miriam Weiskopf — Max Planck Institute for Physics, Boltzmannstr. 8, 85748 Garching, Germany

We study mainly the a_1 resonances occurring in $\tau^- \to \pi^+\pi^-\pi^-\nu_\tau$ decays. To this end, we develop a two-step partial-wave analysis using simulated samples from the Belle II experiment. First, we perform a partial-wave decomposition fit that disentangles the data into partial-wave amplitudes with well-defined quantum numbers and measure their dependence on the invariant mass of the three pion system $m_{3\pi}$. Secondly, we search for resonances in these amplitudes with a resonance-model fit to the measured partial-wave amplitudes. Thereby, we extract mass and width of the resonances.

We present simulation-based input-output studies for the resonance-model fit, validating the resonance-model fit and assessing sensitivity to signals, such as the $a_1(1420)$.

HK 3.4 Mon 17:15 PHIL A 401

Studying the meson photoproduction mechanism through spin-density matrix elements at GlueX — •Niklas Herrmann and Farah Afzal for the GlueX-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum, Bochum, Germany

The primary goal of the GlueX experiment is the search for exotic mesons, states that are forbidden within the quark model but permitted by quantum chromodynamics. GlueX located at Jefferson Lab employs a linearly polarized photon beam in the energy range from 8.2 to 8.8 GeV on a liquid hydrogen target. Current searches for exotic hybrid mesons within the meson spectrum require an understanding of the production mechanism. An important experimental tool to study the production mechanism is the measurement of polarization observables as the Spin-Density Matrix Elements (SDMEs) with a linearly polarized photon beam. In this talk, I present the measurement of the polarized SDMEs in the photoproduction of $\rho^-\Delta^{++}$, using GlueX data from 2017 - 2018. The new GlueX data has significantly better statistical precision compared to the existing SLAC data and provides a precise measurement of the t-dependence of the SDMEs for the range 0.025 to 1.4 GeV^2.

HK 3.5 Mon 17:30 PHIL A 401

Particle Identification ($e\gamma\gamma$) of Primakoff-Electroproduction π^0-Events for PRIMA FAIR Phase-0 — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Frank Maas[1,2,3], •Antoine Martinet[1], Oliver Noll[1,2], Paul Schöner[1], Christoph Rosner[1], Pierre Vijayan[1], and Sahra Wolff[1] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

The FAIR Phase-0 experiment PRIMA, conducted at the Mainzer Mikrotron (MAMI), aims at measuring the π^0 transition form factor (TFF) in doubly-virtual Primakoff kinematics. Improving the TFF uncertainty is crucial, as it contributes a large uncertainty to the Standard Model prediction of the anomalous magnetic moment of the muon. The TFF represents the leading order of the hadronic light-by-light scattering (HLbL) correction. To achieve this, a modified version of the homogeneous $PbWO_4$-based PANDA backward-electromagnetic-calorimeter is used to measure the final state of the scattered electron and the π^0-decay photons. Key to this analysis is the particle identification for the $e\gamma\gamma$ final state. This can be done using the invariant mass of the detected particles, but potentially also using a neural network. This talk presents the current progress on particle identification of electrons and photons using a neural network.

HK 3.6 Mon 17:45 PHIL A 401

Background Modelling in Partial-Wave Analysis of $\tau^- \to \pi^+\pi^-\pi^-\nu_\tau$ decays at Belle II — •Miriam Weiskopf, Godo Kurten, Hans-Günther Moser, Stephan Paul, Claudia Perez-Orive, and Stefan Wallner — Max Planck Institut for Physics, Boltzmannstraße 8, Garching 85748, Germany

We study light mesons appearing as intermediate resonances in the $\tau^- \to \pi^+\pi^-\pi^-\nu_\tau$ decays at the Belle II experiment where τ pairs are produced in e^+e^- collisions. A detailed partial wave-analysis is performed to identify resonances that appear in the 3π system and to measure their properties including spin, parity, mass and width.

We will present our neural-network based approach that is used to model the distributions of backgrounds, such as $\tau^- \to \pi^+\pi^-\pi^-\pi_0\nu_\tau$ or $e^+e^- \to q\bar{q}$, in our data sample. We address challenges such as the high dimensionality of the phase space, limited data coverage, sharp background features, and background distributions that vary across different kinematic regions. The modelled background distributions and their integration into the partial-wave analysis will be presented.

HK 3.7 Mon 18:00 PHIL A 401

Polarization in the two-photon production of pion pairs and how to use it — •Max Lellmann, Achim Denig, Jan Muskalla, and Christoph Florian Redmer — Johannes Gutenberg Universität Mainz

The accuracy of the Standard Model prediction for the hadronic light-by-light contribution to the muon's anomalous magnetic moment a_μ is strongly limited by the knowledge of two-photon couplings of axial and tensor mesons. The coupling of the lightest tensor state, $f_2(1270)$, can be conveniently studied in the process $e^+e^- \to e^+e^-\pi^0\pi^0$, in which the pion pair is produced through the fusion of two virtual photons emitted by the leptons.

A reliable extraction of the tensor state's two-photon coupling requires proper corrections for reconstruction efficiency and other detector effects, which in turn demand accurate Monte Carlo simulations of the process. By implementing such a generator that, for the first time, includes a fully exclusive description of the $e^+e^- \to e^+e^-\pi^0\pi^0$ reaction, additional features of the cross section become accessible and can be used to extract further information from the same data.

This talk will outline the method and introduce the corresponding Monte Carlo generator, HadroTOPS.

HK 4: Structure and Dynamics of Nuclei I

Time: Monday 16:15–18:30 Location: AM 00.011

Group Report HK 4.1 Mon 16:15 AM 00.011

Implementation of the recoil distance Doppler-shift technique at the radioactive beam facility ISOLDE — •Christoph Fransen[1], Alina Didik[1], Andrey Blazhev[1], Rob Bark[2], Max Droste[1], Casper-David Lakenbrink[1], Peter Reiter[1], Carlotta Porzio[3], and Nigel Warr[1,4] for the IS 656-Collaboration — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]iThemba LABS, South Africa — [3]CERN, Switzerland — [4]University of Liverpool, UK

Absolute transition strengths between excited states yield fundamental information on nuclear structure and can be determined from level lifetimes. The recoil distance Doppler-shift (RDDS) technique employing so-called plunger devices is valuable to measure lifetimes in the picosecond range and has been in the focus of our Cologne group for many years. In this talk, we will present the first RDDS campaign at ISOLDE. Particular emphasis will be paid to the special conditions for such experiments at ISOLDE, e.g., with respect to radioactive beams, the sophisticated plunger device, the reaction kinematics, and the special requirements for targets. As a main example, we will focus on an experiment on ^{144}Ba done recently by our group aiming for the implementation of the RDDS technique at ISOLDE and the search for octupole correlations. Further, RDDS experiments on ^{162}Yb and ^{207}Tl performed within the same campaign will be briefly discussed that support the high potential of this technique for investigations of exotic nuclei. Supported by the BMFTR, Joint Project 05P2024 - ISOLDE, Grant No. 05P24PK2.

Group Report HK 4.2 Mon 16:45 AM 00.011

Employing Coincidence Doppler-Shift Attenuation Method approaches to inelastic ion-scattering experiments in the A ≈ 100 mass region — •Anna Bohn, Elias Binger, Tobias Langel, Markus Müllenmeister, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The $A \approx 100$ mass region is a major focus of current research on various nuclear structure phenomena, such as shape evolution and proton-neutron symmetry mixing. Several inelastic ion-scattering experiments have been performed on stable even-even nuclei [1–4], including Te, Sn, Pd, Ru, Mo, and Zr isotopes, at the SONIC@HORUS [5] setup at the University of Cologne. Fundamental properties such as nuclear-level lifetimes, level schemes, and spin information could be investigated. This contribution provides an overview of the most recent results and different analysis approaches employing the Coincidence Doppler-Shift Attenuation Method [1,4].
Supported by the DFG (ZI 510/9-2).

[1] A. Hennig *et al.*, Phys. Rev. C **92** (2015) 064317.
[2] S. Prill *et al.*, Phys. Conf. Ser. **1643** (2020) 012157.
[3] S. Prill *et al.*, Phys. Rev. C **105** (2022) 034319.
[4] A. Bohn *et al.*, EPJ Web Conf. **329** (2025) 03004.
[5] S. Pickstone *et al.*, Nucl. Instr. Meth. A **875** (2017) 104.

HK 4.3 Mon 17:15 AM 00.011

Multi-method analysis of the dipole response in the tin isotopic chain — •Markus Müllenmeister[1], Johann Isaak[2], Michael Weinert[1], Florian Kluwig[1], Tanja Schüttler[1], Paula Behrendt[1], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]Technische Universität Darmstadt, Institute for Nuclear Physics, Germany

Model-independent determination of nuclear properties provides essential benchmarks for both statistical observables, and the assumptions underlying several experimental methods. Such approaches are central to constraining quantities relevant for stellar nucleosynthesis [1] and nuclear structure phenomena [2].

This contribution presents a set of continuum and state-to-state methods applied to the tin isotopes ^{116,118,120}Sn, especially the $^{A-1}$Sn$(d,p\gamma)^{A}$Sn reactions as seen in [3], to extract information in a consistent manner. The combination of selective electromagnetic [4] and hadronic probes and modern analysis techniques [5] enables direct determination of nuclear structure properties, like nuclear level densities (NLDs).

This work is supported by the DFG under (ZI 510/10-2) and (Project-ID 499256822 * GRK 2891 'Nuclear Photonics').

[1] M. Wiedeking *et al.*, Phil. Trans. R. Soc. A. **382** (2024), 20230125.
[2] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019), 360.
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021), 242501.
[4] M. Müscher *et al.*, Phys. Rev. C **102** (2020), 014317.
[5] O. Papst *et al.*, Phys. Rev. Lett. **135** (2025), 052501.

HK 4.4 Mon 17:30 AM 00.011

Lifetime measurements of excited states in ^{101}Pd — •Sven Wagner, Maximilian Droste, Peter Reiter, Ramona Burggraf, Christoph Fransen, Hannah Kleis, and Casper-David Lakenbrink — Institut für Kernpyhsik, Universität zu Köln, Zülpicher Straße 77 D-50937 Köln, Germany

The nucleus ^{101}Pd lies four protons and five neutrons away from the doubly magic ^{100}Sn. Nuclei in this region of the nuclear chart have traditionally been regarded as prototypical vibrational systems, exhibiting characteristic level structures in their low-lying excited states. However, precise lifetime measurements for even-even Pd isotopes have revealed notable deviations from this vibrational behaviour [1]. Experimental information on ^{101}Pd remains limited, with earlier studies reporting discrepant lifetimes for the first excited state [2] and for higher-lying members of the $\nu h_{11/2}$ band [3,4]. Excited states in ^{101}Pd were populated via the fusion-evaporation reaction ^{92}Zr(^{12}C,3n)^{101}Pd using a 50 MeV beam. A precise lifetime measurement was performed at the FN Tandem accelerator of the IKP Cologne employing the recoil-distance Doppler-shift (RDDS) technique to extract reduced transition strengths. New lifetimes for states in the $\nu d_{5/2}$, $\nu g_{7/2}$, and $\nu h_{11/2}$ bands have been obtained. The results will be discussed in the context of nuclear structure in the vicinity of ^{100}Sn.

[1] M. Droste et al., Phys. Rev. C 106, 024329 (2022) [2] D. Ivanova et al., Phys. Rev. C 105, 034337 (2022) [3] M. Sugawara et al., Phys. Rev. C 92, 024309 (2015) [4] V. Singh et al., J. Phys. G 44, 075105 (2017)

HK 4.5 Mon 17:45 AM 00.011

Lifetime Measurements Excited States in ^{99}Pd — •Ramona Burggraf, Peter Reiter, Rainer Abels, Timo Biesenbach, Andrey Blazhev, Maximilian Droste, Arwin Esmaylzadeh, Christoph Fransen, Kai Henseler, Hannah Kleis, Mario Ley, Aaron Pfeil, Joe Roob, Alessandro Salice, Timon Sültenfuss, and David Werner — IKP, Universität zu Köln

Excited states in ^{99}Pd were populated in the ^{90}Zr(^{12}C,3n) fusion-evaporation reaction at a beam energy of 55 MeV using the Cologne plunger setup in combination with the CATHEDRAL γ-ray spectrometer, which consists of 24 HPGe and eight LaBr$_3$ detectors. The setup enabled simultaneous recoil-distance Doppler-shift and fast-timing measurements. The lifetimes of the first excited state and several previously unknown higher-lying levels were extracted using the differential decay-curve method. Longer-lived states were additionally characterised using γ-γ fast timing. Transitional nuclei located southeast of the doubly magic ^{100}Sn have long been considered as prototypical vibrational systems, although recent lifetime data have questioned this interpretation [1]. For ^{99}Pd, however, experimental information on excited states remains scarce. Prior to the present work, only a single lifetime had been reported by Ivanova *et al.* [2], which disagreed with the results obtained in this study. The new set of level lifetimes, including those for higher-lying states, will be presented and compared with large-scale shell-model calculations.

[1] M. Droste et al., Phys. Rev. C 106, 024329 (2022)
[2] D. Ivanova et al., Phys Rev. C 105, 034337 (2022)

HK 4.6 Mon 18:00 AM 00.011

The isovector spin-M1 response of ^{90}Zr and ^{92}Mo — •A. Gupta[1], V. Werner[1], A. D. Ayangeakaa[2,3], M. Beuschlein[1], S. W. Finch[3,4], U. F. Gayer[3,4,5], D. Gribble[2,3], J. Hauf[1], K. E. Ide[1], J. Isaak[1], X. James[2,3], R. V. F. Janssens[2,3], S. R. Johnson[2,3], J. Kleemann[1], P. Koseoglou[1], T. Kowalewski[2,3], B. Löher[6], O. Papst[1], N. Pietralla[1], A. Saracino[2,3], D. Savran[6], and N. Sensharma[2,3] — [1]IKP, TU Darmstadt — [2]UNC, Chapel Hill, NC, USA — [3]TUNL, Durham, NC, USA — [4]Duke U., Durham, NC, USA — [5]ESS, Lund, SE — [6]GSI, Darmstadt

Electron-capture rates in medium-heavy nuclei are crucial for deleptonization in late core-collapse supernovae. These rates depend strongly on Gamow-Teller (GT) strength [1], though direct measurements remain difficult. The isovector spin-flip M1 (IVSM1) response, an isospin analogue of GT transitions, provides an alternative probe, which we investigate in the N = 50 isotones ^{90}Zr and ^{92}Mo. The two extra protons in ^{92}Mo's $g_{9/2}$ orbital beyond the closed pf shell may enhance its IVSM1 strength relative to ^{90}Zr. The dipole response of both nuclei was studied via nuclear resonance fluorescence using a new hybrid HPGe Clover-LaBr$_3$ array at the HIγS facility. Ground-state transition asymmetries will be used to extract the total $M1/E1$ strength up to 10 MeV. The experimental details and preliminary results for the total $M1$ strength distribution will be presented.

Supported by DFG Project No.279384907-SFB 1245 and the U.S. DOE Grant No. DE-FG02-97ER41041 and No. DE-FG02-97ER41033.

[1] K. Langanke et al., Rep. Prog. Phys. **84**, 066301 (2021)

HK 4.7 Mon 18:15 AM 00.011

Lifetime Determination in ^{98}Ru using the Reverse Coincidence Doppler-Shift Attenuation Method — •Tobias Langel, Elias Binger, Anna Bohn, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The Coincidence Doppler-Shift Attenuation Method (CDSAM) is a powerful tool to determine nuclear level lifetimes in the sub-picosecond regime [1–2]. At the SONIC@HORUS detector array [3], located at the University of Cologne, both HPGe γ-detectors and silicon particle-detectors are used to enable coincident detection of inelastically scattered protons and subsequently emitted photons. This significantly suppresses background and feeding contributions, allowing for high-precision lifetime measurements.

The newly developed Reverse CDSAM approach [4] improves the accessibility of lower-intensity transitions. In addition to other experiments conducted in the $A \approx 100$ mass region, a ^{98}Ru(p,p$'\gamma$) experiment was performed and analyzed using both the standard CDSA method and the new reverse approach. This contribution presents the experimental results and discusses the differences between the approaches.

Supported by the DFG (ZI 510/9-2).

[1] A. Hennig *et al.*, Nucl. Instr. Meth. A **758**, 171 (2015)
[2] S. Prill *et al.*, Phys. Rev. C **105**, 034319 (2022)
[3] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017)
[4] A. Bohn *et al.*, EPJ Web Conf. **329**, 03004 (2025)

HK 5: Structure and Dynamics of Nuclei II

Time: Monday 16:15–18:30 Location: AM 00.021

Group Report HK 5.1 Mon 16:15 AM 00.021

Emulators for Hartree-Fock and In-Medium Similarity Renormalization Group — •Margarida Companys Franzke[1,2,3], Tom Plies[1,2], Alexander Tichai[1,2,3], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck Institut für Kernphysik, Heidelberg

Emulation techniques have become a popular tool in nuclear physics to study Hamiltonians with an explicit parametric dependence. An important example is given by two- and three-nucleon interactions derived from chiral effective field theory that depend linearly on low-energy couplings (LECs). To extensively explore the LEC parameter space even simpler methods like Hartree Fock can become computationally costly, which makes the use of emulators necessary. While methods like Hartree-Fock can be emulated with reduced basis methods like eigenvector continuation, the problem is more complex for in-medium similarity renormalization group calculations. For this, more data-driven approaches like Gaussian Processes are more promising.
Funded by the ERC Grant Agreement No. 101020842 and by the DFG - Project-ID 279384907 - SFB 1245.

HK 5.2 Mon 16:45 AM 00.021

A Bayesian approach to the Coulomb breakup of 19C — •Quentin Bozet and Pierre Capel — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, D-55099 Mainz, Germany

The breakup of weakly bound nuclei is a key probe of nuclear structure at the limits of stability. In this work, we investigate the breakup of the one-neutron halo nucleus 19C on a lead target at 69AMeV using the Coulomb-Corrected Eikonal approximation (CCE). To rigorously quantify uncertainties and constrain model parameters, we employ a Bayesian analysis framework for the description of 19C, more specifically on its binding energy and asymptotic normalization constant (ANC). Posterior distributions on these two quantities are inferred from the comparison of precise reaction calculations to experimental cross sections measured at RIKEN as a function of the 18C-n relative energy. Using these posteriors leads also to a good agreement with the cross sections measured as a function of the scattering angle.These experimental cross section as a function of the center of mass energy are indeed used during the computation of the posteriors. Comparison between the posteriors and the experimental cross sections as a function of the scattering angle. Our results demonstrate that Bayesian inference, when combined with the CCE, provides a powerful methodology for interpreting breakup data of exotic nuclei. It enables us to infer reliable estimates of structure observables with meaningful uncertainties.

HK 5.3 Mon 17:00 AM 00.021

Correlated mass models for calcium isotopes from ab initio calculations — •Max Cincar[1,2,3], Zhen Li[1,2,3], Tom Plies[1,2], Urban Vernik[1,2], Matthias Heinz[4,5], Takayuki Miyagi[6], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]National Center for Computational Sciences, ORNL — [5]Physics Division, ORNL — [6]Center for Computational Sciences, University of Tsukuba

Neutron-rich nuclei offer an opportunity to investigate exotic nuclear structure phenomena and properties of the underlying nuclear forces. We present ab initio calculations for neutron-rich calcium isotopes, quantifying various sources of theoretical uncertainties. Based on these calculations we construct correlated mass models for different interactions from chiral effective field theory. Conditioning these models on experimentally known data, we make predictions for unknown two-neutron separation energies.

* Funded by the ERC Grant Agreement No. 101020842, by the DFG - Project-ID 279384907 - SFB 1245, and by the LOEWE Top Professorship LOEWE/4a/519/05.00.002(0014)98.

Group Report HK 5.4 Mon 17:15 AM 00.021

Exploring the Nuclear Structure and Collectivity of Neutron-Rich Tin Isotopes around ^{132}Sn — Maximilian Droste[1], •Peter Reiter[1], and Thorsten Kröll[2] — [1]IKP, Universität zu Köln — [2]IKP, TU Darmstadt

Evolution of nuclear collectivity and structure in the region surrounding the doubly-magic nucleus ^{132}Sn remains a central open question in nuclear structure physics. Recent large-scale shell-model calculations, employing realistic interactions, predict an enhancement of collectivity in the even-even isotopes adjacent to ^{132}Sn. However, a long-standing discrepancy between experimental data for ^{130}Sn and ^{134}Sn and corresponding theoretical predictions has persisted. Two safe Coulomb excitation experiments were conducted at ISOLDE. Post-accelerated radioactive ion beams of ^{130}Sn and ^{134}Sn, delivered by the HIE-ISOLDE accelerator at 4.4 MeV/u, were incident on ^{206}Pb and ^{194}Pt targets. The first excited states of ^{130}Sn and ^{134}Sn were selectively populated and the de-exciting γ rays were measured using the Miniball high-resolution γ-ray spectrometer in coincidence with scattered particles. The newly extracted $B(E2)$ values provide significantly improved experimental constraints and resolve the previously observed tension between theory and experiment, offering a clearer picture of the evolution of collectivity around the $N = 82$ shell closure.
Supported by BMBF Projects 05P21PKCI1, 05P24PKCI1, 05P21RDCI2. This project has received funding from the European Unions Horizon Research and Innovation programme under Grant Agreement No. 101057511

HK 5.5 Mon 17:45 AM 00.021

Low-Lying Dipole Response of ^{42}Ca via Real-Photon Scattering — •Tanja Schüttler[1], Florian Kluwig[1], Ronald Schwengner[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Systematic investigations along isotopic and isotonic chains are of key importance for understanding the influence of shell structure, neutron excess, or nuclear deformation on the low-lying dipole strength of atomic nuclei. In the medium-mass region, the calcium (Z=20) isotopic chain is particularly well suited for such studies, comprising four stable even-even isotopes with N/Z ratios ranging from 1.0 to 1.4. Furthermore, the occurrence of two doubly magic isotopes (^{40,48}Ca) allows probing the evolution of the dipole response with changing shell structure. While the isotopes ^{40,44,48}Ca have already been studied in real-photon scattering experiments [1-4], the low-abundance isotope ^{42}Ca has not yet been investigated. Hence, two (γ,γ') bremsstrahlung experiments on ^{42}Ca were conducted up to the neutron separation threshold $S_n = 11.5\,$MeV at the γELBE facility of the Helmholtz-Zentrum Dresden-Rossendorf [5]. The first results of these measurements will be presented. Supported by the DFG (ZI510/10-2).

[1] T. Hartmann *et al.*, Phys. Rev. Lett. **85** (2000) 274.
[2] T. Hartmann *et al.*, Phys. Rev. C **65** (2002) 034301.
[3] T. Hartmann *et al.*, Phys. Rev. Lett. **93** (2004) 192501.
[4] J. Isaak *et al.*, Phys. Rev. C **83** (2011) 034304 .
[5] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211.

HK 5.6 Mon 18:00 AM 00.021

Nuclear resonance fluorescence study of ^{70}Zn as a probe for nuclear structure at $N = 40$ — •J. Hauf[1], V. Werner[1], N. Pietralla[1], R. V. F. Janssens[2,3], A. D. Ayangeakaa[2,3], D. Balabanski[4], M. Beuschlein[1], R. Beyer[5], S. W. Finch[2,6], A. Gupta[1], D. Gribble[2,3], T. Hensel[5], M. Heumüller[1], F. E. Idoku[2,3], J. Isaak[1], X. James[2,3], S. R. Johnson[2,3], A. Junghans[5], J. Kleemann[1], P. Koseoglou[1], T. Kowalewski[2,3], A. Kusoglu[4], E. Masha[5], C. M. Nickel[1], O. Papst[1], M. Pichotta[5], K. Prifti[1], K. Römer[5], A. Saracino[2,3], L. Shaeding[2,3], P.-A. Söderström[4], K. Schmidt[5], R. Schwengner[5], A. Thees[5], N. Tsoneva[4], S. Turkat[5], A. Wagner[5], and A. Yadav[5] — [1]TU Darmstadt, IKP — [2]TUNL — [3]University of North Carolina — [4]ELI-NP — [5]Helmholtz-Zentrum Dresden-Rossendorf — [6]Duke University

Properties of nuclei at the $N = 40$ subshell closure are strongly influenced by several nuclear-structure effects, such as shape coexistence originating in Type-II shell evolution. This study aims to achieve a better understanding of these effects by investigating the $N = 40$ nucleus ^{70}Zn using the nuclear resonance fluorescence method with bremsstrahlung and quasi-monoenergetic photon beams at γELBE and HIγS, respectively. Preliminary results for the average $E1$- and $M1$-strength distributions and decay branches of ^{70}Zn are shown and discussed. This work is supported by DFG under Project-IDs 499256822 GRK 2891, 279384907 SFB 1245, ELI-RO under ELI-RO/RDI/2024 002, ELI-RO/RDI/2024 007 and US DOE by No. DE-FG02-97ER41041 (UNC), No. DE-FG02-97ER41033 (TUNL).

HK 5.7 Mon 18:15 AM 00.021

Low-Lying Dipole Strength in ^{144}Nd and ^{142}Ce studied via Nuclear Resonance Fluorescence — •Florian Kluwig[1], Deniz Savran[2], Tanja Schüttler[1], Ronald Schwengner[3], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Darmstadt, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Germany

The Pygmy Dipole Resonance (PDR) constitutes a low-energy excitation component within the electric dipole response of atomic nuclei. Despite extensive experimental and theoretical efforts over several decades [1-3], the structure and precise origin of the PDR remain subjects of ongoing investigation. Systematic studies, particularly along isotopic and isotonic chains, serve to resolve these open questions. Our work focuses on the $N = 84$ isotones, ^{144}Nd and ^{142}Ce, situated near the $N = 82$ magic shell closure. These nuclei were probed using the Nuclear Resonance Fluorescence (NRF) technique, based on real-photon scattering. Given their low-angular-momentum transfer capability, real photons are uniquely effective probes for isolating and characterizing the PDR strength [4]. This contribution presents and compares NRF data obtained for ^{144}Nd and ^{142}Ce, thereby contributing to the understanding of the PDR systematics in this mass region. Supported by the DFG (ZI510/10-2).

[1] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70** (2013) 210.
[2] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360.
[3] E.G. Lanza *et al.*, Prog. Part. Nucl. Phys. **129** (2023) 104006.
[4] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903.

HK 6: Heavy-Ion Collisions and QCD Phases I

Time: Monday 16:15–18:15 Location: PHIL C 601

Group Report HK 6.1 Mon 16:15 PHIL C 601

Thermalization of heavy quarks in heavy-ion collisions: a fluid-dynamic perspective — •Federica Capellino — GSI Helmholtzzentrum Darmstadt

Heavy quarks (i.e. charm and beauty) are powerful tools to characterize the quark-gluon plasma (QGP) produced in heavy-ion collisions at the LHC and at RHIC top energies. Although they are initially produced out of kinetic equilibrium via hard partonic scattering processes, recent measurements of the anisotropic flow of charmed hadrons pose the question of a possible thermalization of heavy quarks in the medium. By exploiting a mapping between transport theory and hydrodynamics, we developed in recent years a fluid-dynamic description of heavy-quark diffusion in the QCD plasma. In this contribution, I will report the latest results on heavy-quark thermalization in the QGP from our fluid-dynamic perspective. First, we compute the out-of-equilibrium corrections to the heavy-quark phase-space distribution, enabling a consistent description of both integrated yields and momentum spectra of charm hadrons. Second, we explore a 2+1-dimensional fluid-dynamic treatment of charm diffusion to study the development of charm anisotropic flow in both heavy- and light-ion collision systems. Finally, we investigate the universality of the fluid-dynamic description of heavy quarks by searching for attractor solutions that are insensitive to the details of the initial conditions.

This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).

HK 6.2 Mon 16:45 PHIL C 601

Heavy-quark dynamics in the QGP * attractors, thermalization, and universality — •Ruwen Schulz — Physikalisches Institut, Universität Heidelberg

Heavy quarks are produced in hard scatterings at the very beginning of a heavy-ion collision. Consequently, heavy-quarks experience all stages of a heavy-ion collision, and their dynamics are highly sensitive to the properties of the quark*gluon plasma (QGP) phase in particular. Recent studies have demonstrated that a fluid-dynamical description of heavy-quark transport in the QGP, combined with a realistic hadronization and freeze-out procedure, can successfully reproduce experimental particle spectra with remarkable precision. While this success is widely acknowledged, the underlying reasons are not yet fully understood. In this talk, I will discuss the dynamics of heavy-quarks in the QGP, with a focus on possible signs of thermalization*or hydrodynamization*within the finite lifetime of the QGP. Special emphasis will be placed on pre-thermal universal behavior, including scaling features and (hydrodynamic) attractors that may govern heavy-quark evolution even far from equilibrium.

HK 6.3 Mon 17:00 PHIL C 601

Measurement of directed flow (v_1) of D^0 mesons in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.36$ TeV — •Alica Marie Enderich for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

Directed flow is the first harmonic of the azimuthal particle distribution in ultra-relativistic heavy-ion collisions. It is sensitive to the spatial profile of the initial conditions and the pre-equilibrium early time dynamics. Recent predictions indicate that the slope of the directed flow at mid-rapidity for D^0 mesons, driven by the transport of charm quarks in a tilted medium, can be several times larger than the one for light-flavor hadrons. Heavy-ion collisions also generate extremely strong electromagnetic fields, primarily induced by spectator protons. Unlike light quarks, the formation time of charm quarks is comparable to the time at which the magnetic field reaches its maximum strength. As a result, charm quarks are expected to exhibit a much larger charge-dependent directed flow than light quarks.

During Run 2, ALICE provided the first measurement of the charge-dependent v_1 for D^0 mesons in Pb-Pb collisions at LHC. As the experimental measurement was limited by statistics, it is now repeated in Run 3. The reconstruction of the decay topology is improved via ML techniques and the measurement is extended to lower p_{T}.

In this talk, current results on the charge-integrated and charge-dependent v_1 for D^0 mesons are presented. The measurements are compared with theoretical model calculations and results from other experiments.

HK 6.4 Mon 17:15 PHIL C 601

Exploring charm and beauty hadronisation, collectivity, and final-state interactions at the LHC with ALICE — •Biao Zhang for the ALICE Germany-Collaboration — Physikalisches Institut Im Neuenheimer Feld 226 69120 Heidelberg Germany

Beauty and charm quarks, produced in initinal hard scatterings, offer a effective probe to test perturbative QCD (pQCD). We present the first ALICE measurement of B-meson production in pp collisions at $\sqrt{s} = 13.6$ TeV, providing new constraints on pQCD calculations and beauty-quark fragmentation. Charm hadronisation shows striking deviations from universal fragmentation expectations, with charm baryon production posing a persistent puzzle for QCD-based models. In this context, measuring higher-mass excited charm-baryon states provides essential insight into the mechanisms that govern baryon formation. We report the first ALICE reconstruction of excited Ξ_c^0 states via the $\mathrm{D}^0\Lambda$ decay channel, enabled by the large Run 3 pp dataset. This new reconstruction strategy offers enhanced sensitivity to the non-universal nature of charm-quark hadronisation.

Charm-quark collectivity is studied via the first D^0 elliptic-flow measurement in O–O collisions, bridging pp and Pb–Pb systems and constraining heavy-quark transport coefficients.

Finally, new analyses of correlations between Λ_c^+ and D^+ with protons in pp collisions at $\sqrt{s} = 13.6$ TeV, using the large-statistics Run 3 dataset, will also be presented. These measurements open a new avenue for exploring charm*hadron interactions and their role in the formation of charm-bearing bound states.

HK 6.5 Mon 17:30 PHIL C 601

Analysis strategy for a Ξ_c^+ lifetime measurement with ALICE at the LHC — •Simon Pijahn for the ALICE Germany-Collaboration — Pysikalisches Institut, Universität Heidelberg

Experimentally measured charm-baryon lifetime ratios from LHC and

Fermilab were long understood to be well described within the Heavy Quark Expansion (HQE) framework. However, in 2018 LHCb reported an Ω_c^0 lifetime almost four times larger than previous measurements, inverting the expected lifetime hierarchy. This result has since been supported by measurements from BELLE II and by more precise LHCb determinations of the Ω_c^0 and Ξ_c^0 lifetimes. These persistent discrepancies highlight the need for additional, precise lifetime measurements for an accurate treatment of higher order terms in the HQE framework and to clarify the experimental situation. As the HQE is strong in predicting lifetime ratios, corresponding measurements of all charm baryons are of interest.
To complement ongoing measurements of charm-baryon lifetimes with the ALICE detector, this contribution presents the analysis strategy and performance for a measurement of the Ξ_c^+ baryon lifetime in pp collisions at $\sqrt{s} = 13.6$ TeV. The analysis employs the Kalman Filter Particle package for secondary vertex reconstruction, boosted decision trees for candidate selection, and a data-driven approach to disentangle prompt from non-prompt contributions.

HK 6.6 Mon 17:45 PHIL C 601

Evolution of perturbations of the energy-momentum tensor during the pre-equilibrium phase of HIC — •Lennart Weber[1], Jie Zhu[1,2,3], and Sören Schlichting[1] — [1]Bielefeld University — [2]CCNU, Wuhan, Inst. Part. Phys. — [3]Hua-Zhong Normal University

Non-eq. Green's functions provide a powerul framework for describing the pre-equilibrium evolution of the QGP created in HICs. They enable a systematic transition from initial state model to hydrodynamic simulations. Previous studies have calculated the Green's functions which propagate initial energy and transverse momentum perturbations on top of a homogeneous background. In this work, we generalize the formalism to include initial transverse tensor perturbations, computed analytically in the free-streaming regime and numerically within the conformal relaxation time approxiamtion from moments of the distribution. The non-eq. Green's functions exhibit damping behavior similar to that found for the energy and momentum perturbations studied in earlier works. The derived Green's functions are further benchmarked against hydrodynamic constitutive relations at late times and then Fourier transformed into coordinate space for practical use in the pre-eq. dynamics package, KoMPoST. Furthermore, we run hydrodynamic simulations and investigate the effects of the pre-eq. evolution on generation of momentum anisotropy. In summary, this work completes the description of transverse perturbations and provides a consistent framework for evolving the full energy-momentum tensor from the initial time to the onset of hydrodynamics.

HK 6.7 Mon 18:00 PHIL C 601

Validating the Pre-equilibrium Evolution of Heavy Ion Collisions in KøMPøST — •Jens Hügel[1], Sören Schlichting[1], Clemens Werthmann[2], and Victor Ambrus[3] — [1]Universität Bielefeld, Germany — [2]Universiteit Gent, Belgium — [3]Universitatea de Vest din Timișoara, Romania

We explicitly verify the validity of the open source package KøMPøST [1] for modelling the early time dynamics of the QGP in heavy ion collisions. Since KøMPøST is based on the dynamics of a kinetic theory description to implement a macroscopic evolution of the energy-momentum tensor, we assess its applicability by comparing KøMPøST results to fully microscopic calculations in kinetic theory in the relaxation time approximation (RTA) [2]. We find that KøMPøST accurately describes the full 2+1D evolution of the energy-momentum tensor in the pre-equilibrium stage with the exception of the components related to elliptic flow. We investigate possible error sources and attempt to modify KøMPøST in order to bring it into agreement with the full kinetic theory solution.

[1] KoMPoST, Phys.Rev.C 99 (2019) 3, 034910 [2] Ambrus, Werthmann, Schlichting, "Opacity dependence of transverse flow, preequilibrium, and applicability of hydrodynamics in heavy-ion collisions" Phys.Rev.D 107 (2023) 9, 094013

HK 7: Nuclear Astrophysics I

Time: Monday 16:15–18:15 Location: PHIL A 602

Group Report HK 7.1 Mon 16:15 PHIL A 602

Equation of State: From Ultracompact Objects to Color Superconductivity in Proto-Neutron Stars — •Ishfaq Ahmad Rather, Selina Kunkel, Sarah Pitz, and Jürgen Schaffner-Bielich — Institute of Theoretical Physics, Goethe University, Frankfurt am Main

We present a comprehensive overview of our group's recent research on the properties of compact stars, probing the equation of state (EoS) across dark matter, hadronic, and quark matter regimes. We explore the impact of scalar fields and dark sector, showing that modified scalar potentials and self-interacting bosonic dark matter can lead to the formation of ultracompact boson stars and alter the macroscopic properties of neutron stars, potentially mimicking black holes. We utilize EoS constrained by chiral effective field theory to analyze the early evolution of compact stars, determining the minimal masses of proto-neutron stars (PNS) and highlighting the role of thermal effects on stability limits. Employing a renormalization group consistent NJL model, we analyze the stability windows of color-superconducting (CSC) phases, demonstrating that stable color-flavor-locked (CFL) cores are consistent with current astrophysical constraints. Furthermore, we investigate the phase diagram and analyze the trajectories of constant entropy per baryon to identify which CSC phases are accessible at maximum central densities throughout various evolutionary stages of PNS characterized by different entropies and lepton fractions.

Funded by DFG through the CRC-TR 211-Project No. 315477589 TRR 21, and the Alexander von Humboldt Foundation.

HK 7.2 Mon 16:45 PHIL A 602

Proto-Neutron Stars with Color Superconductivity — •Selina Kunkel[1], Ishfaq Ahmad Rather[1], Marco Hofmann[2], Hosein Gholami[2], and Jürgen Schaffner-Bielich[1] — [1]Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany — [2]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

At high densities and low temperatures, hadronic matter is expected to undergo a first-order phase transition into a color-superconducting state. While such conditions occur in neutron stars, studies focusing only on cold neutron stars are not fully conclusive because they neglect the evolutionary processes that may influence the appearance of color-superconducting phases. A proto-neutron star, however, describes the earliest evolutionary stages during the first seconds to minutes after core collapse and therefore has different thermodynamic properties compared to a cold neutron star - in particular higher temperatures and trapped neutrinos. To address this, we incorporate proto-neutron star conditions into the equation of state. Since the total baryon number of a neutron star is conserved during its early evolution, tracking stellar configurations from the maximum mass of the hot proto-neutron star to the final cold neutron star allows us to investigate whether color-superconducting phases can form at any point along this trajectory.

Funded by DFG through the CRC-TR 211-Project No. 315477589*TRR 21.

HK 7.3 Mon 17:00 PHIL A 602

Experimental Studies of Proton Capture Reactions on Stable Rb Isotopes — •Svenja Wilden, Benedikt Machliner, Martin Müller, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The p nuclei - stable neutron-deficient isotopes not produced via neutron-capture - are synthesized through photodisintegration reactions in the γ process. Since many of the relevant reactions involve unstable nuclei and cannot be measured directly, Hauser-Feshbach calculations are essential, and experimental data are needed to constrain the nuclear inputs. Proton-induced reactions therefore play a central role in improving γ-process models.

In this work, the cross sections for the ^{85}Rb$(p,\gamma)^{86}$Sr and ^{87}Rb$(p,\gamma)^{88}$Sr reactions were measured using the in-beam method at the HORUS spectrometer at the University of Cologne. The results extend the database of proton-capture reactions around $A \approx 85$, and the ^{87}Rb study nearly completes the systematic investigation of the stable $N = 50$ isotones [1].

Comparisons with Hauser-Feshbach calculations show significant deviations for both isotopes, indicating deficiencies in the proton optical model potential, while variations in nuclear level densities and γ-strength functions have only minor effects. The new data provide constraints for improving statistical-model predictions and refining reaction rates.

Supported by the DFG (ZI 510/12-1).

[1] S. Wilden *et al.*, Eur. Phys. J. A 61 (2025) 142.

HK 7.4 Mon 17:15 PHIL A 602

Stacked target experiments for nuclear astrophysics — •Martin Müller, Benedikt Machliner, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The study of nucleosynthesis processes brings together cutting-edge science performed in a wide variety of fields. One of the main contributions from experimental nuclear physics is the determination of reaction cross sections and reaction rates. While many different techniques exist, the activation technique is among those that have been used the most over the decades, due to the relative simplicity with which high precision results can be obtained. However, since cross sections at energies relevant to nuclear astrophysics are tiny, long irradiation times at high intensities are required. This can be remedied by using the stacked target technique, in which multiple targets are irradiated at the same time. The energy projectiles loose while passing through each target layer enables cross section measurements at multiple energies at once. The price to pay for this is an increased energy uncertainty. In order to reduce these uncertainties, precise knowledge of target thicknesses are needed. This contribution will introduce a new setup for Rutherford Backscattering spectrometry commissioned at the University of Cologne, a Geant4 based simulation of energy losses, that is capable of propagating the uncertainties in the target thicknesses, as well as cross sections determined using the stacked target method. Studied reactions include ^{170,172}Yb(α,γ), ^{170,172}Yb(p,γ), ^{55}Mn$(\alpha,(2)n)$, and ^{58}Fe(p,n). Supported by the DFG (ZI 510/12-1).

HK 7.5 Mon 17:30 PHIL A 602

Nuclear two-photon decay investigation of 98Mo in the ESR Heavy Ion Storage Ring — •Carlo Forconi for the E0018 Experiment-Collaboration — GSI Darmstadt, Germany

The nuclear two-photon or double gamma (2γ) decay is a rare second-order electromagnetic process in which an excited nucleus emits two gamma rays simultaneously. Its branching ratio is significantly lower than that of competing first-order processes such as internal conversion, pair creation, or single-photon emission, making its experimental observation extremely challenging. However, in the ESR at GSI, these competing decay modes can be suppressed by storing fully ionised ions and selecting a 0+ - 0+ transition with excitation energy below the electron-positron pair creation threshold (1022 keV). Under these conditions, the two-photon decay becomes the only available decay channel. In this talk, I will report on the current status of the analysis of an experiment investigating the 2γ decay of 98Mo, which has a first excited 0+ state at 734.75keV. The experiment was performed at the GSI facility in Darmstadt, where fully stripped 98Mo ions were produced using the projectile fragmentation of 100Mo primary beam on 9Be target in the transfer line. These ions were then transported and stored in the ESR, operated in the isochronous mode. Two non-destructive Schottky detectors were used, allowing for precision measurement of the ions revolution frequencies and extraction of both the nuclear half-life and mass. Preliminary results indicate that the measured half-life of 98Mo is consistent with the expected theoretical extrapolation estimates from previously studied 0+ - 0+ nuclear transitions.

HK 7.6 Mon 17:45 PHIL A 602

Towards including hyperons in many-body perturbation theory calculations of dense matter — •Samet Dokur[1,2], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Department of Physics, Technische Universität Darmstadt — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [3]Max-Planck-Institut für Kernphysik, Heidelberg

We investigate the so-called "hyperon puzzle" by systematically analyzing the impact of hyperons on the properties of dense matter. To this end, we employ systematically improvable interactions derived from chiral effective field theory and compute the corresponding equation of state using many-body perturbation theory. Our aim is to incorporate hyperon-nucleon and hyperon-nucleon-nucleon interactions up to next-to-leading order using the decuplet saturation approximation in our current many-body framework, which is already capable of describing dense matter with nucleon-nucleon and three-nucleon interactions up to next-to-next-to-next-to-leading order. We will outline the many-body approach, address the conceptual and technical challenges associated with hyperonic forces and present first results for the equation of state of neutron-rich matter including calculations of chemical potentials in beta equilibrium.

* Funded by the LOEWE Top Professorship LOEWE/4a/519/05.00. 002(0014)98.

HK 7.7 Mon 18:00 PHIL A 602

Dark matter effects on the properties of hybrid and twin stars — •Harish Chandra Das — Goethe-Universität Frankfurt am Main, Institut für Theoretische Physik, Frankfurt, 60438, Germany

We investigate the influence of dark matter (DM) on the structure and stability of hybrid and twin stars within a two-fluid framework in which DM interacts with baryonic matter purely through gravity. The baryonic sector is described using relativistic mean-field theory for nucleonic matter and a constant sound-speed parametrization for quark matter, while the DM component is modeled as self-interacting fermions. We find that the presence of DM suppresses the emergence of hybrid and twin star branches compared with DM-free configurations. The degree of suppression depends sensitively on the phase-transition pressure and the energy-density discontinuity for fixed sound speed, as well as on the DM particle mass and fractional abundance. Stars featuring DM-dominated cores or halos are governed primarily by DM properties, whereas the emergence of twin or hybrid configurations remains controlled by the quark-matter equation of state. Incorporating current observational constraints further narrows the allowed parameter space for twin stars in both scenarios.

HK 8: Instrumentation I

Time: Monday 16:15–18:15 Location: PHIL A 301

Group Report HK 8.1 Mon 16:15 PHIL A 301

Status report on the CBM-TRD — •Dennis Spicker for the CBM-Collaboration — Institut für Kernphysik, Goethe-Uni, Max von Laue Str. 1, 60438, Frankfurt am Main

At the Facility for Antiproton and Ion Research (FAIR), the Compressed Baryonic Matter experiment (CBM) is designed to measure particles resulting from heavy-ion collisions at exceedingly high interaction rates. The Transition Radiation Detector (TRD), a subsystem of the CBM experiment, will comprise four layers of Multi-Wire-Proportional-Chambers (MWPC), each equipped with a foam radiator enabling the generation of transition radiation. The principal objective of the TRD is to distinguish between electrons and pions, to augment the light nuclei identification, and to provide tracking information.

This report gives an overview of the current status of the TRD project. Series production of detector modules is commencing. Various quality assurance procedures have been developed for use during series production and on finished detector modules. A new software framework is intended to facilitate the management of the results of these procedures. Also, an improved version of the readout front-end electronics is currently undergoing testing.

Supported by:
German BMFTR-grants 05P24PM1 and 05P24RF2
HFHF: Helmholtz Forschungsakademie Hessen für FAIR
NRW-FAIR-Netzwerk

HK 8.2 Mon 16:45 PHIL A 301

Development of a gas system for the Transition Radiation Detector of the CBM experiment — •Nikolai Podgornov[1,2], James Ritman[1,2,3], and Peter Wintz[3] for the CBM-Collaboration — [1]Ruhr-Universität Bochum — [2]GSI — [3]Forschungszentrum Jülich

The Transition Radiation Detector (TRD) of the Compressed Baryonic Matter (CBM) experiment is essential to identify electrons with a momentum p>1 GeV/c with an efficiency of over 90%. The TRD uses a mixture of the noble gas xenon and the quenching gas CO2. Since xenon is an expensive gas, a critical part of the TRD is its gas system, which must maintain a stable and optimal gas mixture to ensure efficient detection of charged particles and transition radiation. Gas mixture purity is also an important factor. This requires a constant flow for purging of the TRD chambers with precisely controlled overpressure maintained within a range of 0.3 - 0.7 mbar. In addition, the system must be closed and ensure complete xenon recovery and purification. This report discusses the status of a gas system prototype and plans for its upgrade toward the full-size system. This includes reassembling the prototype on a new chassis and conducting subsequent long-term leak-tightness and stability tests. An updated piping and instrumentation diagram will be presented, and the control logic will be discussed in the context of migration to a new Programmable Logic Controller suitable for a full-size system. Additionally, a concept for system monitoring based on the Experimental Physics and Industrial Control System (EPICS) will be presented.

HK 8.3 Mon 17:00 PHIL A 301

Measuring the gas tightness of CBM-TRD wire chambers in Node-RED flows — •Philipp Kähler — Institut für Kernphysik, Universität Münster

The Transition Radiation Detector (TRD) in the CBM experiment at FAIR will provide electron identification, enabling the study of the hot and dense medium created in heavy-ion collisions via the measurement of di-electrons at intermediate masses. Furthermore, the TRD will serve as an intermediate tracking station and, moreover, augments the identification of light nuclei for the hypernuclei programme of CBM.

As gaseous detector using a Xe/CO_2 85:15 gas mixture, the gas loss per detector chamber has to be minimised to not exceed an accepted upper limit of 1 ml/h. To test the corresponding gas tightness is a crucial QA step during serial chamber production for this detector.

In this talk, a new QA test stand for gas tightness assessment based on a direct gas loss measurement is presented. The data acquisition is implemented in *Node-RED* flows on a *Raspberry Pi*-based platform, which includes ADCs of corresponding required precision as well as a high automation level of the measurement routines.

HK 8.4 Mon 17:15 PHIL A 301

Construction of the Cherenkov-Detector for the P2-Experiment — Sebastian Baunack[1], Maarten Boonekamp[4], Boris Gläser[1], Shruti Gudla[1], •Franz Halter[1], Jayanta Naik[1], Rahima Krini[1], Frank Maas[1,2,3], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], Siddharth Takker[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institute of Nuclear Physics, Mainz, Germany — [2]Helmholtz-Institut Mainz, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment at the MESA accelerator facility in Mainz aims at a precise determination of the weak mixing angle $\sin^2\theta_W$. The Weinberg angle will be extracted from parity violating asymmetry in elastic electron-proton scattering at low Q^2. Therefore the measurement verifies a fundamental parameter of the Standard Model and may open a door to new physics with a target relative accuracy of 0.16%.
The key detector element will be a Cherenkov detector ring, in which Cherenkov light is detected by photomultiplier tubes. To ensure an accurate measurement, the detectors must be carefully aligned and shielded.
This talk will present the design challenges, current status, and recent progress of the detector components.

HK 8.5 Mon 17:30 PHIL A 301

Design of a luminosity monitor for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Bonnekamp[2,4], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,3], Jayanta Naik[1], Moran Neher[1], •Tobias Rimke[1], Paul Schöner[2], Siddharth Thakker[1], and Malte Wilfert[1] — [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 — [4]IRFU, CEA, Universite Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment at the future MESA accelerator in Mainz plans to measure the weak mixing angle $\sin^2(\theta_W)$ in parity violating elastic electron-proton scattering. The aim of the experiment is a very precise measurement of the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}$ GeV^2. In order to achieve this accuracy, it is necessary to monitor the stability of the electron beam and the liquid hydrogen target. Any helicity correlated fluctuation of the target density leads to false asymmetries.

Therefore, it is planned to install a luminosity monitor in forward direction close to the beam axis. The motivation and challenges for designing an air Cherenkov luminosity monitor will be discussed. Furthermore, I show the current prototype design with results from promising test runs with the electron beam of the MAMI accelerator and detailed simulation studies.

HK 8.6 Mon 17:45 PHIL A 301

Magnetic-field mapping requirements and strategy for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Bonnekamp[2,4], Boris Gläser[1], •Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,3], Jayanta Naik[1], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], Siddharth Thakker[1], 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 — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment at the upcoming MESA accelerator aims to perform a high-precision determination of the weak mixing angle by measuring the parity-violating asymmetry in elastic electron-proton scattering at low momentum transfer ($Q^2 \approx 4.5 \times 10^{-3}$ GeV^2). To reach the targeted uncertainty, the experiment relies on a solenoid-based spectrometer providing full 2π azimuthal acceptance and controlled transport of scattered electrons to the integrating Cherenkov detector system. Precise knowledge of the magnetic field distribution inside the solenoid is essential for Q^2 reconstruction, systematic-uncertainty control, and background separation. Therefore, a dedicated magnetic-field mapping approach is planned to characterize the 3D field response under operating conditions. The talk will outline requirements of mapping a high-current, large-aperture solenoid and discuss strategies for establishing a validated magnetic-field model for the P2 spectrometer.

HK 8.7 Mon 18:00 PHIL A 301

Mirror System and Mirror Alignment Monitoring of the CBM RICH — •Sven Peter for the CBM-Collaboration — Justus Liebig University, Gießen

The CBM (Compressed Baryonic Matter) experiment at FAIR (Facility for Antiproton and Ion Research) will study extremely dense matter resulting from heavy ion collisions starting in 2028. The CBM Ring Imaging Cherenkov Detector (RICH) uses CO_2 as radiator and multi-anode photomultiplier tubes as readout. The mirrors (R=3 m) consist of 80 individual mirror tiles (about 40 cm×40 cm). A prototype of the mirror wall has been built and a gluing procedure has been developed that does not cause harmful distortion of the mirror. The RICH is planned to be periodically exchanged with the MUCH (Muon Chamber) detector by craning. This carries the risk of mirror misalignment but only misalignment upto 1 mrad can be tolerated. Potential misalignment must be detected and accounted for during data analysis to ensure accurate ring diameters, locations, and subsequent ring-track matching. The CLAM method (Continuous Line Alignment and Monitoring, originally developed for the COMPASS RICH-1) was adapted for the CBM RICH. A ray-optics simulation of the mirror system was used to compare different approaches for misalignment quantification. Supported by BMBF grant no. 05P24RG6.

HK 9: Instrumentation II

Time: Monday 16:15–18:15 Location: PHIL B 302

Group Report HK 9.1 Mon 16:15 PHIL B 302
Status of the CBM Micro Vertex Detector* — •Franz Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) is the first downstream detector of the fixed-target CBM Experiment at the future Facility for Antiproton and Ion Research (FAIR). It enables high-precision tracking of low-momentum particles in direct proximity of the target with the first of four stations being placed only 8 cm downstream the interaction point in the target vacuum. ~ 300 MIMOSIS (TJ-180 nm) CMOS Monolithic Active Pixel Sensors (MAPS) provide $> 99\%$ detection efficiency and a 5–6 μm spatial resolution (5 μs frame time), also after irradiation to 5 Mrad and $1 \times 10^{14}\, n_{\mathrm{eq}}/\mathrm{cm}^2$ (TID+NIEL), fulfilling the requirements and preparing for final sensor submission. Sensors are wire-bonded to thin flex cables and glued onto both sides of Thermal Pyrolytic Graphite (380 μm) carriers, which provide stiff, low-X_0 support with excellent thermal conductivity. Actively cooled aluminum heat sinks outside the acceptance extract the heat.

In this contribution, we present the detector concept, highlights from the CBM-compatible readout validated in mCBM, and results from the final MIMOSIS prototype under CBM-like conditions. A focus will be the challenges associated with vacuum operation, stringent material budget constraints (0.3–0.5% X_0), and double-sided integration as we progress toward station assembly and readiness for first beam in 2028.

*This work has been supported by BMFTR (05H24RF5), HGS-HIRe, HFHF, GSI and Eurizon.

HK 9.2 Mon 16:45 PHIL B 302
Results of Recent Testing Campaigns of the Analogue Pixel Test Structure — •Maximilian Spors[1,2], Malte Grönbeck[1,2], Alexander Rachev[1,2], Lars Döpper[1,2], Philip Hauer[1,2], and Bernhard Ketzer[1,2] for the ALICE Germany-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Forschungs- und Technologiezentrum Detektorphysik

For the Long Shutdown 4 of the LHC, the ALICE Collaboration is planning a major upgrade of its detectors, known as ALICE 3. The tracking system of ALICE 3 will be entirely based on Monolithic Active Pixel Sensors (MAPS), fabricated using TPSCo's 65 nm CMOS imaging process. Dedicated small-scale Analogue Pixel Test Structures (APTS), originally developed for the Inner Tracking System 3 project, are used to study the analogue response to incident radiation. As this technology is also planned to be used for the ALICE3 tracking system, the APTS measurements provide insights into the characteristics of sensors fabricated in this process, such as detection efficiency, spatial resolution and in-pixel efficiencies.

This presentation summarizes the results of recent testing campaigns, consisting of test beam measurements at ELSA, as well as laboratory experiments using X-ray sources.

This work is supported by BMFTR.

HK 9.3 Mon 17:00 PHIL B 302
Status of the MANTA project — •Michael Deveaux — GSI, Darmstadt, Germany

Building a next generation of ultra-light particle tracking detector calls for sensors combining good ($\sim$ 10 μm) spatial resolution with fast ($\sim$ 10 ns) time stamping, very light material budget and low power dissipation.

Thanks to their fine granularity, their low (0.05% X_0) material budget and the possibility of achieving a low energy consumption well below ~ 50 mW/cm^2, next generation CMOS Monolithic Active Pixel Sensors are considered as valuable technology candidate for this application. On the other hand, their time stamping capability and rate capability have still to be improved in order to handle reliably particle fluxes of $10 - 100$ MHz/cm^2.

Being formed under the umbrella of the DRD3, the MANTA collaboration aims to respond to this challenge by developing a versatile sensor design. This design is intended to yield a single ASIC, which may be configured by slow control to the needs of different tracking detectors.

The presentation introduces the vision of MANTA and discusses the underlying technological concept.

HK 9.4 Mon 17:15 PHIL B 302
Status of the MIMOSIS sensor for the CBM Micro Vertex Detector* — •Benedict Arnoldi-Meadows for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The CMOS Monolithic Active Pixel Sensor (MAPS) MIMOSIS will be used as the sensor of the Micro Vertex Detector (MVD) of the CBM experiment, which is foreseen to receive beam on target in 2028. The sensor is currently being developed by IPHC Strasbourg in cooperation with University Frankfurt and GSI, with the MIMOSIS-2.1 sensor being its latest and last prototype.

Both in-beam performance studies validating changes in the sensor, and studies related to the selection, preparation, and operation of suitable sensors in the experiment have been conducted with MIMOSIS-2.1 prototype sensors. This contribution will present the recent progress made towards the final sensor for the experiment.

*This work has been supported by BMFTR (05H24RF5), GSI, Eurizon, HGS-HIRe, and HFHF.

HK 9.5 Mon 17:30 PHIL B 302
Asynchronous Readout for Pixel Detectors — •Tim Stellhorn for the ALICE Germany-Collaboration — Wilhelm-Klemm Straße 9, 48149 Münster

ALICE 3 is a next-generation high-energy physics experiment for the LHC Run 5. The Outer Tracker (OT) of ALICE 3 will be the largest tracker consisting solely of silicon sensors based on Monolithic Active Pixel Sensors (MAPS) with an active area of 60 m^2. To meet its requirement of an improved timing resolution of 100 ns, new readout models are investigated. The asynchronous readout approach is based on Asynchronous Priority Arbiters (APAs) and is implemented in the Sensor Pixel Asynchronous Readout CMOS (SPARC) chiplet.

This talk will focus on simulations of the asynchronous readout with the prototyping framework PixESL. A network in PixESL consists of front-end nodes as well as readout nodes and the communication between these nodes is based on the Transaction Level Modelling (TLM) framework of SystemC. The input to PixESL is a list of pixels with recorded hits and the related Time-of-Arrival (ToA) and the Time-over-Threshold (ToT), which is generated in an Allpix-squared simulation. As a result of the PixESL simulation, readout delays of recorded hits from the pixels to the memory of the chip will be analysed depending on different APA tree architectures.

HK 9.6 Mon 17:45 PHIL B 302
Status of the Readout of the CBM Micro Vertex Detector* — •Benedikt Gutsche for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Compressed Baryonic Matter (CBM) Experiment will be one of the main experiments at the future FAIR facility. Its Micro Vertex Detector (MVD) will be composed of four sensor planes in vacuum and will be equipped with Monolithic Active Pixel Sensors (MIMOSIS). The sensor is being developed by IPHC Strasbourg and will run with a sustained rate of up to 80 MHz/cm^2. Like other parts of CBM, the detector will be read out using radiation hard electronics (GBTx) and PCIe based FPGA boards (CRI).

In this contribution, we report on the integration of a CRI-based readout for a setup consisting of two MIMOSIS sensors, which was the first time the setup was used in the common CBM readout chain. The operation and data consistency has been validated by using correlations with other subsystems of CBM during an experimental run in May 2025. We will present the first in-beam results of this test setup.

*This work has been supported by BMFTR (05H24RF5), GSI, and HFHF.

HK 9.7 Mon 18:00 PHIL B 302
The MADHAT module - A prototype structure for the ALICE 3 Outer Tracker — •Malte Grönbeck for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — Forschungs- und Technologiezentrum Detektorphysik

ALICE 3 is a novel heavy-ion experiment foreseen to be installed during the Long Shutdown 4 of the Large Hadron Collider. Its key feature will be a 60 m^2 silicon MAPS-based tracking detector, with the active area of the Outer Tracker spanning up to 45 m^2. The sensor tech-

nology will be based on the 65 nm production node of TPSCo. The material-budget target of less than 1% X_0 per layer requires investigations into different cooling systems, electrical interconnections and the mechanical stability. Therefore a prototype sensor called MADHAT (Mechanical Assessment Design for Heat And Thermal solutions) and an associated detector module carrying 8 sensors was designed and built. These simple microchips are capable of emulating the heat dissipation, while simultaneously measuring the surface temperature with an integrated temperature probe.
This talk will discuss the MADHAT module design and its readout electronics.
Supported by BMFTR.

HK 10: Invited Talks

Time: Tuesday 11:00–13:00 Location: MED 00.915

Invited Talk HK 10.1 Tue 11:00 MED 00.915
Baryon scattering amplitudes from lattice QCD — •John Bulava — Ruhr Universtität Bochum

Lattice QCD computations of baryon scattering amplitudes are continually improving. As a first-principles Monte Carlo approach, such simulations elucidate the quark mass dependence of baryon interactions, providing useful input to chiral effective theories. I will review computations of the nucleon-nucleon interaction at unphysically heavy quark masses, for which agreement has been recently attained between several independent groups. I will then present first results for light quark masses, which make contact to chiral effective theories for the first time.

Invited Talk HK 10.2 Tue 11:30 MED 00.915
Exploring Triaxial Deformation in Neutron-rich Nuclei — •Kathrin Wimmer[1], Byul Moon[2], and Wolfram Korten[3] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]Center for Exotic Nuclear Studies, Institute for Basic Science, Daejeon 34126, Republic of Korea — [3]IRFU, CEA, Université Paris-Saclay, F-91191 Gif-sur-Yvette, France

Understanding nuclear shapes far from stability is key to refining nuclear models. While many deformed nuclei are well described by axial symmetry, some isotopes require a triaxial description, where the nucleus lacks a single axis of symmetry. This triaxiality has long been debated, with contrasting theoretical models offering different interpretations. Neutron-rich Zr and Mo isotopes are ideal candidates to explore this question due to predicted shape coexistence and evolving collective structure.

To probe this, we performed a high-resolution in-beam γ-ray spectroscopy experiment at RIBF using the HiCARI array. Nucleon-removal reactions populated ^{108,110}Zr and ^{110,112}Mo. Excited-state lifetimes were extracted via the line-shape method, and new level schemes were established, revealing characteristic signatures associated with triaxial deformation. The results, interpreted using modern theoretical models, provide new constraints on deformation in this mass region.

In this talk, I will present the experiment, discuss the results in detail, and provide an outlook for further studies of triaxial deformation in neutron-rich nuclei.

Invited Talk HK 10.3 Tue 12:00 MED 00.915
Jet Targets for Nuclear and Hadron Physics Experiments — •Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster

Jet beams are widely used as targets in many fields of physics. Prominent examples are scattering experiments at hadron and lepton accelerators or at high-power laser facilities, where pure and windowless targets with adjustable thickness are required in vacuum. Depending on the specific experimental situation, different types of targets such as gas-jets, cluster-jets or pellet streams can be used to fulfil the required properties. However, in recent years new experimental challenges have emerged that require a significant improvement in the performance of existing target technologies and the development of new target beam generation and monitoring techniques. Inspired by this, new research projects have been initiated, focusing on the development of state-of-the-art jet targets. This talk gives an overview of the developments on cryogenic gas-jet, cluster-jet and frozen pellet/filament targets at the University of Münster.

Invited Talk HK 10.4 Tue 12:30 MED 00.915
Probing neutrinos with the KATRIN and LEGEND experiments — •Susanne Mertens — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg

The absolute mass scale and fundamental nature of the neutrino remain among the most pressing open questions in astroparticle physics today. Beta decay experiments provide unique laboratory probes of these properties. In particular, the kinematics of single beta decay allow for a model-independent determination of the absolute neutrino mass. The KATRIN experiment currently sets the most stringent direct limit on this quantity. The observation of neutrinoless double beta decay would demonstrate that neutrinos are their own antiparticles. The LEGEND experiment is designed to achieve unprecedented sensitivity to this rare process. This talk will present the KATRIN and LEGEND experiments, highlighting recent results and outlining future prospects.

HK 11: Hadron Structure and Spectroscopy III

Time: Tuesday 16:15–18:30 Location: PHIL C 301

Group Report HK 11.1 Tue 16:15 PHIL C 301
Recent results from the CBELSA/TAPS experiment and plans for a new experiment at ELSA: INSIGHT — •Tobias Seifen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

Based on the high quality photoproduction data, our understanding of the spectrum and the properties of N^*- and Δ^*-baryons has substantially improved. Polarization data, as taken by the CBELSA/TAPS experiment for various final states, are a key to resolve the baryon spectrum. The measurement of polarization observables is indispensable for performing an unambigious partial wave analysis to extract the resonances from the data.

In contrast to the non-strange baryon sector, so far, little is known about the excited Λ and Σ spectrum. For decades, progress in the strange baryon sector has been hampered by the lack of data.

Here, the new INSIGHT experiment at ELSA will provide high quality data and therefore crucial information on Λ^* and Σ^* resonances and will also investigate the possible existance of multi-quark states in the strange quark sector.

INSIGHT features a unique combination of an almost complete angular coverage for high-resolution photon measurements, charged-particle detection and the ability to perform measurements using a transversally or longitudinally polarized target.

This talk will discuss recent results from the CBELSA/TAPS experiment as well as the plans for the future INSIGHT experiment at ELSA.

Group Report HK 11.2 Tue 16:45 PHIL C 301
The study of unconventional baryon structure in the light quark sector with the BGOOD and INSIGHT experiments — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The existence of exotic multi-quark states beyond valence three quark and quark-antiquark systems has been unambiguously confirmed in the heavy quark sectors and equivalent structures may be evidenced in the light, *uds* sector. The BGOOD photoproduction experiment at ELSA is ideal to study spatially extended, molecular-like structure which may manifest in reaction mechanisms. BGOOD is comprised of a central calorimeter for neutral meson momentum reconstruction and complemented by a magnetic spectrometer in forward directions for charged particle identification.

Our published results in the strangeness sector suggest a dominant role of meson-baryon dynamics which may have an equivalence to the P_C states in the charmed sector. This includes structure in $K^0\Sigma^0$ and $K^+\Sigma^+$ photoproduction at the K^*Y thresholds.

The new INSIGHT experiment at ELSA will be an important upgrade for both the BGOOD and CBELSA/TAPS experiments and will feature a unique combination of almost complete angular coverage for high-resolution photon identification and charged-particle detection with polarised beams and targets.

I will present BGOOD results and anticipated INSIGHT measurements using simulated data.

HK 11.3 Tue 17:15 PHIL C 301

Production Mechanism Studies of the N^* and Δ Resonances in Proton-Proton Collisions — •Saket Kumar Sahu[1,2], Ahmed Marwan Foda[2], Johan Messchendorp[2], James Ritman[1,2,3], and Deborah Rönchen[3] — [1]Ruhr University Bochum — [2]GSI Helmholtzzentrumfür Schwerionenforschung GmbH — [3]Forschungszentrum Jülich

Excited nucleon states (N^* and Δ resonances) help us to probe the non-perturbative regime of Quantum Chromodynamics (QCD) and baryon structure. One way to access their internal properties is through their coupling to virtual photons produced in elementary reactions. Our long-term goal is to study Dalitz transitions of N^* and Δ resonances generated in proton-proton collisions. In this work, we study the production mechanisms of these resonances which will also serve as a baseline measurement for interpreting data from heavy-ion collisions. The High Acceptance Di-Electron Spectrometer (HADES) at GSI Darmstadt, which is a versatile magnetic spectrometer designed for measuring wide range of particles across large angular acceptance, is ideal for performing these studies. This analysis aims to extract differential cross-sections for the exclusive production of N^* and Δ channels in proton-proton collisions at $\sqrt{s} = 3.47$ GeV and also their coupling strengths in proton-proton collisions. This talk will present results of the analysis of proton-proton scattering data collected in February 2022 by the HADES collaboration, along with preliminary comparisons to fits using the Jülich*Bonn (JüBo) dynamical coupled*channel model.

HK 11.4 Tue 17:30 PHIL C 301

$K^+\Sigma(1385)^-$ photoproduction at the BGOOD experiment — •Martin Ludwig for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

In the past twenty years, many exotic multi-quark states have been discovered in the heavy-quark sector. Although their exact binding mechanism is still under discussion, their proximity to certain thresholds suggests they may be molecular-like states. If so, one may expect similar states to appear in the light (uds) sector as well.

One way to search for such states is via photoproduction off the proton or neutron. The BGOOD experiment at the ELSA facility is ideally suited for these studies, as it combines a central calorimeter with a forward spectrometer that enables charged-particle reconstruction at extreme forward angles. These forward angles correspond to low momentum transfer to the recoil baryon, which may be a favourable condition for the formation of loosely bound molecular states.

Previous studies of strangeness-photoproduction channels at BGOOD have provided hints that exotic hadrons similar to the P_c pentaquarks may actually exist in the light-quark sector. In this context, another interesting channel to investigate is $\gamma n \to K^+\Sigma(1385)^-$. Preliminary results for its differential cross section for beam energies ranging from threshold up to 2050 MeV will be presented.

HK 11.5 Tue 17:45 PHIL C 301

$K^{*+}\Lambda$ and $K^{*+}\Sigma^0$ photoproduction at the BGOOD experiment — •Amelia Carina de Lope Fend for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

In recent years exotic multi-quark states such as the XYZ mesons and the P_c pentaquark states have been discovered in the charm quark sector. Structures in $\gamma p \to K^+\Sigma^0$ and $\gamma p \to K^0\Sigma^+$ cross sections may be evidence of an equivalence in the light quark sector where $(K^*\Sigma)^+$ and $K^{*+}\Lambda$ dynamically generated states may exist.

The BGOOD experiment at the ELSA facility is especially suited to investigate this, as it provides a unique forward spectrometer for K^+ identification and momentum reconstruction and a central calorimeter for neutral hadron decays.

Current studies of the photoproduction reactions $\gamma p \to K^{*+}\Lambda$ and $\gamma p \to K^{*+}\Sigma^0$ are archieved via the identification of the decay $K^{*+} \to K^+\pi^0$ and focus on measuring the differential cross section with high statistical precision at forward K^{*+} angles. Preliminary results will be presented.

HK 11.6 Tue 18:00 PHIL C 301

$K^0\Sigma^0$ photoproduction at the BGOOD experiment — •Adrian Sonnenschein for the BGOOD-Collaboration — Physikalisches Institut, Nussallee 12, 53115 Bonn, Germany

The BGOOD experiment at the ELSA accelerator facility uses an energy tagged bremsstrahlung photon beam to investigate hadronic excitations in meson photoproduction in the light quark sector.

The associated photoproduction of K^0_S and hyperons is of particular interest. A cusp-like structure observed in the $\gamma p \to K^0_S\Sigma^+$ reaction at the K^* threshold is described by models including multi-quark resonances through dynamically generated vector meson-baryon interactions. This is the same model which predicted the P_C pentaquark states observed at LHCb through $D^*\Sigma_c$ interactions and if proven correct, would provide evidence of molecular-like states in the strangeness sector. The model predicts a peak like structure in $K^0_S\Sigma^0$ photoproduction at the K^* threshold, which is the motivation for the measurement present here.

The reaction $\gamma n \to K^0_S\Sigma^0$ has been measured at BGOOD from threshold to a beam energy of 2600 MeV. The analysis procedure is based upon a previous BGOOD publication, however employing additional kinematic fitting techniques with improved statistical precision. Preliminary differential cross section measurements will be presented.

HK 11.7 Tue 18:15 PHIL C 301

Energy Calibration of an Electromagnetic Calorimeter for the PRIMA Experiment at MAMI — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Frank Maas[1,2,3], Antoine Martinet[1], Oliver Noll[1,2], Paul Schöner[1], Christoph Rosner[1], •Pierre Vijayan[1], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

The PRIMA experiment which was conducted at the MAMI accelerator facility in Mainz aims to measure the doubly virtual transition form factor (TFF) of the π^0 via the π^0-electroproduction in the Primakoff kinematics. A modified version of the PANDA backward calorimeter (EMC) was installed in the A1 spectrometer hall at MAMI, for detecting both the scattered electron and the π^0 decay γ-particles. The experiment will give new input to the hadronic corrections of the anomalous magnetic moment of the muon (g_μ-2 puzzle). In order to achieve a precise measurement of the TFF, the kinematics of this process needs to be determined with high precision.

For this purpose, a reliable energy calibration procedure of the EMC is mandatory. The talk therefore gives insight into the energy calibration of the electromagnetic calorimeter for the PRIMA-setup at MAMI.

HK 12: Hadron Structure and Spectroscopy IV

Time: Tuesday 16:15–18:30 Location: PHIL A 401

Group Report HK 12.1 Tue 16:15 PHIL A 401
Search for exotic states in η_c decays at BESIII — Tessa Bertelsmeier[1], Jans Böing[1], Anja Brüggemann[1], Nils Hüsken[2], Nikolai in der Wiesche[1], Lois Kröger[1], Hannah Neuwirth[1], •Frederik Weidner[1], and Alfons Khoukaz[1] — [1]Universität Münster, Germany — [2]Johannes Gutenberg-Universität Mainz, Germany

The BESIII detector at the e^+e^- collider BEPCII in Beijing, China, provides the world's largest data sample of the charmonium J/ψ with more than 10 billion events collected from 2009 to 2019.

Starting from the radiative J/ψ decay into $\gamma\eta_c$, we analyse the reactions $\eta_c \to \eta' h\bar{h}$ (with $h\bar{h} = \pi\pi$, $2(\pi\pi)$, $K\bar{K}$, $\eta\eta$) to determine the corresponding branching ratios as well as the mass and width of the η_c. Moreover, these η_c decays provide the opportunity to investigate possible exotic content in $h\bar{h}$ intermediate states that lie in the mass region below 2 GeV/c^2, where the lightest scalar glueball is predicted.

Our studies are based on a partial wave analysis approach that gives access to the partial decay widths of contributing resonances decaying into the $h\bar{h}$ subsystems. By coupling the considered channels multichannel effects can be correctly incorporated. The extracted widths are directly comparable to theoretical predictions, which assume glueball admixtures carried by certain considered resonances.

This work is supported by the DFG under project numbers 443159800, 547123630 and GRK 2149/2 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

Group Report HK 12.2 Tue 16:45 PHIL A 401
Search for the Lightest Glueball via the Reactions $\psi(2S) \to \phi + \pi\pi, 4\pi, K\bar{K}, \eta\eta$ and $\eta\eta'$ at BESIII — •Nikolai in der Wiesche, Frederik Weidner, Anja Brüggemann, Lois Kröger, Tessa Bertelsmeier, Jans Böing, Hannah Neuwirth, and Alfons Khoukaz for the BESIII-Collaboration — Universität Münster, Germany

The self-interaction of gluons is one of the most fundamental features of QCD, which implies the existence of purely gluonic bound states, called glueballs. However, to this day, no unambiguous experimental evidence of such state has been found. Theoretical calculations predict the mass of the lightest glueball, with quantum numbers $J^{PC} = 0^{++}$, to be between 1.6 GeV and 1.7 GeV. Therefore, the three experimentally observed isoscalar 0^{++} states $f_0(1370)$, $f_0(1500)$ and $f_0(1710)$, are promising candidates to contain admixtures of this glueball. Due to many contradictory measurements of their properties, the assignment of these states is still controversial.
In this talk, the current progress of a large-scale coupled-channel analysis project investigating the reactions $\psi(2S) \to \phi + \pi\pi, 4\pi, K\bar{K}, \eta\eta$ and $\eta\eta'$ will be presented. Using the world's largest $\psi(2S)$ data set obtained at BESIII, this project aims at extracting the properties of the f_0 states, which are produced as intermediate resonances in the recoil systems of the ϕ meson.
This work is supported by the DFG under the project number 547123630 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

HK 12.3 Tue 17:15 PHIL A 401
Partial-Wave Analysis of $B^0 \to J/\psi K^+\pi^-$ at Belle (II) — •Martin Bartl, Hans-Günther Moser, and Stefan Wallner — Max-Planck-Institut für Physik, München

We will present Monte Carlo studies for a partial-wave analysis (PWA) of $B^0 \to J/\psi K^+\pi^-$ at Belle and Belle II. The PWA disentangles contributions from numerous intermediate resonances, e.g. K^* mesons in the $K\pi$ subsystem. Background components are described using neural network techniques. We will discuss the search for exotic, i.e. non-$q\bar{q}$, states, which can appear in the $J/\psi\pi$ and $J/\psi K$ subsystems, complementing recent observations by LHCb.

HK 12.4 Tue 17:30 PHIL A 401
Light Hybrid Mesons with Functional Methods — •Franziska Münster[1], Christian Fischer[2], and Markus Huber[3] — [1]Institute for theoretical physics, JLU, Gießen, Germany — [2]Institute for theoretical physics, JLU, Gießen, Germany — [3]Institute for theoretical physics, JLU, Gießen, Germany

In my talk, I discuss the theoretical description of light hybrid mesons*hadrons composed of a quark, an antiquark, and a gluon. Their explicit gluonic degree of freedom makes them particularly interesting for studying the nonperturbative dynamics of QCD. Unlike ordinary mesons, hybrid mesons can carry exotic quantum numbers that simple quark*antiquark configurations cannot access in the nonrelativistic quark model. Their study is further motivated by some possible experimental candidates reported in recent years. The most prominent candidate for a light hybrid meson is the isovector state $\pi_1(1600)$ 1^{-+}. To investigate such systems, we employ a functional approach based on Dyson*Schwinger and Bethe*Salpeter equations. Hybrid mesons are treated as genuine three-body bound states, which requires solving a three-body Bethe*Salpeter equation that explicitly includes quark, antiquark, and gluon degrees of freedom. I outline the structure of this framework and discuss its implications for the spectrum and internal dynamics of hybrid mesons.

HK 12.5 Tue 17:45 PHIL A 401
First steps towards the mixing of Glueballs and Mesons using the Dyson-Schwinger and Bethe-Salpeter equations — •Jonathan Yigzaw, Christian Fischer, and Markus Huber — Justus-Liebig-Universität Gießen Germany

The spectrum of Quantum Chromodynamics (QCD) contains not only conventional quark-antiquark mesons but also purely gluonic bound states, the glueballs. While glueball masses have been studied extensively in pure Yang-Mills theory, their mixing with mesons of identical quantum numbers remains a largely open question. While in recent years functional methods have been successfully used to produce mass spectra for pure Yang-Mills theory, and the ongoing study of mesons in this framework has led to a fuller understanding of their properties, the effects of their mixing have not been studied yet.

As a first step towards a fully mixed spectrum of mesons and glueballs, I use the Dyson-Schwinger and Bethe-Salpeter equations to calculate the coupled set of equations in the scalar and pseudoscalar channels. I will present the resulting impact on the spectra and discuss the possible implications.

HK 12.6 Tue 18:00 PHIL A 401
Partial Wave Analysis for Baryonic Resonances for the HADES Experiment — •Ahmed Marwan Foda — GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany

The HADES collaboration at GSI investigates baryonic resonances and their decay channels using exclusive channels with pion and proton beams, which enable direct resonance formation at fixed center-of-mass energy ($\sqrt{s}$). This approach complements photo-induced studies and, combined with Partial Wave Analysis (PWA), provides crucial insights into resonance couplings, particularly in two- and three-pseudoscalar meson production. A central focus is the role and medium modification of vector mesons in baryon-dense matter, with pion-induced reactions and PWA offering unprecedented access to ρN and ωN final states, relevant for phenomena such as ρ meson melting and dilepton emissions in heavy-ion collisions.

To advance resonance exploration, a modular PWA software package is being developed, incorporating frameworks such as K-Matrix, N/D methods, and a baryon pseudoscalar fit based on the JuBo coupled-channel model. This enables comparison of electro- and photoproduction predictions with proton-proton data, refining resonance contributions. The effort coincides with recently analyzed proton-induced data together with approved pion beam time at GSI targeting the third resonance region, and a complementary experiment at J-PARC. Current results include illustrative fits from pion-proton reactions in the second resonance region, and proton-proton reactions at 4.5 GeV, demonstrating the framework's potential for upcoming campaigns.

HK 12.7 Tue 18:15 PHIL A 401
Coupled-Channel Partial-Wave Analysis of the Decays $\psi(2S) \to \omega + K\bar{K}, \pi\pi, \eta\eta, \eta\eta', 4\pi$ — •Lois Kröger, Tessa Bertelsmeier, Jans Böing, Anja Brüggemann, Nikolai in der Wiesche, Hannah Neuwirth, Frederik Weidner, and Alfons Khoukaz for the BESIII-Collaboration — University of Münster

The BESIII experiment provides a datasample of 2.7 billion events of the vector charmonium $\psi(2S)$ produced in electron-positron collisions. This high-statistics data sample is utilised to perform a coupled-channel partial-wave analysis of the decays $\psi(2S) \to \omega + K\bar{K}, \pi\pi, \eta\eta', \eta\eta, 4\pi$. The resonance parameters and the partial widths of the isoscalar, scalar resonances $f_0(1370)$, $f_0(1500)$ and $f_0(1710)$ produced as intermediate states in the analysed decay chains are studied. As these resonances lie in the same mass range as the lightest predicted glueball and also share the same quantum numbers, they are candidates to have an admixture of this predicted purely gluonic state. Therefore, this analysis aims to gain insight on the composition of the f_0 states below 2 GeV via the extracted resonance information in search for the lightest glueball. As a fundamental prediction of QCD, experimental evidence for the lightest glueball would greatly contribute to the understanding of the strong interaction. First results of the analysis will be presented in this talk. This work is supported by the DFG under the project number 547123630.

HK 13: Structure and Dynamics of Nuclei III

Time: Tuesday 16:15–18:45 Location: AM 00.011

Group Report HK 13.1 Tue 16:15 AM 00.011

Fast-Timing Lifetime Measurements Following Thermal-Neutron Capture: Probing Shape Coexistence in Mid-Shell Sn Isotopes — •V. Karayonchev[1], F. Wu[2], C. Andreoiu[2], C. Petrache[3], J.-M. Régis[4], C. Michelagnoli[5], M. Beuschlein[6], J. Jolie[4], and C.R. Ding[7] — [1]ANL, Lemont, IL, USA — [2]SFU, Burnaby, BC, Canada — [3]Université Paris-Saclay, CNRS/IN2P3, IJCLab, Orsay, France — [4]IKP, Köln, Germany — [5]ILL, Grenoble, France — [6]IKP, Darmstadt, Germany — [7]School of Physics and Astronomy, Sun Yat-sen University, Zhuhai, China

Thermal-neutron capture reactions produce high-energy primary γ rays that can be used as clean and selective gates, greatly reducing background in γ–γ coincidence measurements. When combined with the fast-timing technique using $LaBr_3$ detectors, this approach enables precise lifetime measurements of excited states populated through very weak decay branches — states that are often inaccessible with conventional methods. These measurements provide unique insight into the structure of stable nuclei.

This talk will present the methodology of fast timing following thermal-neutron capture and illustrate its capabilities through recent studies of mid-shell tin isotopes. In particular, lifetime and monopole ($E0$) strength measurements of low-lying 0^+ states shed new light on shape coexistence phenomena in ^{116,118,120}Sn. The experimental results will be compared with predictions from Multi-Reference Covariant Density Functional Theory (MR-CDFT).

Group Report HK 13.2 Tue 16:45 AM 00.011

γ-ray spectroscopy of neutron-rich radioactive isotopes using two-neutron transfer reactions — •C.M. Nickel[1], V. Werner[1], G. Rainovski[2], A. Blazhev[3], A. Esmaylzadeh[3], C. Fransen[3], K.E. Ide[1], J. Jolie[3], K. Gladnishki[2], V. Karayonchev[3], D. Kocheva[2], R. Lică[4], N.M. Mărginean[4], H. Mayr[1], C. Mihai[4], R.E. Mihai[4], S. Pascu[4], N. Pietralla[1], F. von Spee[3], T. Stetz[1], and R. Zidarova[1] — [1]TU Darmstadt — [2]U Sofia — [3]U Cologne — [4]IFIN-HH

Moderately neutron-rich radioactive nuclei can be efficiently populated by the (^{18}O,^{16}O) two-neutron transfer reaction. It allows measurements of γ-ray coincidences and angular correlations as well as excited-states' lifetimes, hence, electromagnetic matrix elements. We have recently applied it to Zr, Te, Sm, Er, Yb, Pt and Pb isotopes [1]. Lifetime data on the neutron rich isotopes ^{210}Pb [2] and ^{200}Pt [3] were obtained from recoil-distance Doppler-shift experiments at the Cologne and IFIN-HH tandem facilities. Data on ^{210}Pb solidify a discrepancy in shell-model descriptions of 2^+_1 and 4^+_1 states around ^{208}Pb, whereas the expected transition of γ-softness to sphericity towards N=126 is probed in ^{200}Pt.

[1] T. Stetz, H. Mayr *et al.*, Phys. Rev. C **112**, 034325 (2025).
[2] C.M. Nickel, V. Werner *et al.*, Phys. Rev. C. (2025, accepted).
[3] C.M. Nickel, V. Werner *et al.*, Phys. Rev. C. (2025, submitted).
*Supported by BMBF (Grant Nos. 05P21RDCI2 and 05P24RD3) and by DFG (GRK 2128 'Accelence', IRTG 2891 'Nuclear Photonics' and INST 216/988-1 FUGG).

HK 13.3 Tue 17:15 AM 00.011

Lifetime measurement of excited states of ^{172}W — •K. E. Ide[1], V. Werner[1], R. Abels[2], U. Ahmed[1], D. Bittner[2], T. Biesenbach[2], A. Blazhev[2], A. Esmaylzadeh[2], C. Fransen[2], J. Jolie[2], H. Kleis[2], C. -D. Lakenbrink[2], M. Ley[2], H. Mayr[1], M. Müllenmeister[2], C. M. Nickel[1], R. Novak[2], A. Pfeil[2], N. Pietralla[1], J. Roob[2], F. von Spee[2], T. Stetz[1], T. Sültenfuss[2], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IKP, Uni Köln

Nuclear quadrupole collectivity is identified from enhanced $E2$ decay rates. A sudden increase of the $E2$ strength of the $2^+_1 \to 0^+_1$ transition from N=96 (^{170}W) to N=98 (^{172}W) in the W isotopic chain is unexpected compared to the neighboring Hf isotopic chain. This discrepancy was investigated by lifetime measurements of ^{170}W [1] which confirmed the low $B(E2; 2^+_1 \to 0^+_1)$ value. In this work we investigate yrast $B(E2)$ values of ^{172}W to study the structural evolution of the yrast band in comparison to ^{170}W. The experiment was performed at the Cologne 10 MV FN-tandem accelerator facility and used the Cologne plunger device [2] and the CATHEDRAL spectrometer. The fast-timing method and the RDDS method are used complementarily to determine the lifetimes of yrast states. First results will be presented and compared to the confined β-soft (CBS) rotor model [3].

[1] K. E. Ide *et al.*, LNL report 2019 (2020).
[2] A. Dewald, O. Möller, and P. Petkov, PPNP **67** (2012) 786.
[3] N. Pietralla and O. M. Gorbachenko, PRC **70** (2004) 011304.
Supported by DFG (GRK 2128, GRK 2891 'Nuclear Photonics', INST 216/988-1 FUGG) and by BMBF under Grant No. 05P21RDCI2.

HK 13.4 Tue 17:30 AM 00.011

First measurement of lifetimes of excited states in ^{176}Hg — •C.-D. Lakenbrink[1], C. Müller-Gatermann[2], C. Fransen[1], M. P. Carpenter[2], A. Didik[1], C. Heymer[1], J. Jolie[1], D. Seweryniak[2], and K. Wimmer[1] — [1]Institute for Nuclear Physics, University of Cologne — [2]Physics Division, Argonne Nat'l Laboratory

The neutron-deficient mercury isotopes are known to exhibit shape coexistence between a weakly-deformed oblate π(0p-2h) and a prolate π(4p-6h) configuration [1]. For the very neutron-deficient nucleus ^{176}Hg the excitation energies of the 4^+_1 and 6^+_1 states lie at the crossing of these two configurations making an assignment from energy systematics ambiguous [1,2]. Also from the kinematic moments of inertia a structural change is expected between the 2^+_1 and 8^+_1 states. Transition strengths in the neighboring ^{178}Hg suggest a configuration mixing in the 2^+_1 state and different theoretical models predict this to be the onset of a shape transition with decreasing neutron number [3].
Thus an investigation of transition strengths between the low-lying yrast states in ^{176}Hg was conducted. The experiment was performed at ANL employing the recoil distance method and recoil-decay tagging.

This work was supported by the German Research Foundation (DFG) under contract number FR 3276/3-1 and by the U.S. Department of Energy under contract number DE-AC02-06CH11357. It used resources of ANL's ATLAS facility, which is a DOE User Facility.
[1] R. Julin *et al.*, J. Phys. G **27**, R109 (2001)
[2] L.P. Gaffney *et al.*, Phys. Rev. C **89**, 024307 (2014)
[3] C. Müller-Gatermann *et al.*, Phys. Rev. C **99**, 054325 (2019)

HK 13.5 Tue 17:45 AM 00.011

Lifetimes of Excited States in the Normal and Superdeformed Bands of Doubly Magic ^{40}Ca — •Timon Sültenfuss[1], Maximilian Droste[1], Peter Reiter[1], Andrey Blazhev[1], Duy Duc Dao[2], Frédéric Nowacki[2], Konrad Arnswald[1], Anna Bohn[1], Ramona Burggraf[1], Hannah Kleis[1], Sarah Prill[1], Michael Weinert[1], and David Werner[1] — [1]Institut für Kernpyhsik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany — [2]Université de Strasbourg, IPHC, 23 rue du Loess, 67037 Strasbourg, France

Lifetimes of excited states in the doubly magic nucleus ^{40}Ca have been measured in an experiment performed at the FN tandem accelerator of the University of Cologne. Excited states were populated via the $(p, p'\gamma)$ reaction at a proton beam energy of 15 MeV. The detector array SONIC@HORUS, comprising 12 silicon detectors for charged-particle identification and 14 HPGe detectors for high-resolution γ-ray spectroscopy, was used to measure scattered protons and emitted γ-rays, respectively. Lifetimes of the first excited 2^+, 4^+, and 6^+ states were extracted using the Doppler-Shift Attenuation Method. The new results were compared with recent large-scale shell model calculations, showing excellent agreement for the level scheme as well as the new lifetimes which are identified as members of a normal-deformed structure in ^{40}Ca. In addition, preliminary lifetime results for states in the superdeformed band of ^{40}Ca will be presented and compared with state-of-the-art shell-model predictions.

HK 13.6 Tue 18:00 AM 00.011

RDDS Lifetime Measurements in Neutron-Deficient ^{172}Os — •Alina Didik[1], Christoph Fransen[1], Casper-David Lakenbrink[1], Dania Al Daas[1], Andrey Blazhev[1], Jan Jolie[1], Carina Heymer[1], Franziskus von Spee[1], Katarzyna Hadynska-Klek[2], Grzegorz Jaworski[2], Michalina Komorowska[2], Michal Kowalczyk[2], Adam Nalecz-Jawecki[2], Pawel Napiorkowski[2], Marcin Palacz[2], Krysztof Rusek[2], and Katarzyna Wrzosek-Lipska[2] — [1]IKP, University of Cologne, Germany — [2]Heavy Ion Laboratory, University of Warsaw, Poland

In the lighter isotopes ^{168,170}Os the $B_{4/2} = B(E2;4_1^+ \to 2_1^+)/B(E2;2_1^+ \to 0_1^+)$ ratios drop far below the values expected for collective nuclei, indicating a rapid structural change, explained only very recently to result from strong band mixing including triaxiality. The nucleus ^{172}Os appears to lie just at the boundary of this evolution. Earlier data on transition strengths [1] suggest rotor-like behavior for the 2_1^+ and 4_1^+ states, but a sharp increase of the $B(E2)$ values from the 6_1^+ and 8_1^+ states hints for structural changes within the lower yrast states. However, the latter is not expected from the level energy systematics. To clarify this discrepancy, we performed a new RDDS experiment on ^{172}Os at HIL using the Cologne plunger combined with the EAGLE γ-ray spectrometer. For the first time, level lifetimes were determined from a $\gamma\gamma$ coincidence analysis to eliminate the need for assumptions on delayed feeding in contrast to the earlier dataset. Supported by the DFG, Grant No. FR 3276/3-1.

[1] A. Virtanen et al., Nucl. Phys. A591, 145 (1995)

HK 13.7 Tue 18:15 AM 00.011

Determination of ground-state decay level width in ^{27}Al using the temperature-dependent self-absorption technique — •K. Prifti[1], V. Werner[1], N. Pietralla[1], U. Ahmed[1], M. Baumann[1], M. Beuschlein[1], J. Bormans[1,2], I. Brandherm[1], M. L. Cortes[1], B. Götz[1], A. Gupta[1], J. Hauf[1], B. Hesbacher[1], M. Heumüller[1], K. E. Ide[1], J. Isaak[1], I. Jurosevic[1], J. Kleemann[1], P. Koseoglou[1], J. Lu[1], H. Mayr[1], C. M. Nickel[1], O. Papst[1], T. Ramaker[1], M. Rech[1], D. M. Richter[1], T. M. Sebe[3,4], T. Stetz[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]ELI-NP, IFIN-HH, Romania — [4]Politehnica Bucharest, Romania

The first temperature-dependent relative self-absorption (TRSA) measurement was conducted at the Darmstadt High-Intensity Photon Setup (DHIPS) at the superconducting Darmstadt linear electron accelerator (S-DALINAC) on the nucleus ^{27}Al using a bremsstrahlung photon beam with an endpoint energy of 5.5 MeV. This technique enables the separation of the natural linewidth of the nuclear transition from the Doppler broadening caused by the thermal motion of atoms in the solid target. The present work aims to measure the ground-state decay width of the 3957 keV level with high precision. Measurements were performed with and without an absorbing target at three different temperatures: 77 K, 320 K, and 600 K. The technique and its connection to both nuclear and atomic theory will be presented with a discussion of the results. This work was supported by the DFG under Project-ID 279384907–SFB 1245 and Project-ID 499256822–GRK 2891 "Nuclear Photonics".

HK 13.8 Tue 18:30 AM 00.011

Results and recent updates for electron-gamma coincidence experiments at the S-DALINAC — •Bastian Hesbacher[1], J. Birkhan[1], J. Isaak[1], D. H. Jakubassa-Amundsen[2], O. Möller[1], N. Pietralla[1], T. Ramaker[1], D. Richter[1], X. Roca-Maza[3], D. Schneider[1], and G. Steinhilber[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Mathematisches Institut, LMU München, Germany — [3]INFN, Sezione di Milano, Italy

The all-electromagnetic $(e,e'\gamma)$ reaction had first been used for nuclear structure measurements in the 1980s [1]. Since then very few experiments were based on this reaction. In 2021 first successful $(e,e'\gamma)$ measurements were performed at the S-DALINAC with improved resolution of electron energy, gamma energy and coincidence time by two orders of magnitude [2]. The scattered electrons were registered with the QCLAM spectrometer. The γ-radiation was detected by $LaBr_3$:Ce detectors. Measurements on ^{12}C and ^{96}Ru targets were performed and demonstrated the superior performance of the new facility over previous attempts to study $(e,e'\gamma)$ reactions. Results on the γ-decay behaviour and angular distributions of ^{96}Ru will be presented. In addition, recent updates for the experimental setup will be presented which enhance the performance for upcoming experimental campaigns.

This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245

[1] C. N. Papanicolas et al., Phys. Rev. Lett. **54**, 26 (1985).
[2] B. Hesbacher et al., Nucl. Instrum. Methods Phys. Res. A **1078**, 170574 (2025).

HK 14: Structure and Dynamics of Nuclei IV

Time: Tuesday 16:15–18:45 Location: AM 00.021

Group Report HK 14.1 Tue 16:15 AM 00.021

Collinear laser spectroscopy reveals signatures of triaxial deformation in neutron-rich Ru — •Kristian König for the ATLANTIS-Collaboration — TU Darmstadt

The region of refractory metals below tin exhibits a diverse spectrum of nuclear phenomena, i.e. quickly changing deformations and shape coexistence. Particularly, in the neutron-rich Ru isotopes, there are indications for triaxial ground state deformations. This was explored at a new collinear laser spectroscopy setup (ATLANTIS) installed at the low-energy branch of CARIBU at Argonne National Laboratory. There, a californium-252 fission source can uniquely produce sufficiently intense low-energy ion beams of neutron-rich isotopes in this part of the nuclear chart. Laser spectroscopy was performed in $^{96,98-102,104,106-114}$Ru and charge radii as well as electromagnetic moments were extracted. The findings are compared to the latest BSkG models, which are energy density functionals of the Skyrme type. These comparisons reveal clear signatures of triaxial ground states in the neutron-rich Ru isotopes.

This work was supported by DFG Project-Id 279384907-SFB 1245, BMBF 05P19RDFN1 and NSF Grant No. PHY-21-11185, and by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357, with resources of ANL's ATLAS facility, an Office of Science User Facility.

HK 14.2 Tue 16:45 AM 00.021

Investigating the GDR of ^{164}Dy using NRF — •M. Heumüller[1], J. Kleemann[1], N. Pietralla[1], A. D. Ayangeakaa[2,3], S. W. Finch[2,4], D. Gribble[2,3], J. Hauf[1], J. Isaak[1], X. K.-H. James[2,3], R. V. F. Janssens[2,3], S. R. Johnson[2,3], T. Kowalewski[2,3], B. Löher[5], O. Papst[1], K. Prifti[1], A. Saracino[2,3], D. Savran[5], N. Sensharma[2,3], and V. Werner[1] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]U. of NC, Chapel Hill, USA — [4]Duke U., Durham, USA — [5]GSI, Darmstadt

The GDR's geometrical model provides predictions for the γ-decay behavior in elastic photon and 2_1^+ Raman scattering reactions. To rigorously test these for the first time, a photonuclear experiment was recently performed on the GDRs of the spherical and deformed nuclides ^{140}Ce and ^{154}Sm, respectively, at the High Intensity γ-ray Source (HIγS) at TUNL, USA [1]. HIγS's quasi-monochromatic, polarized, and tunable photon beam was employed to selectively photoexcite energy slices of the GDR and subsequently measure their γ-decay. The results are in stunning agreement with the geometrical model predictions. A similar NRF experiment was conducted on the GDR of the strongly deformed ^{164}Dy at HIγS. ^{164}Dy is of particular interest due to its suspected higher degree of triaxiality. Experimental γ-ray spectra and the current status of the data analysis will be presented.

This work is supported by the DFG under Project-ID 499256822 – GRK 2891 'Nuclear Photonics' – and US DOE under No. DE-FG02-97ER41041 (UNC), No. DE-FG02-97ER41033 (TUNL).

[1]J. Kleemann *et al.*, Phys. Rev. Lett. **134**, 022503 (2025).

HK 14.3 Tue 17:00 AM 00.021

Vibrations, rotations and single-particle excitations in ^{168}Dy — •Johan Emil Linnestad Larsson[1,2,3], Helena Albers[3], Jeroen Bormans[1,2,3], Magdalena Górska[3], Tuomas Grahn[4], Costel M. Petrache[5], Norbert Pietralla[1], and Volker Werner[1,2] — [1]Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI, 64289 Darmstadt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [4]University of Jyväskylä and Helsinki Institute of Physics, P.O. Box 35, FI-40014 Jyväskylä, Finland — [5]Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France

The low excitation energies of first excited 2^+ states in the rare-earth nuclei close to the mid-shell are an indicator of their degree of deformation, and it reveals more complicated dependencies on neutron number [1].

In order to further study these isotopes, we performed the first ever projectile-fragmentation of ^{170}Er with an energy of 1 GeV/u at the GSI Helmholtzzentrum für Schwerionenforschung GmbH. The key isotope of ^{168}Dy was cleanly separated, identified and implanted in the DESPEC setup [2]. The newly observed transitions and transition probabilities reveal novel structures in ^{168}Dy, as well as providing a new interpretation of the isotope.

References: [1] Z. Patel et al., PRL 113, 262502 (2014). [2] A. Mistry et al., NIM A 1033, 166662 (2022).

HK 14.4 Tue 17:15 AM 00.021

Nuclear structure in heavy neutron-rich nuclei in the vicinity of N=126 and northwest of ^{132}Sn via multinucleon-transfer reactions — •Rainer Abels and Peter Reiter for the AGATA22.04-Collaboration — IKP, Universität zu Köln, Germany

Multinucleon-transfer (MNT) reactions offer a powerful tool to access to access exotic neutron-rich nuclei. Excited reaction products from the ^{136}Xe + ^{208}Pb system at 1 GeV were investigated using the high-resolution γ-ray tracking array AGATA coupled to the mass spectrometer PRISMA at LNL, Italy positioned at the grazing angle. For the beam-like fragments, energy E, atomic number Z, velocity β, charge state q, and mass number A were measured over the range Z = 52-58, enabling a clean selection of the nuclei of interest. Kinematic coincidences were exploited to enhance the identification of the hard-to-reach neutron-rich lead isotopes on the target-like side. Mass-yield distributions have been extracted and compared with calculations from the GRAZING model for MNT reactions. Based on the relative cross-section systematics for different transfer channels, the capabilities and limitations for the production of the hard-to-reach neutron-rich isotopes with this experimental method will be discussed. Preliminary results on excited states of beam-like nuclei in the Xe-Ba mass region will also be presented.

Supported by the German BMBF under 05P21PKFN9 and ENSAR2-TNA.

HK 14.5 Tue 17:30 AM 00.021

***Ab initio* description of deformed nuclei from angular-momentum projection** — •Mualla Aytekin[1], Benjamin Bally[1], Thomas Duguet[2], and Alexander Tichai[1,3,4] — [1]Technische Universität Darmstadt, Department of Physics — [2]IRFU, CEA, Université Paris-Saclay — [3]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Max-Planck-Institut für Kernphysik, Heidelberg

Atomic nuclei are complex quantum many-body systems that exhibit rich emergent collective behavior. To understand how such phenomena arise from the underlying nuclear forces, we investigate neon and magnesium isotopes using *ab initio* methods. We will present axially deformed mean-field calculations based on chiral two- and three-nucleon interactions and, via angular-momentum projection, explore the low-lying spectroscopy of the ground-state rotational bands. Finally, we will outline recent developments towards a projected coupled-cluster framework aimed at providing a unified description of both nuclear bulk properties and collective features. These developments open the door to a systematic and consistent treatment of deformed nuclei across the nuclear chart.

* Funded by the ERC Grant Agreement No. 101162059.

HK 14.6 Tue 17:45 AM 00.021

Electromagnetic response of nuclei using Gogny energy density functionals — •Nithish Kumar Covalam Vijayakumar[1,2], Gabriel Martínez-Pinedo[2,1], Luis Miguel Robledo Martín[3], and Samuel Andrea Giuliani[3] — [1]Institut für Kernphysik,Technische Universität Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Universidad Autónoma de Madrid, Madrid, Spain

Electromagnetic response of nuclei plays an important probe in the understanding of nuclear structure. This quantity is fundamental for the description of neutron capture and photodissociation rates for r-process nucleosynthesis. R-process studies require calculations of many nuclei and typically the response is extracted by using linear response approaches such as quasiparticle random phase approximation (QRPA). But the standard QRPA approach is computationally expensive. A more efficient way of solving the QRPA equations based on Finite amplitude method (FAM) was introduced and thus making its applications more advantageous for heavy nuclei. In this work, we have developed a FAM computer code using the finite range Gogny energy density functionals and axial symmetry preserving Hartree-Fock- Bogoliubov framework. Various test calculations of the new code and the comparison of electromagnetic response results with standard QRPA calculations and available experimental data was performed. We also plan to extend the approach of FAM in the context of nuclear fission for evaluating collective inertias.

HK 14.7 Tue 18:00 AM 00.021

Coulomb excitation of ^{212}Ra at HIE-ISOLDE — •H. Mayr[1], G. Rainovski[2], N. Pietralla[1], and V. Werner[1] for the ISOLDE IS748-Collaboration — [1]TU Darmstadt — [2]Sofia University, Bulgaria

The generalised seniority scheme is a truncated version of the nuclear shell model [1] applicable to the structure of atomic nuclei in the vicinity of shell closures. The number of unpaired nucleons, the seniority ν, is considered an approximate quantum number. The region of the even-even Po-Rn-Ra nuclei with $N=124$ exhibits strong signs of seniority-like behaviour, e.g. the energy spacing between yrast states decreases with increasing angular momentum. However, no data is available to confirm or falsify the anticipated parabolically increasing trend in the absolute $E2$ transition strength with the filling of the j-shell for the $\Delta\nu=2$ seniority-changing $2_1^+ \to 0_1^+$ transition [2]. Therefore, a Coulomb-excitation experiment was conducted at HIE-ISOLDE in 2024 in order to obtain the $B(E2; 2_1^+ \to 0_1^+)$ value of ^{212}Ra. The ^{212}Ra beam was impinged on a ^{120}Sn target with 4.5 MeV/u. γ rays of deexciting ^{212}Ra nuclei were observed by the Miniball array [3]. Particles were recorded by a DSSD. The $B(E2; 2_1^+ \to 0_1^+)$ value is deduced from γ-ray yields. The status of the analysis will be presented.

[1] I. Talmi, Nucl. Phys. A **172**, 1 (1971).
[2] J. J. Ressler *et al.*, Phys. Rev. C **69**, 034317 (2004).
[3] N. Warr *et al.*, Eur. Phys. J. A **49**, 40 (2013).

Supported by the BMFTR (05P24RD3, 05P24PKCI1), Horizon Europe (101057511), the ELI-RO programme (RDI/2024-007 ELITE) and the Romanian Ministry of Research and Innovation (PN23210106).

HK 14.8 Tue 18:15 AM 00.021

The vanishing $\nu 11/2^-[505]$ extruder orbital — •Jeroen Peter Bormans[1,2,3], Johan Emil Linnestad Larsson[1,2,3], Magdalena Górska[2], Helena Albers[2], Tuomas Grahn[4], Costel Marian Petrache[5], Norbert Pietralla[1], and Volker Werner[1] — [1]Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI, 64289 Darmstadt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [4]University of Jyväskylä and Helsinki Institute of Physics, P.O. Box 35, FI-40014 Jyväskylä, Finland — [5]Université Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France

The single-particle structure of neutron-rich odd$-N$ Sm isotopes is of interest for judging the structural role of the $\nu 11/2^-[505]$ orbital in describing the sudden onset of deformation. In the mass $A \sim 150$ region, this sudden onset has been attributed to the interplay between the spherical-driving extruder ($h_{11/2}$) orbital and deformation-driving intruder orbital(s) ($i_{13/2}$) [1]. We have conducted a gamma-ray spectroscopy experiment with the DESPEC setup at GSI, where excited states of the neutron-rich rare-earth nuclei were populated with the projectile fragmentation of a ^{170}Er beam impinging on a thick ^{9}Be target. The results of the measurement on ^{157,159}Sm will be presented and discussed.

[1] P. Kleinheinz et al., PRL 32, 68 (1974).

HK 14.9 Tue 18:30 AM 00.021

Shell Evolution towards N = 32: Inelastic Scattering of ^{49}K$_{30}$ and ^{51}K$_{32}$ — •Debajyoti Das[1,2], Kathrin Wimmer[2,3], Sidong Chen[4], Ting Gao[4], and Marina Petri[4] for the RIBF249-Collaboration — [1]IKP, TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]IKP, Universität zu Köln, Germany — [4]University of York, UK

The evolution of nuclear shell structure far from stability provides key insights into nuclear forces. In recent years, significant experimental and theoretical efforts have been focused on the emergence of sub-shell closures at neutron numbers $N = 32$ and 34 in neutron-rich Ca isotopes. In particular, the strength of the shell gap and the extent of the validity of these new magic numbers for neighboring proton numbers have been under investigation. In neutron-rich potassium isotopes, the proton $1s_{1/2}$ and $0d_{3/2}$ single-particle orbitals are inverted compared to the normal ordering. At ^{51}K, with $N = 32$, the ground state re-emerges as $3/2^+$. How this re-inversion of proton single-particle levels between ^{49}K and ^{51}K influences the development of the neutron sub-shell closure at $N = 32$ remains an open question. To address this, we investigate the collective nature of ^{49,51}K and compare it with ^{50,52}Ca nuclei studied in the same experiment. Inelastic scattering in inverse kinematics at relativistic beam energies was performed at the RNC/RIBF facility. γ rays from excited states were detected using the DALI2$^+$ array together with the newly developed HYPATIA detectors. In this talk, I will present an overview of the experiment and show preliminary results for ^{49,51}K Coulomb and nuclear excitations.

HK 15: Heavy-Ion Collisions and QCD Phases II

Time: Tuesday 16:15–18:45 Location: PHIL C 601

HK 15.1 Tue 16:15 PHIL C 601

Flow phenomena at high nuclear densities with HADES — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

Heavy-ion collisions in the few-GeV energy range create strongly interacting matter at extreme baryon densities, comparable to those in neutron star mergers. Precise measurements of the dense-matter *Equation-of-State* in this regime are therefore essential for the understanding of neutron stars.

We present new results from HADES (*High-Acceptance Dielectron Spectrometer*) located at the SIS18, GSI Darmstadt, the only current setup capable of measuring rare and penetrating probes at the high-μ_B frontier of the QCD phase diagram.

High-statistics measurements of collective flow for protons and light nuclei are reported in Au+Au and Ag+Ag collisions at $\sqrt{s_{\mathrm{NN}}} =$ 2.42 and 2.55 GeV, along with recent Au+Au data at $\sqrt{s_{\mathrm{NN}}} =$ 1.98, 2.07, 2.16, and 2.24 GeV, extending the excitation function to lower beam energies ($200 - 800$ AMeV).

Beyond directed and elliptic flow, flow coefficients v_n up to 6^{th} order are measured for the first time in this energy range, enabling a 3D characterization of angular particle emission in momentum space. Furthermore, the event-by-event flow fluctuations can be explored via correlations between the different flow coefficients, providing even stronger constraints on the *Equation-of-State*, and will also be presented.

This work was supported by the Helmholtz Forschungsakademie HFHF and GSI F&E.

HK 15.2 Tue 16:30 PHIL C 601

Low-mass, low-momentum virtual photon measurement with HADES — •Iuliana-Carina Udrea for the HADES-Collaboration — TU Darmstadt/GSI GmbH

Collisions of heavy nuclei at relativistic energies create a hot and dense medium, offering a unique environment to explore its microscopic properties using electromagnetic probes.

Dileptons are particularly advantageous for this purpose, as they do not interact strongly with the surrounding matter, allowing them to carry undisturbed information about the QCD matter produced during the reaction.

In particular, low-invariant-mass and low-momentum dileptons are highly sensitive to the transport properties of the system, providing a means to identify signatures of novel phases, such as precursor phenomena of color superconductivity, in dense QCD matter.

In this contribution, we outline the key steps towards investigating soft dileptons. For this purpose data from Ag+Ag collisions at 1.23A GeV with a nominal magnetic field strength are compared with a reduced magnetic field (5% of B_{max}), the latter increasing the acceptance for low-momentum leptons. Additionally, we will present the new data collected in 2025 for Au+Au collisions at 0.8A GeV with a lower magnetic field strength, allowing us to study the low-mass and low-momentum dileptons in more detail.

This work is supported by: GSI F&E and HGS-HIRe.

HK 15.3 Tue 16:45 PHIL C 601

Characterising the hot and dense fireball with virtual photons at HADES — •Niklas Schild for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

The High-Acceptance Di-Electron Spectrometer (HADES) at GSI, Darmstadt, investigates heavy-ion and elementary collisions at beam energies of a few GeV, providing valuable insights into QCD matter at high densities and moderate temperatures. One key aspect of HADES is the study of these collisions via rare electromagnetic probes, which offer unique access to the evolution of the system due to their penetrating nature.

In this contribution, we present recent measurements of dielectron production from Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV and $\sqrt{s_{NN}} = 2.42$ GeV. Expanding on previous results, we aim to study dielectron spectra in a multi-differential manner, considering observables such as invariant mass, centrality, rapidity, and transverse momentum. This not only provides detailed information about the properties of the hot and dense medium created in the collisions, but also allows for a more refined and differential comparison with theoretical models. This will be crucial for advancing our understanding of the thermal radiation emitted by the medium and, as such, can help to further constrain and improve existing descriptions.

This work has been supported by BMFTR and HGS-HIRe.

HK 15.4 Tue 17:00 PHIL C 601

Dielectron analysis in p+p collisions at 1.58 GeV beam energy with HADES — •Karina Scharmann for the HADES-Collaboration — Justus-Liebig-Universität Gießen

In this contribution we present preliminary results on the dielectron production in p+p interactions at 1.58 GeV beam energy measured with the **H**igh **A**cceptance **D**i**E**lectron **S**pectrometer (HADES). The HADES RICH detector has been upgraded with a new photon detection camera which strongly enhances the electron efficiency and conversion pair rejection. With this upgrade, a signal-to-background ratio above 1 is achieved over the entire dielectron spectrum. 0.5 billion collisions have been analyzed showing a contribution of π^0 and η Dalitz decays in a signal up to an invariant mass of 600 MeV/c^2. Furthermore, by analyzing elastic $p + p$ collisions, a normalization procedure for differential cross sections has been established. Additionally, collisions with the empty target (target mounting) provide a p+Mylar spectrum and allow the extraction of a p+n reference spectrum.

The p+p and p+n dielectron spectra can serve as a baseline for the understanding and interpretation of Ag+Ag collisions which have been measured in HADES at the same energy. A precise understanding of the dielectron production in elementary reactions is needed to disentangle the various contributions to the measured dielectron yield in Ag+Ag collisions.

HK 15.5 Tue 17:15 PHIL C 601

Dissecting the moat regime at low energies — •Shi Yin and Fabian Rennecke — Justus Liebig University Giessen, Heinrich-Buff-Ring 16 D-35392 Giessen

Dense QCD matter can feature a moat regime, where the static energy of mesons is minimal at nonzero momentum. Valuable insights into this regime can be gained using low-energy models. This, however, requires a careful assessment of model artifacts. We therefore study the effects of renormalization and in-medium modifications of quark-meson interaction on the moat regime. To capture the main effects, we use a two-flavor quark-meson model at finite temperature and baryon density in the random phase approximation. We put forward a convenient renormalization scheme to account for the nontrivial momentum dependence of meson self-energies and discuss the role of renormalization conditions for renormalization group consistent results on the moat regime. In addition, we demonstrate and that its extent in the phase diagram critically depends on the interaction of quarks and mesons.

HK 15.6 Tue 17:30 PHIL C 601

Hydrodynamic attractors in periodically driven weakly and strongly coupled systems — •Simon Schneider[1], Sören Schlichting[2], Aleksas Mazeliauskas[3], Louis Onwuka[4], Martin Vrdoljak[5], and Toshali Mitra[6] — [1]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [2]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [3]Institut für Theoretische Physik, Universät Heidelberg, D-69120 Heidelberg, Germany — [4]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [5]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [6]Institut für Theoretische Physik, Universät Heidelberg, D-69120 Heidelberg, Germany

We study equilibration and hydrodynamic response in systems undergoing periodic expansion and contraction in one spatial direction. We use strongly coupled holographic, weakly coupled kinetic and hydrodynamic frameworks to study the shear response to periodic drive for different amplitudes and frequencies. Unlike the monotic Bjorken expansion, the system does not approach equilibrium or even Navier-Stokes behavior. For small drive amplitudes and frequencies, the late time cyclic attractor is universal across systems and is described by MIS theory. For large drive amplitudes, the non-linear heating induces the drift in the system properties and the attractor behaviour.

HK 15.7 Tue 17:45 PHIL C 601

Numerical simulations of stochastic fluids via the Metropolis algorithm — •Mattis Harhoff[1], Sören Schlichting[1], and Lorenz von Smekal[2,3] — [1]Fakultät für Physik, Universität Bielefeld, Universitätsstr. 25, Bielefeld, 33615, Germany — [2]Institut für Theoretische Physik, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392, Gießen, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), Campus Gießen, 35392, Gießen, Germany

Stochastic hydrodynamics provides a dynamical framework for the evolution of fluctuations in heavy-ion collisions, but poses significant challenges in numerical simulations. We present an algorithm for the simulation of non-relativistic stochastic hydrodynamics in two spatial dimensions in a box, both in the cases of compressible and incompressible fluids. We use the robust Metropolis algorithm, handling fluctuations and dissipation at once by systematically replacing dissipative terms in the hydrodynamic equations by random forces. The algorithm can easily be modified for numerical simulations of other hydrodynamic theories. We present test cases as well as numerical calculations of the renormalization of shear viscosity, and give an outlook to critical dynamics and relativistic theories.

HK 15.8 Tue 18:00 PHIL C 601

Event Generator Comparison for Centrality Studies in Heavy-Ion Collisions at FAIR Energies — •Beatriz Artur — IKF, Goethe-Universität Frankfurt

The initial geometry of a relativistic heavy-ion collision greatly influences important observables of the strongly interacting matter, such as collective flow or event-by-event fluctuations of conserved quantities. Experimentally, it cannot be measured directly, so other observables have to be used as a proxy. The multiplicity of produced charged particles at mid-rapidity or the energy deposition of the forward-going spectator particles can be used, for instance. In this work, we compare different event generators, such as PHQMD, DCM-QGSM-SMM and SMASH+afterburner for centrality studies. We look specifically into the fragment production in the forward direction, since all models employ different methods for cluster production. Implications on an optimized strategy for centrality determination and consequent definition of the reaction volume will be discussed.

HK 15.9 Tue 18:15 PHIL C 601

Monte-Carlo sampling of nucleon positions in the nuclear shell model for heavy-ion collisions — •Lisa Kröger[1], Oscar Garcia-Montero[2], and Sören Schlichting[1] — [1]Bielefeld University — [2]University of Santiago de Compostela

Recently, it has been shown that investigating the structure of atomic nuclei is essential for correct description of fluctuations imprinted into the initial stage of a heavy-ion collision event. In fact, the examination of the N-body density distributions has shown to be crucial for better understanding deeply inelastic scattering (DIS) and nucleus-nucleus collisions [1]. Motivated by the recent interest to represent quantitatively the structure properties of the incoming nuclei, we present a new sampling algorithm which takes on account quantum correlations of the nuclear many-body wave function. Using the nuclear shell model (NSM) as a proof of concept model, a Markov Chain Monte Carlo method algorithm was implemented in order to generate nucleon positions, according to the full N-nucleon probability distribution. We benchmark it by comparing our numerical results to the analytic one- and two-body densities. By using this algorithm, quantum correlations in the nucleus are then imprinted into the positions. Additionally, the usage of the NSM permits the extension of this algorithm to large systems, such as Au and Pb, which are still prohibitively expensive for full *ab-initio* computations. We explore the impact of these new sources of fluctuation on the creation of long-range correlations by exploring initial state observables sensitive to the N-body densities, such as the initial eccentricities, extracted from the novel McDIPPER model [2].

HK 15.10 Tue 18:30 PHIL C 601

Dependence of resonance parameters on the pion momentum spectra — •Tim Weinreich — Physikalisches Institut, Universität Heidelberg

Ultrarelativistic heavy-ion collisions, which are studied at the Large Hadron Collider and Relativistic Heavy Ion Collider, are believed to create a deconfined state of matter called the Quark-Gluon-Plasma. It has been demonstrated that this state can be adequately described by relativistic viscous hydrodynamics. However, some of the measured observables or features observed in experimental data remain to be fully understood.

For instance, the pion spectrum at low transverse momentum indicates a discrepancy between experimental data and hydrodynamic models. One potential explanation for this phenomenon is the insufficient treatment of resonances that contribute to the total particle spectra. In fact, heavy-ion collision models typically neglect or omit uncertainties in all resonance parameters, e.g., resonance masses, decay widths, and branching ratios.

This talk presents a systematic study investigating the dependence of resonance parameter uncertainties on the pion production. This study is conducted using the FastReso [1] framework to calculate the irreducible spectral components for resonance decays.

This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).

[1] Mazeliauskas, A. *et al.* Eur. Phys. J. C 79, 284 (2019)

HK 16: Nuclear Astrophysics II

Time: Tuesday 16:15–18:30 Location: PHIL A 602

Group Report HK 16.1 Tue 16:15 PHIL A 602
Constraining the s-Process Path Using Indirect Methods at MESA and FAIR — •Tanja Heftrich[1], Jan Butz[1], Pierre Capel[2], Leon Fähnrich[1], Alina Gottschalk[1], Carolin Grün[1], Michael Heil[3], Felix Panholzer[1], René Reifarth[4], Concettina Sfienti[2], Monica Alejandra Sanjinez Ortiz[2], and Davud Sokolovic[1] — [1]Goethe University Frankfurt — [2]Johannes Gutenberg University Mainz — [3]GSI Helmholtzzentrum für Scherionenforschung — [4]Los Alamos National Laboratory

The slow neutron-capture process (s-process) is responsible for the synthesis of about half of the elements heavier than iron in stellar environments. Its modeling relies critically on precise neutron-capture cross sections, in particular for unstable nuclei that are not directly accessible to conventional measurements.

In this contribution, we present indirect approaches to determine (n,γ) reaction rates relevant for the s-process. In Mainz at the future MESA accelerator, neutron-capture cross sections are constrained via the inverse reaction using electron-induced processes, using $(e,e'n)$ reaction to access the nuclear response to virtual photons. Complementarily, experiments at FAIR employ Coulomb breakup measurements of the type (γ^*,n) at the R3B setup, where electromagnetic excitation in the Coulomb field of a heavy target provides access to the radiative capture process by detailed balance.

HK 16.2 Tue 16:45 PHIL A 602
Results for the $(\mathbf{n},\gamma)$-reaction on natural Krypton via the actiavion method. — •Jan Butz, Leon Fähnrich, Carolin Grün, Alina Gottschalk, Tanja Heftrich, Samira Ikerkourn, Felix Panholzer, and Davud Sokolovic — Goethe-Universität, Frankfurt am Main, Germany

An important step in understanding the origin of life is to study stellar nucleosynthesis. The abundance of elements up to iron is produced almost exclusively through nuclear fusion, whereas most heavy elements are formed via neutron-capture in the s- and r-processes. The s-process occurs inside the shell burning of massive and asymptotic giant branch stars, while the r-process, however, requires extreme conditions, like type II supernovae or neutron star mergers.

Krypton plays a vital role in the s-process due to the branching points of ^{81}Kr and ^{85}Kr. These branching points are nuclei where the decay rate is of the same order of magnitude as the neutron capture rate, $r_\beta \approx r_n$. To gain insight into these points, it is crucial to study the (n,γ) reaction and how these nuclei behave under stellar conditions. The cross sections for the $^{78}\mathrm{Kr}(\mathrm{n},\gamma)^{79}\mathrm{Kr}$ and $^{84}\mathrm{Kr}(\mathrm{n},\gamma)^{85\mathrm{m}}\mathrm{Kr}$ reactions could be determined at various temperatures using a natural krypton sample and the activation method. The resulting values and outlook will be presented.

HK 16.3 Tue 17:00 PHIL A 602
Updates on constraining the ^{95}Zr(n,γ) cross section via the Oslo-method — •Tom Sittig[1], Abdallah Karaka[1], Anna Bohn[1], Artemis Spyro[2], Devin Hymers[1], Markus Müllenmeister[1], Michael Weinert[1], Sarah Prill[1], Sebastian Schröder[1], and Dennis Mücher[1] — [1]Institute of Nuclear Physics, University of Cologne, Cologne, Germany — [2]Facility for Rare Isotope Beams, Michigan State University, East Lansing, Michigan, USA

The ^{95}Zr(n,γ) cross section is of pivotal understanding for the slow neutron capture process (s-process) as the long-lived ^{95}Zr isotope is a branching point at which β-decay is in competition with the production of ^{96}Zr.
In the case of the unstable isotope ^{95}Zr, a direct measuements of the neutron capture cross section is currently not possible. Using the Oslo method, we have constrained the neutron capture cross section of ^{95}Zr(n,γ) experimentally, for the first time. We utilized the ^{96}Zr(p,p') reaction at the 10 MV FN-Tandem accelerator of the Institute for Nuclear Physics at the University of Cologne using the SONIC@HORUS detector array. We have successfully used the newly developed "Shape" method to significantly reduce the model uncertainties of our result by extracting the absolute nuclear level density at the neutron separation energy.
The preliminary results of these measurements and their impact on the s-process will be presented.

Group Report HK 16.4 Tue 17:15 PHIL A 602
Study of the ^{14}N$(\alpha,\gamma)^{18}$F reaction at Felsenkeller underground lab with the gas-jet target setup — •Anup Yadav[1,2], Daniel Bemmerer[1], Konrad Schmidt[1], Eliana Masha[1], Axel Boeltzig[1], Peter Hempel[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]Technische Universität Dresden

A precise reaction rate for $^{14}\mathrm{N}(\alpha,\gamma)^{18}\mathrm{F}$ is required for modeling stellar evolution. The $^{14}\mathrm{N}(\alpha,\gamma)^{18}\mathrm{F}$ reaction takes place during the helium-burning phase in asymptotic giant branch (AGB) stars other helium-burning sites. This reaction influences different nucleosynthesis pathways and is part of the reaction chains $^{14}\mathrm{N}(\alpha,\gamma)^{18}\mathrm{F}(\beta^+)^{18}\mathrm{O}(\alpha,\gamma)^{22}\mathrm{Ne}$ and $^{14}\mathrm{N}(\alpha,\gamma)^{18}\mathrm{F}(\beta^+)^{18}\mathrm{O}(p,\alpha)^{15}\mathrm{N}(\alpha,\gamma)^{19}\mathrm{F}$, which are important for the production of ^{22}Ne and ^{19}F, respectively. However, at helium-burning energies the cross section is dominated by low-energy resonances whose properties remain insufficiently constrained. The reaction was studied at the Felsenkeller shallow-underground laboratory using a newly developed gas-jet target setup, in which an α beam was directed onto a nitrogen gas jet and the emitted γ rays were detected with high-purity germanium detectors. Precise angular distributions, branching ratios, resonance energies, and strengths were measured for three selected resonances at $E_r = 573$, 1136, and 1618 keV, with the lowest-energy resonance being relevant for helium-burning temperatures. We will present the new experimental results and discuss their astrophysical impact. Future measurements using the gas-jet target at the Felsenkeller underground laboratory will also be outlined.

HK 16.5 Tue 17:45 PHIL A 602
Low energy resonances in the ^{15}N$(\alpha,\gamma)^{19}$F-reaction — •Peter Hempel[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Eliana Masha[1], Felix Mayer[1,2], Konrad Schmidt[1], Simon Vincent[2,3], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden — [3]Deutsches Zentrum für Astrophysik (DZA)

The $^{15}\mathrm{N}(\alpha,\gamma)^{19}\mathrm{F}$-reaction contributes to fluorine production in several astrophysical sites including AGB stars, type II supernovae, and Wolf Rayet stars. The reaction occurs during the helium burning phase. However, the reaction rate at astrophysical energies is still poorly known. Here we report on data from a measurement of astrophysically relevant resonances in the 0.5 - 1.1 MeV center of mass energy range. The experiment has been carried out at the Felsenkeller 5 MV shallow-underground accelerator in Dresden using tantalum nitride solid targets enriched in ^{15}N and the new FeliciTAS 4π BGO γ-ray calorimeter.

HK 16.6 Tue 18:00 PHIL A 602
Constraining r-process nucleosynthesis with multi-objective Galactic chemical evolution models — •Marta Molero — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, Darmstadt 64289, Germany

The astrophysical site(s) of the r-process are uncertain, with candidates such as neutron star mergers and magneto-rotational supernovae predicting different event rates, delay times, and heavy-element yields. Galactic chemical evolution models constrain these properties by comparing model predictions with observed abundances. We explore, in a systematic and data-driven way, the astrophysical conditions under which r-process enrichment can reproduce the observed trends of multiple neutron-capture elements in the Milky Way. Rather than assuming a fixed site, we adopt a flexible, parametric approach to test whether a common set of r-process parameters can explain the chemical evolution of several heavy elements. We compute a grid of one-infall, homogeneous models varying: Eu yield per event, r-process event rate, enrichment delay time, and progenitor mass range. For each of the $\sim 10^5$ models, we predict [X/Fe] vs. [Fe/H] trends by scaling Eu yields with the solar r-process pattern. A multi-objective optimisation based on Pareto fronts identifies models that best reproduce the abundance trends. In this talk, I will present and discuss best fitting Eu models as well as the limitations in reproducing, at the same time, both light and heavy neutron-capture elements, reflecting how the solar r-process scaling relation becomes less robust towards lightest elements.

HK 16.7 Tue 18:15 PHIL A 602

Constraining neutron capture rates for the r-process — •Christan Schlaier[1], Jessica Berkman[2], Konstantinos Bosmpotinis[2], Sean Liddick[2], Andrea Richard[2], Artemis Spyrou[2], and Dennis Muecher[1] — [1]Institute for Nuclear Physics, University of Cologne, Cologne, Germany — [2]FRIB, Michigan State University, USA

The formation of the second r-process peak ($A \approx 130$) depends critically on neutron capture rates of nuclei below ^{132}Sn. Current theoretical predictions for these rates vary by orders of magnitude.

In 2025, an experiment at the Facility for Rare Isotope Beams (FRIB) at the Michigan State University was performed, aiming to experimentally constrain the neutron capture rates of these key nuclei for r-process nucleosynthesis, for the first time. The measurement utilized the SuN^{++} setup, which consists of the Summing NaI and CeBr3 (SuN^{++}) detector coupled with an Double Sided Strip Detector (DSSD) for particle identification and beam correlation. A cocktail beam of neutron-rich isotopes centered around ^{128}Ag was implanted into the setup to measure β-decay properties. The high efficiency and 4π coverage of SuN^{++} allow for the precise determination of β-decay intensities and the extraction of statistical nuclear properties, such as nuclear level densities and γ-ray strength functions. This contribution will discuss the experimental procedure and present preliminary results.

HK 17: Instrumentation III

Time: Tuesday 16:15–18:15 Location: PHIL A 301

Group Report HK 17.1 Tue 16:15 PHIL A 301
The MAGIX Experiment at MESA — •David Markus — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

At the new high-intensity, low-energy electron accelerator MESA, construction of the multi-purpose MAGIX experiment is in the final phases and preparations for the first physics run are underway. This first run with beam is planned to both provide a new more precise measurement of the transition form factor between the Hoyle state and the ground state of carbon-12 and to provide data to calibrate the new detectors, using a thin diamond foil as target.

In the future, MAGIX will use a gas jet target, which will be capable of operating with a variety of gases and enable a new frontier in high precision electron scattering experiments. Combined with MESA's high intensity electron beam and two high precision magnetic spectrometers, these experiments aim to contribute to the study of hadron structure and few-body systems, as well as investigations of reactions relevant to nuclear astrophysics and into the dark sector.

In the focal plane of the spectrometers, which are connected windowlessly to the scattering chamber, the two detector systems of MAGIX are installed, a time projection chamber for particle tracking and a trigger veto system combining plastic scintillation detectors and passive lead absorbers for particle identification and triggering.

This contribution outlines the physics program at MAGIX and provides an overview of both the setup of MAGIX and and the planned first physics experiment.

HK 17.2 Tue 16:45 PHIL A 301
GEM detectors for AMBER - Production and streaming readout — •Shania Müller[1,2], Pascal Henkel[1], Max Knauseder[1,2], Jakob Krauss[1,2], Jonathan Kunecke[1,2], Jan Paschek[1,2], and Bernhard Ketzer[1,2] — [1]Helmholz-Institut für Strahlen- und Kernphysik, University of Bonn, Germany — [2]Forschungs- und Technologiezentrum Detektorphysik

The AMBER experiment at CERN's Super Proton Synchrotron is a facility that explores how the fundamental properties of mesons and baryons emerge from the underlying quark and gluon dynamics. In its first physics runs in 2023 and 2024, the experiment measured cross-sections for antiproton production in hadron-hadron collisions. The run in 2025 has been a preparation run for the upcoming proton electric form-factor measurement using a high-energy muon beam, showing the feasibility of the planned experimental program.

To measure the trajectories of scattered muons downstream of the traget close to the beam, a new generation of 30×30 cm^2 triple-GEM detector stations are being produced and integrated into the setup. These detectors are constructed and characterized in the laboratories at the University of Bonn. To fulfill the requirements for this physics program a new free-streaming data acquisition system was established. To match the free-streaming mode, the self-triggering VMM3a front-end chip was implemented to readout the GEM detectors.

This talk will present the construction procedure of the detectors, their quality assurance and the characterization using the new readout system. Supported by BMFTR.

HK 17.3 Tue 17:00 PHIL A 301
Drift-field distortion corrections of the ALICE TPC in LHC Run 3 — •Janis Jäger for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

At CERN's Large Hadron Collider (LHC), the Time Projection Chamber (TPC) of the ALICE experiment provides an excellent tracking and particle identification performance. For LHC Run 3, the Multiwire Proportional Chambers (MWPCs) were replaced with stacks of four Gas Electron Multiplier (GEM) foils to cope with the high interaction rates of up to 50 kHz and enabling a continuous data acquisition. Despite the low intrinsic ion-backflow properties of the 4-GEM setup, a residual amount of ions, produced during the amplification process, drift back into the active volume of the TPC, leading to space-charge distortions of the drift field. Further effects such as geometric imperfections and interaction rate variations lead to additional static and time-dependent drift-field distortions. These drift-field distortions need to be corrected to preserve the intrinsic particle tracking precision of the ALICE TPC.

This talk will give an overview of the observed drift-field distortions in the ALICE TPC in Run 3, together with the correction procedure and its precision.

Supported by BMFTR and the Helmholtz Association.

HK 17.4 Tue 17:15 PHIL A 301
A New Automatised Wire Tension Measurement for the CBM-TRD Chambers — •Hannes Olbring for the CBM-Collaboration — Institut für Kernphysik, Universität Münster

At the Facility for Antiproton and Ion Research (FAIR) in Darmstadt the Compressed Baryonic Matter (CBM) experiment is currently being built. The goal of the experiment is to study the QCD phase diagram at high net baryon densities using heavy ion collisions at interaction rates of up to 10 MHz.
The Transition Radiation Detector (TRD) of CBM is based on Multiwire Proportional Chambers (MWPCs). The wire electrodes of the MWPCs will be produced with a well-controlled mechanical wire tension, dictated by the requirements on the electrostatic deflection caused by high voltages applied to the wires. To check the proper tension prior and after the wire gluing, a wire tension measurement device needs to be built. The wires will be brought to (harmonic) oscillation by an air blast, such that the actual measurement of the tension can be achieved by measuring the oscillation frequency. This talk will focus on commissioning and first performance measurements of a newly constructed wire tension measurement device and its automatisation.
We thank our colleagues from IFIN-HH, Măgurele, Romania, in particular Marian Olteanu, for the collaboration on developing this new device. This work is supported by BMFTR grant 05P24PM1.

HK 17.5 Tue 17:30 PHIL A 301
Hit Position Reconstruction and Tracking with the CBM-TRD in mCBM Beam Data — •Henning Pauels for the CBM-Collaboration — Institut für Kernphysik, Universität Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed-target experiment currently under construction at FAIR in Darmstadt. It is designed to investigate the QCD phase diagram at high net-baryon densities using heavy-ion beams from the SIS100 accelerator.

The Transition Radiation Detector (TRD) will play an important role in both the identification and the tracking of particles in CBM. To further confirm its performance as part of the future full CBM experiment, TRD modules were included in the in-beam measurements of the mCBM setup at the SIS18 facility at GSI. Consisting of modules of almost all of CBM's subdetectors, mCBM performed data taking and reconstruction under high-rate conditions. This talk will focus on the

TRD hit and track reconstruction using two TRD modules operated in mCBM runs.

This work is supported by BMFTR grant 05P24PM1.

HK 17.6 Tue 17:45 PHIL A 301

Developing radiopurity screening with alpha spectrometry for the LEGEND experiment — •Christoph Seibt, Björn Lehnert, Steffen Turkat, and Kai Zuber for the LEGEND-Collaboration — TU Dresden

LEGEND is one of the leading experiments in the search for neutrinoless double-beta ($0\nu\beta\beta$) decay. With its second phase, LEGEND-1000, the experiment uses one ton of germanium crystals enriched in ^{76}Ge to reach a discovery potential of half-lives greater than 10^{28} years.
However, to reach this sensitivity, an extremely low background level of 10^{-5} cts/(keV kg yr) at $Q_{\beta\beta}$ is necessary. One step towards this goal is to minimize the radioactivity of all components and to classify them with material screening methods.
We report on our recent efforts in developing alpha spectrometry with improved sensitivity beyond commercial low background solutions. Using an Frisch-gridded ionization chamber offers a high resolution and allows an analysis on individual radionuclides of one decay chain. In addition, we are sensitive to surface contaminations of less than 0.5 mBq/m^2 for ^{238}U and ^{232}Th. This presentation will show the optimization of the energy resolution, efforts in background reduction and first screening measurements with test samples.

This work is supported by: U.S. DOE, NSF, LANL, ORNL and LBNL LDRD programs; European ERC and Horizon programs; German DFG, BMBF, and MPG; Italian INFN; Polish NCN and MNiSW; Czech MEYS; Slovak RDA; Swiss SNF; UK STFC; Canadian NSERC and CFI; LNGS and SURF facilities.

HK 17.7 Tue 18:00 PHIL A 301

LHCb OT Straw-Tube Modules in mCBM: Integration and First Beam-Time Results — •Luca Schramm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt

Several of the former LHCb Outer Tracker (OT) straw tube modules were successfully installed and evaluated in the mini CBM (mCBM) test environment. The CERN-LHCb collaboration donated the OT straw tube detector to GSI. The aim is to install it as part of the Forward Tracking Systems in FAIR experiments such as PANDA and recently also as part of the Muon Detector of the CBM.

During the spring of 2025, the LHCb modules were operated under varied high-voltage and threshold settings during heavy-ion beam tests at GSI to assess performance stability. The contribution will present the beam-test setup and results obtained. A joint PANDA-CBM cooperation developed simulation and reconstruction software to enable the analysis of beam-test data. The results demonstrate consistent straw tube performance across the tested conditions, confirming the detector's readiness for integration into either experiment.

HK 18: Instrumentation IV

Time: Tuesday 16:15–18:15 Location: PHIL B 302

HK 18.1 Tue 16:15 PHIL B 302

The LowRAD project: achieving ultra-Low background for the future liquid xenon experiments — •Ying-Ting Lin, Christian Weinheimer, Volker Hannen, Christian Huhmann, Lutz Althüser, Daniel Wenz, Robert Braun, David Koke, Philipp Schulte, and Patrick Unkhoff — Universität Münster, Institut für Kernphysik

Liquid xenon (LXe) has become a cornerstone medium for rare event detection, including searches for dark matter and neutrino physics. To achieve an order of magnitude improvement in sensitivity for the next generation LXe experiment such as XLZD, the requirement of having ultra-low background must be satisfied, as even a trace amount of radioactive impurity can impact the sensitivity of the detector. The LowRAD project aims to establish the guidelines for the construction of cryogenic distillation systems capable of reducing the concentrations of the most critical radioactive impurities, 222Rn and 85Kr, to unprecedented levels. Demonstrators are actively under construction with their performance systematically evaluated. This talk will present the working principles and design choices of each system, including a multi-column configuration that maximizes xenon recovery and a novel heat pump dedicated to LXe distillation. Furthermore, online diagnostic systems are planned to enable continuous monitoring of, crucially, the level of background reduction. The emphasis will be placed not only on the performance, but also on the integrative design philosophy that ensures scalability and long-term operation.

Supported by the ERC Advanced Grant "LowRad" (101055063).

HK 18.2 Tue 16:30 PHIL B 302

Measuring the nuclear spin polarization of a pulsed H$^-$ ion source — •Simon Jakob Pütz[1,2,4], Tarek El-Kordy[5], Ralf Engels[2], Nicolas Faatz[1,2,6], Ralf Gebel[1], Kirill Grigoryev[1], Chrysovalantis Kannis[3], Yury Valdau[1], Jan Wirtz[1], and Yury Litvinov[1] — [1]GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt — [2]Institut für Kernphysik, Forschungszentrum Jülich, Wilhelm-Johnen-Straße, 52428 Jülich — [3]Heinrich-Heine-Universität Düsseldorf, Universitätsstraße 1, 40225 Düsseldorf — [4]Institut für Kernphysik, Universität zu Köln, Zülpicherstraße 77, 50937 Köln — [5]FH Aachen, University of Applied Sciences, Bayernallee 11, 52066 Aachen — [6]RWTH Aachen, Otto-Blumenthal-Straße 19, 52074 Aachen

At the Forschungszentrum Jülich, the COSY accelerator was fed with polarized H$^-$ / D$^-$ ions for stripping injection into the ring. For polarized beamtimes, knowing the initial polarization directly behind the source is essential before conducting experiments. An automated and reliable data acquisition system was developed to improve the time and energy effieciency of the process. For this purpose, the applicability of the Lamb-shift polarimeter was expanded to include pulsed H$^-$ and D$^-$ ion beams. Unlike other methods, the LSP is capable of measuring the nuclear spin polarization of particle beams in the keV energy range. The presented study adresses the optimization of nuclear spin polarimetry for upcoming polarized sources of the COSY type without pre-acceleration.

HK 18.3 Tue 16:45 PHIL B 302

Design of a High-Power Liquid Hydrogen Target for the P2 Experiment at MESA using CFD — Sebastian Baunack[1], Maarten Bonnekamp[2,4], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,3], Jayanta Naik[1], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], •Siddharth Thakker[1], 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 — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The upcoming P2 experiment at the MESA accelerator in Mainz aims to detect parity-violating asymmetries in elastic electron-proton scattering. It is designed for a determination of the weak mixing angle, $\sin^2\theta_W$, to a high precision of 0.16% at low momentum transfer.
To measure this small asymmetry with high precision, the experiment requires a high-luminosity, 60 cm liquid hydrogen (lH_2) target cell, which is designed using Computational Fluid Dynamics (CFD). The total heat deposited by the electron beam into the target cell materials is estimated to be over 3100 W, with a total loop heat load of 4000 W. The lH2 flowing through the cell is cooled by a heat exchanger coupled to a helium coolant supply. Additionally, a dedicated gas system is being constructed to manage all required operational gases. This talk presents the CFD simulations of the target cell, the design of the target loop and gas system, and an introduction to the P2 experiment itself.

HK 18.4 Tue 17:00 PHIL B 302

Completion of the $\overline{\text{P}}$ANDA cluster-jet target setup — •Hanna Eick, Daniel Bonaventura, Philipp Brand, Liridon Deda, Friederike Rummler, Michael Weide, and Alfons Khoukaz for the PANDA-Collaboration — Institute for Nuclear Physics, University of Münster, Germany

Cluster-jet targets offer a wide range of potential applications, due to their unique windowless and internal design, making them an attractive choice for various experimental settings. A powerful state-of-the-art cluster target source, specifically designed and constructed for the future $\overline{\mathrm{P}}$ANDA experiment at FAIR, has been successfully assembled and integrated with a dedicated target setup at COSY/Jülich. This target system will play a decisive role in the upcoming KOALA experiment at the GSI in Darmstadt over the next years. To optimize its performance, a comprehensive study has been conducted to investigate the target's properties, focusing on vacuum pressure distributions along the target beam line and target jet density at different stagnation conditions. Furthermore, a newly commissioned beam dump, equipped with multiple diagnostic tools, has undergone intensive testing. This presentation highlights the key findings, with particular emphasis on achieving a high target density of up to 10^{15} atoms/cm^2 at the interaction point and > 2.1 m behind the jet nozzle, while maintaining minimal residual pressure background, through careful adjustment of the orifice system within the beam dump. This project has received funding from GSI F&E (MSKHOU2023, MSKHOU2527), NRW Netzwerke (NW21-024-E), BMBF (05P21PMFP1).

HK 18.5 Tue 17:15 PHIL B 302

New nozzle production method and vacuum simulations for the $\overline{\mathrm{P}}$ANDA cluster-jet target — •Michael Weide, Daniel Bonaventura, Philipp Brand, Hanna Eick, Sophia Vestrick, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

In antiproton-proton annihilation experiments such as the upcoming $\overline{\mathrm{P}}$ANDA experiment at FAIR, internal targets have a key role as they allow the accelerator beam to be utilized for multiple interactions with the target. Initially, this target will be realized by a cluster-jet target (CJT) operated with H_2, that produces clusters of sizes ≤ 20 microns in diameter.

Due to the costly production of antiprotons, a challenge of such an experiment is minimizing background reactions. Thus, good vacuum conditions are mandatory. To predict the vacuum conditions for an experimental setup, a vacuum simulation model is developed and compared with experimental data recorded at a similar experimental setup at COSY (FZ Jülich).

The core piece of a CJT is a copper de-Laval nozzle, for which a new in-house production process is being developed at the Institute of Nuclear Physics at the University of Münster. This allows to perform detailed analysis on the influence of the geometry and shape of the nozzle. The current status as well as beam studies of the new nozzle design are presented.

The research project was supported by BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 18.6 Tue 17:30 PHIL B 302

The cryogenic windowless jet target for e-p scattering experiments at MAGIX at MESA — •Liridon Deda, Philipp Brand, Jost Froning, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

MAGIX experiment will provide a versatile physics program, ranging from studies of baryonic matter structure to searches for dark sector particles. By combining the high-intensity, energy-recovering electron beam of MESA with a state-of-the-art windowless jet target, MAGIX aims to perform high-precision e-p scattering experiments without target background. The MAGIX jet target is designed to be operated with various gases, including hydrogen, helium, and almost all heavier gases. A target thickness of more than 10^{18} atoms/cm^2 is delivered at the interaction point when using hydrogen. Achieving such high target thickness requires a high gas flow rate at cryogenic temperatures, which is then pressed through a de Laval nozzle. The nozzle geometry defines how the target expands, thus numerical simulations of the jet's formation and propagation are necessary to understand and optimize the target performance. In this contribution, the setup, performance, and development of the MAGIX jet target including various simulations for different gases will be presented and discussed. Additionally, the adaptation for the generation of a frozen filament jet structure will be described.

This project has received funding from CRC1660 (project number 514321794).

HK 18.7 Tue 17:45 PHIL B 302

Development and Commissioning of an RFQ Cooler-Buncher for Laser Spectroscopy — •Finn Köhler[1], Julian Palmes[1], Bernhard Maass[2], Kristian König[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Physics division, Argonne National Laboratory, USA

At rare-isotope beam facilities, radio-frequency-based beam cooler-bunchers (RFQCB) are particularly used to prepare ion beams for high-precision experiments at low energies (< 50 keV). They can accumulate rare beams for up to several seconds, cool them through collisions with a buffer gas, and emit ion bunches with a short time and energy width. This contribution will report on the development of a new, compact RFQCB that produces ion bunches well suited for laser spectroscopy measurements at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) in Darmstadt. A two level differential pumping scheme allows for a high-pressure region at the entrance of the RFQCB to efficiently capture incoming ions despite its short length. A laser ablation ion source is included at the injection side of the device to give access to a wide variety of ion species. We will report on the first commissioning results at COALA. As a next step, the device will serve as an injector, paving the way for laser-spectroscopy studies of ion bunches separated and extracted directly from a multi-reflection time-of-flight (MR-ToF) mass spectrometer. This project was supported by DFG (Project-ID 279384907 - SFB 1245) and BMFTR (05P24RD8).

HK 18.8 Tue 18:00 PHIL B 302

Characterization of hydrogen clusters using shadowgraphy measurements — •Anna Luna Hannen, Hanna Eick, and Alfons Khoukaz — Institute for Nuclear Physics, University of Münster, Germany

Cluster-jet targets can be used in accelerator beam experiments that require high event rates and precise measurements of the resulting particles, for example the upcoming $\overline{P}$ANDA experiment or MAGIX the experiment.

The properties of a cluster beam and the individual clusters can be studied using e.g. shadowgraphy measurements. The cluster beam is created using a cluster-jet source. The clusters are then illuminated with a short-pulsed laser, allowing the shadow of the clusters to be photographed. Through the analysis of the resulting shadowgraphy images, the size and velocity distributions of the clusters can be determined.

Measurements were taken at the Münster cluster-jet target using shadowgraphy, and size distributions were already measured as a result. Future goals are to refine the measurements and analysis of the shadowgraphy images.

This talk provides an overview of the shadowgraphy experiment and the new developments in the shadowgraphy measurements. This research project was supported by BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 19: Invited Talks

Time: Wednesday 11:00–13:00 Location: MED 00.915

Invited Talk HK 19.1 Wed 11:00 MED 00.915
Nucleosynthesis of heavy elements in explosive astrophysical environments — •Daniel Siegel — Institut für Physik, Universität Greifswald

The astrophysical origin of about half of the elements heavier than iron - those synthesized via rapid neutron capture (the r-process) - remains an open problem. Multimessenger astronomy with gravitational waves has revolutionized the way we observe the Universe and linked neutron-star mergers to r-process nucleosynthesis via emission from the radioactive decay of r-process nuclei (a kilonova). However, ample evidence ranging from first-principle arguments to observations of stellar spectra of metal-poor stars and Galactic archeology indicate that a significant if not dominant fraction of r-process nucleosynthesis should be associated with the death of massive stars. Starting from neutron-star mergers, I will discuss recent theoretical and observational developments on heavy-element formation in the death of (massive) rotating stars (collapsars, magnetorotational supernovae, and the accretion-induced collapse of white dwarfs). As new observational capabilities such as the James Webb Space Telescope yield first exquisite results, multi-messenger astronomy may soon lead to new and perhaps surprising answers to the long-standing, fundamental question of how the Universe creates its heaviest elements.

Invited Talk HK 19.2 Wed 11:30 MED 00.915
Recent results from laser spectroscopy with CRIS at ISOLDE: nuclear structure studies and beyond — •Jessica Warbinek for the CRIS-Collaboration — CERN, Switzerland — KU Leuven, Belgium

Over the past decade, collinear resonance ionization spectroscopy (CRIS) has developed into a versatile platform for studying atomic and nuclear properties of rare and short-lived quantum systems. CRIS enables high-precision measurements of trends in nuclear charge radii, electromagnetic moments, and the determination of nuclear spins across the nuclear chart, even for isotopes produced at rates as low as a few tens of ions per second. Recent advances have significantly improved the sensitivity toward the most exotic isotopes and expanded the scope and versatility of the technique.

CRIS has opened a new experimental frontier through the first study of short-lived radioactive molecules, in particular RaF, which provide promising platforms for precision tests of fundamental symmetries and searches for physics beyond the standard model at low energies. The production and studies of negative molecular ions further lay the groundwork for proposed future cooling and trapping approaches.

This contribution highlights recent results from CRIS and experimental developments instrumental in achieving them. Future opportunities for precision studies of exotic nuclei at ISOLDE will be outlined.

Invited Talk HK 19.3 Wed 12:00 MED 00.915
QCD at FAIR: Strong QCD Across Communities — •Johan Messchendorp[1] and Frank Nerling[1,2] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Institut für Kernphysik, Goethe-Universität Frankfurt, Frankfurt, Germany

Hadron physics lies at the intersection of several communities, linking QCD theory and effective approaches to emergent phenomena in hadrons and nuclei, the behavior of strongly interacting matter under extreme conditions, and the macroscopic properties of compact stars. In this plenary talk, we will highlight the synergy and added value of a coherent mid- and long-term hadron-physics agenda at GSI/FAIR (“QCD at FAIR”) as a common language, leveraging shared facilities across fields – from precision studies of hadron-hadron interactions and hadron spectroscopy to in-medium modifications and electromagnetic transition form factors – thereby connecting hadron and nuclear structure, heavy-ion physics, and astro(particle) physics. We outline a staged roadmap from SIS18 to SIS100 and, ultimately, high-intensity antiproton beams at HESR, and discuss the resulting impact on ‘strong QCD’.

Invited Talk HK 19.4 Wed 12:30 MED 00.915
New Directions in Micropattern Gaseous Detector Technologies — •Philip Hauer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

Micropattern Gaseous Detectors (MPGDs) have become a cornerstone technology in modern particle, hadron, and nuclear physics experiments, providing charged-particle tracking over large areas with high spatial resolution, exceptional rate capability, and a minimal material budget. The next generation of experiments demands even greater performance regarding high-rate and low material budget.

This talk will review the research and development activities driving this evolution. A crucial step is to further improve on the amplification stage by using novel approaches including optimized geometries or advanced materials. Concurrently, the research path extends beyond these core advancements to address systemic challenges. This includes the development of stable high-voltage powering schemes for large-area detectors, and the design of highly integrated, radiation-tolerant readout electronics.

This talk reviews recent advancements and directions in MPGD technologies. The practical realization will be illustrated through their implementation in exemplary current detectors and their role in the design of upcoming experiments, underlining how continued MPGD innovation is essential to unlock the physics potential of future experiments.

Supported by BMFTR.

HK 20: Focus Session: QCD@FAIR

Time: Wednesday 13:45–15:45 Location: AM 00.014

Group Report HK 20.1 Wed 13:45 AM 00.014
"QCD at FAIR" – A hadron physics driven compaign towards FAIR completion — •Frank Nerling — GSI Helmholtz Centre for Heavy Ion research, Darmstadt, Germany, Helmholtz Research Academy Hesse for FAIR, Campus Frankfurt — Goethe University Frankfurt

A newly established initiative has successfully been launched to strengthen the First Science(+) programme of the upcoming FAIR accelerator facility, also in view of anti-protons delivered by the High Energy Storage Ring in the future. While investigating fundamental questions related to the strong interaction in the non-perturbative regime, the overarching goal is to keep the expertise and interest of the community in hadron physics at FAIR. In this Focus Session, the hadron physics opportunities at the existing and upcoming experiments at SIS18/SIS100 of GSI/FAIR as summarised in the corresponding White Paper are discussed.

Group Report HK 20.2 Wed 14:05 AM 00.014
Physics opportunities for hadron physics at FAIR — •Christoph Hanhart — IAS-4, Forschungszentrum Jülich, 52428 Jülich

In this talk I will discuss the physics program planned for proton and pion induced reactions at FAIR. In particular I will highlight two cases: The perspectives to measure hyperon-nucleon and hyperon-hyperon scattering lengths and to study the hidden charm pentaquarks, so far seen only at LHCb.

Group Report HK 20.3 Wed 14:25 AM 00.014
Hadron physics studies at the pion beams facility with HADES — •Manuel Lorenz for the HADES-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI) — Goethe University Frankfurt

We present the physics program of π–N and π–A reactions up to $\sqrt{s} \approx 2.35$ GeV at the GSI pion-beam facility in combination with the HADES spectrometer. On proton targets, the program enables systematic studies of baryon resonances and their electromagnetic structure up to the third resonance region. Differential cross sections and polarization observables are used in Partial-Wave Analyses to tightly constrain baryon–meson and baryon–virtual-photon couplings, in particular ρN and ωN. Moreover, e^+e^- measurements probe the electromagnetic transition form factors in the time-like region and clarify the role of vector mesons. On nuclear targets, pion beams provide excellent kinematic conditions, with small relative momenta in the final state, enhancing sensitivity to medium effects. This allows us to explore vector-meson propagation in cold nuclear matter and to study the production of hidden- and open-strangeness particles. The same kinematics are ideally suited to investigate hypernuclei formation from low–relative-momentum strange baryons. In addition, these measurements provide a crucial connection to neutrino-nucleus interaction modeling by delivering high-precision hadronic baselines that constrain the reaction dynamics underlying long-baseline neutrino-oscillation experiments.

Group Report HK 20.4 Wed 14:45 AM 00.014

Spectroscopy of η'-mesic nuclei at GSI and FAIR — •Kenta Itahashi[1] and Yoshiki Tanaka[2] for the Super-FRS Experiment-Collaboration — [1]Department of Physics, The University of Osaka, Japan — [2]High Energy Nuclear Physics Laboratory, RIKEN, Saitama, Japan

We have conducted experimental search for η'-nuclei, a bound system of an η'-meson and a carbon 11 nucleus, using FRS at GSI as a high-resolution spectrometer. We measured the missing mass of the $^{12}C(p,d)$ reaction near the η'- emission threshold and selected formation events of the η'-mesic nuclei by tagging a high-momentum proton emitted in the two nucleon absorption channel, $\eta' NN \to NN$, where N denotes a nucleon. The measured excitation spectrum may indicate first experimental observation of the bound systems of an η' and a ^{11}C nucleus. We deduced the real part of the $\eta'-^{11}C$ potential to be $-61 \pm 1 \pm 5$ MeV with the local and global statistical significance of 3.5 σ and 2.1 σ, respectively. We plan a new experiment to improve the statistical sensitivity and extend the excitation-energy region of the measurement. We make use of a new solenoidal magnet to be transferred from SPring-8, Japan, which has larger geometry and higher magnetic field to achieve better tagging efficiency. We also discuss possibilities to utilize secondary beams such as pions or antiprotons, using the combination of SIS100 and the SuperFRS.

Group Report HK 20.5 Wed 15:05 AM 00.014

Hadron physics with proton and deuteron beams at the CBM experiment — •James Ritman for the CBM-Collaboration — GSI mbH, Darmstadt — Ruhr-Uni-Bochum

The high-intensity 30 GeV/c proton and deuteron beams soon available at FAIR will enable a rich program of hadron and QCD studies. These beams will be directed towards the large acceptance CBM detector, which provides an excellent basis for fully exclusive reconstruction of all final-state reaction products. These data will not only play a crucial role in contextualising the results from heavy-ion reactions, but will also provide great opportunities in the realm of hadron physics. The physics program includes investigations of hadron-hadron interactions and the composition of hadrons, as well as the mapping of baryon and meson spectra, including exotic states and quantifying hadron structure. This talk will present an overview of both, the detector set-up and expected performance for the related measurements.

Group Report HK 20.6 Wed 15:25 AM 00.014

QCDatFAIR Round Table Discussion — •Frank Nerling[1,2] and Johan Messchendorp[3] — [1]GSI Helmholtz Research Academy Hesse for FAIR, Campus Frankfurt — [2]Goethe University Frankfurt — [3]GSI Helmholtz Centre for Heavy Ion research, Darmstadt, Germany

We discuss the contributions of this Focus Session including the status and perspectives of the newly established initiative.

HK 21: Structure and Dynamics of Nuclei V

Time: Wednesday 13:45–15:45 Location: AM 00.011

Group Report HK 21.1 Wed 13:45 AM 00.011

Towards high-precision laser spectroscopy of trapped radioactive ions — •Phillip Imgram[1,2], Stefanos Pelonis[1], Tobias Christen[1], Julien Grondin[1], Angelos Karadimas[1], Arda Kayaalp[1], Sandro Kraemer[1], Agota Koszorus[1], Pierre Lassegues[1], Robbe Van Duyse[1], and Ruben de Groote[1] — [1]Department of Physics and Astronomy, Instituut voor Kern-en Stralingsfysica, KU Leuven, 3001, Leuven, Belgium — [2]Facility for Antiproton and Ion Research in Europe GmbH, Darmstadt, Germany

Benchmarking nuclear models through precise measurements of nuclear observables such as nuclear charge radii and electromagnetic moments in exotic, short-lived nuclei is crucial, and most precise and nuclear-model-independent results are achieved through laser spectroscopy. Here, well-established in-source or collinear laser spectroscopy techniques are usually limited in precision by either the temperature of the ions or the interaction time of the ions with the laser light. To overcome both limitations, a new offline beamline has been commissioned at KU Leuven to develop laser spectroscopy on trapped ions at radioactive ion beam (RIB) facilities [1]. This contribution will give an overview of the project and present the first results from our linear Paul trap, which includes the deceleration, trapping, and laser cooling of Sr^+ ions from a 10 keV beam energy to a few 10 mK in temperature and first laser spectroscopy measurements. Finally, an outlook on the upcoming developments in Leuven will be provided and prospects for implementation of this setup at RIB facilities will be explored. [1] P. Imgram et al., Rev. Sci. Instr. 96, 093302 (2025)

HK 21.2 Wed 14:15 AM 00.011

POSEIDON: A new setup for collinear laser spectroscopy at the N=126 factory — •Julian Palmes[1], Guy Savard[2], and Jason Clark[2] for the POSEIDON-Collaboration — [1]Institut für Kernphysik der Technischen Universität Darmstadt, Darmstadt, Germany — [2]Argonne National Laboratory, Lemont, USA

The nuclear charge radius is a fundamental nuclear observable and a sensitive probe of the forces and correlations that shape atomic nuclei. While for stable isotopes, absolute radii can be determined by muonic spectroscopy and electron scattering, the extraction of differential charge radii of exotic nuclei relies on optical isotope shift measurements. In the neutron-rich region near the N=126 shell closure, which is of special interest for astrophysical processes, our knowledge of those fundamental properties is sparse. These isotopes are difficult to produce due to limited cross-sections for conventional methods. Multi-nucleon transfer (MNT) reactions provide sufficiently large cross sections but have large momentum transfers, making beam collection challenging.

At the N=126 factory at the Argonne National Laboratory, a gas catcher directly after the target will collect these exotic nuclei and allow spectroscopy on MNT reaction products. We present POSEIDON, our newly designed collinear laser spectroscopy beamline and present plans to measure the charge radius of platinum isotopes across N=126.

This project is supported by the German Research Foundation (Project-ID 279384907 - SFB1245).

HK 21.3 Wed 14:30 AM 00.011

Precision mass measurement of n-deficient cadmium isotopes at ISOLTRAP — •Christoph Schweiger for the ISOLTRAP-Collaboration — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Isoltrap [1] is a multi-ion-trap mass spectrometer located at ISOLDE/CERN dedicated to high-precision mass measurements of artificially produced, short-lived, exotic radionuclides far from stability. Experimentally, Isoltrap employs multi-reflection time-of-flight and Penning-trap mass spectrometry techniques for direct mass measurements. Following the mass-energy equivalence, the measured masses can be related to nuclear binding energies, reflecting the underlying interactions and structure in the nucleus. Knowledge of the binding energies therefore allows the study of nuclear structure and nuclear astrophysics. To this end mass filters are employed. In addition, precision mass data have applications in fundamental physics such as neutrino or weak interaction studies.

Following an introduction of the experimental setup, recent mass measurements of neutron-deficient cadmium isotopes in vicinity of the self-conjugate doubly-magic ^{100}Sn will be presented. The contribution will also include technical developments that improved the experimental setup significantly.

[1] Lunney, D. et al., J. Phys. G: Nucl. Part. Phys. 44, 064008 (2017)

HK 21.4 Wed 14:45 AM 00.011

Progress towards Collinear Laser Spectroscopy of stable Phosphorus Atoms — •Imke Lopp, Kristian König, Daniela Tandara, and Wilfried Nörtershäuser — Institut für Kernphysik, Technische Universität Darmstadt

Phosphorus is of special interest for collinear laser spectroscopy, since it offers a proton-halo candidate, ^{26}P, at the proton dripline. By measuring isotope shifts, collinear laser spectroscopy provides access to changes in the nuclear charge radii along the isotopic chain, enabling a sensitive probe of halo structures. In the case of phosphorus, experimental challenges have prevented laser spectroscopy so far. There are no laser-accessible transitions from the ionic or atomic ground state. However, from meta-stable atomic states, transitions in the deep UV at 215 nm and 255 nm can be accessed with state-of-the-art laser systems. Therefore, a charge exchange cell is used to populate these states using in-flight charge exchange reactions. Preparation studies on stable ^{31}P are performed at the COALA setup at TU Darmstadt, where a new charge exchange cell and Penning Ionisation Gauge ion source are commissioned for this purpose. The status of the new charge exchange cell and ion source, as well as the progress towards collinear laser spectroscopy of stable phosphorus atoms will be presented.

This project is supported by BMFTR (05P24RD8) and the German Research Foundation (Project-ID: 279384907 - SFB 1245)

HK 21.5 Wed 15:00 AM 00.011

Laser Spectroscopy of neutron-rich and neutron-deficient Tm isotopes with RADRIS at GSI/HIM and RISIKO at JGU Mainz — •Jana Weyrich for the RADRIS-Collaboration — GSI, Darmstadt, DE — Helmholtz-Institut, Mainz, DE — Johannes Gutenberg-Universität, Mainz, DE

Nuclear shell effects stabilize the nuclei of heavy and superheavy elements against spontaneous fission, counteracting the Coulomb repulsion of the protons in the nucleus. Thus, studying physical properties in that region of the nuclear chart enhances our understanding of the nuclear structure. These elements, however, are radioactive, often short-lived, and generally produced only in limited quantities. As a result, the technique of **R**esonance **I**onization **S**pectroscopy (RIS) plays a crucial role in studying atomic spectra to determine atomic and nuclear properties, as it features high sensitivity, efficiency, and selectivity. As on-line studies of the rare species are time- and cost-intensive, it is advisable to investigate lighter atomic homologues in advance.

In this work, studies of ^{169}Tm and ^{170}Tm were performed with the RISIKO mass separator at JGU Mainz, Germany, to study the sensitivity of ionization schemes. Further on-line studies with the **RA**diation **D**etected **R**esonance **I**onization **S**pectroscopy (RADRIS) apparatus at GSI-FAIR in Darmstadt, Germany, included ^{152m}Tm, ^{153}Tm, and ^{154m}Tm. In this contribution, the results will be discussed, which include isotope shift measurements in three optical transitions and a first determination of the magnetic moment of ^{152m}Tm.

HK 21.6 Wed 15:15 AM 00.011

Investigating molecular formation and breakup towards measurements of the halo candidate ^{8}B — •Julien Spahn[1], Jason Clark[2], Bernhard Maass[2], Peter Müller[2], Wilfried Nörtershäuser[1], and Guy Savard[2] — [1]Institute for nuclear physics, TU Darmstadt, Germany — [2]Physics division, Argonne National Laboratory, USA

Since the first discovery of halo nuclei, neutron halos in particular have been characterized using nuclear reactions and laser spectroscopy. A measurement of the nuclear charge radius of the more exotic proton halo in the isotope ^{8}B, however, is still pending. An ongoing effort at Argonne's ATLAS facility aims to investigate ^{8}B via collinear laser spectroscopy. However, ^{8}B ions readily form molecules with residual contaminants in the He buffer gas of the gas catcher used to cool and extract the ions. These molecular species reduce the yield of the pure (bunched) ^{8}B beam. This contribution will focus on the commissioning of a new setup allowing investigation of the beam composition in continuous and bunched mode, relying on neural network based analysis of alpha decays detected via an MCP behind a velocity filter. Additionally, first results from online experiments investigating the molecular formation in the gas catcher and the breakup of the formed molecules in the RFQ will be presented.

This project was supported by DFG (Project-ID 279384907 - SFB 1245) and by the U.S. Department of Energy, Office of Nuclear Physics, under Contract No. DE-AC02-06CH11357, with resources of ANL's ATLAS facility, an Office of Science User Facility.

HK 21.7 Wed 15:30 AM 00.011

Production and Collinear Laser Spectroscopy of Helium-like Boron Ions — •Emily Burbach, Hendrik Bodnar, Finn Köhler, Kristian König, Imke Lopp, Wilfried Nörtershäuser, and Julien Spahn — Institut für Kernphysik, Technische Universität Darmstadt

Nuclear ground state properties of short-lived isotopes can be studied using collinear laser spectroscopy (CLS). Differential root-mean-square charge radii can be derived from isotope shifts of atomic transitions between different isotopes. For light systems, also the absolute charge radius can be determined by applying NRQED calculations and high-precision absolute frequency measurements. The Collinear Apparatus for Laser Spectroscopy and Applied Sciences (COALA) at TU Darmstadt is suitable for high-precision transition frequency measurements at the ppb-level that are required for light isotopes. There, highly charged boron ions were produced in an electron beam ion source. We present experimental details on the efficient production of helium-like boron ions in the metastable $^{3}S_{1}$ state, where laser-accessible atomic transitions occur at 283 nm and the subsequent laser spectroscopy measurements. The absolute charge radius of ^{11}B can be determined from the transition frequency and NRQED calculations, which was previously demonstrated for ^{12}C [1]. An overview of the current status of the analysis is given.

This project is supported by DFG (Project-ID 279384907 - SFB 1245).

[1] P. Imgram et al., Phys. Rev. Lett. **131**, 243001 (2023).

HK 22: Structure and Dynamics of Nuclei VI

Time: Wednesday 13:45–15:45 Location: AM 00.021

Group Report HK 22.1 Wed 13:45 AM 00.021

Momentum-dependent electroweak currents in deformed nuclei — •Rui Han[1], Betânia Backes[2], Jacek Dobaczewski[2,3], Weiguang Jiang[4], Markus Kortelainen[5,6], Gabriel Martínez-Pinedo[1,7,8], and Herlik Wibowo[2] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Department of Physics, University of York, York, United Kingdom — [3]Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, Warsaw, Poland — [4]Institut für Kernphysik and PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität, Mainz, Germany — [5]Department of Physics, University of Jyväskylä, Jyväskylä, Finland — [6]Helsinki Institute of Physics, University of Helsinki, Helsinki, Finland — [7]Institut für Kernphysik (Theoriezentrum), Fachbereich Physik, Technische Universität Darmstadt, Darmstadt, Germany — [8]Helmholtz Forschungsakademie Hessen für FAIR, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

For weak processes such as neutrino-nucleus scattering and muon capture, the momentum transfer can be large enough that long-wavelength approximations break down, and chiral EFT two-body currents may contribute significantly. A framework is presented to evaluate momentum-dependent one- and two-body electroweak currents in deformed open-shell nuclei within nuclear DFT. Magnetic dipole moments serve as a benchmark for validating the consistent implementation of chiral two-body currents, and current progress toward a unified finite-q treatment for weak processes is outlined.

Group Report HK 22.2 Wed 14:15 AM 00.021

Two-body currents at finite momentum transfer and WIMP-nucleus scattering — •Catharina Brase[1,2,3], Zhen Li[1,2,3], Yukiya Chiba[4], Takayuki Miyagi[4], Javier Menéndez[5,6], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI

Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg — [4]Center for Computational Sciences, University of Tsukuba — [5]Departament de Física Quántica i Astrofísica, Universitat de Barcelona — [6]Institut de Ciències del Cosmos, Universitat de Barcelona

We study two-body currents (2BCs) in scattering processes off medium-heavy nuclei. The inclusion of 2BCs at finite momentum transfer is important for various electroweak processes. In this work, we calculate structure factors for spin-dependent WIMP-nucleus scattering, which are needed for dark matter direct detection experiments. The structure factors encode the nuclear response and have to be calculated theoretically. We investigate the effects of 2BCs with full momentum transfer dependence on the structure factors for ^{19}F, ^{29}Si, ^{129,131}Xe. Our results are compared to previous calculations that used approximation schemes to include 2BCs.

HK 22.3 Wed 14:45 AM 00.021

Searching for signatures of the possible resonant neutrinoless double electron capture in ^{152}Gd at the Felsenkeller shallow-underground laboratory — •Lars Rudert, Björn Lehnert, Steffen Turkat, and Kai Zuber — TU Dresden

The hypothesized Majorana nature of neutrinos is a key motivation for many large-scale research projects in contemporary particle physics. While neutrinoless double-beta decay plays a central role in the experimental search for this property, double electron capture (ECEC) has gained increasing attention as an alternative probe. The two-neutrino mode of ECEC was first experimentally observed in 2019 by the XENON1T collaboration in ^{124}Xe. However, the observation of neutrinoless double electron capture remains an open experimental challenge.

A long-term measurement is currently being conducted using a ^{152}Gd-enriched gadolinium oxide sample, which is considered the most promising candidate for a resonance-enhanced neutrinoless double electron capture. This contribution focuses on an experiment employing an ultra-low-background well-type HPGe detector at the Felsenkeller shallow-underground laboratory, operated by the Nuclear Physics group at TU Dresden. During the ongoing measurement campaign, further optimizations of the background sensitivity are being performed and are currently under discussion. This includes an extended characterization of the detector with respect to the expected X-ray emissions from the theoretical decay.

HK 22.4 Wed 15:00 AM 00.021

Electron-capture decay of Tc-98 — •Dominik Elchine[1], Martin Müller[2], Markus Schiffer[3], and Erik Strub[1] — [1]Division of Nuclear Chemistry, University of Cologne, Zülpicher Str. 45, 50674 Cologne, Germany — [2]Institute for Nuclear Physics, University of Cologne, Zülpicher Str. 77, 50937 Cologne, Germany — [3]Faculty of Arts and Humanities, Department of Prehistoric Archaeology, Laboratory of Isotope Archaeology

From simple symmetry and energy considerations it can be concluded that ^{98}Tc might undergo electron capture decay (EC). In this work we provide evidence for an EC decay of ^{98}Tc measuring 2.67 g K[TcO$_4$] that contains approximately 1 GBq of ^{99}Tc. By use of a lead shielding for the sample, it was possible to identify the coincident $4^+ \to 2^+$ and $2^+ \to 0^+$ γ transitions in the daughter nuclide ^{98}Mo at the clover setup of the Institute for Nuclear Physics at the University of Cologne. For the first time, the EC/β^- branching ratio of 0.29(3)% was determined directly. With a log ft of 14.21(7) this decay does almost tie with the log ft of the ^{36}Cl EC decay [14.23(1)] for the same highest second forbidden nonunique transition.

HK 22.5 Wed 15:15 AM 00.021

Chasing the elusive nuclear two-photon decay in ^{72}Ge — •Michael Weinert[1], Wolfram Korten[2], Yury Litvinov[1,3], Markus Müllenmeister[1], Peter Reiter[1], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]IRFU, CEA, Université Paris-Saclay, France — [3]GSI Helmholtszentrum für Schwerionenforschung, Darmstadt, Germany

A recent study at the ESR storage ring at GSI, Darmstadt, allowed to indirectly observe the nuclear two-photon (2γ) decay of the first excited state in ^{72}Ge [1]. By storing the excited and fully ionized nucleus in the ESR, conventional electron conversion can no longer depopulate the 0^+ isomer and the rare second-order electromagnetic process becomes the dominant decay path. It could be shown that the isomeric state has a much longer, yet finite lifetime in the ESR system, serving as an indirect observation of the 2γ decay. This contribution presents the current endeavors on complementary ^{72}Ge$(p,p'\gamma)$ experiments, hunting for the direct observation of this extremely rare decay process. Besides finding a way to strongly populate the isomeric state, several orders of magnitude of natural and beam induced γ-ray background have to be suppressed. An overview of the latest experiments witht he SONIC@HORUS setup in Cologne [2] and with the ELIFANT array [3] at IFIN-HH, Bucharest, will be given.

[1] D. Freire-Fernández *et al.*, Phys. Rev. Lett. **133**, 022502 (2024)
[2] S. G. Pickstone *et al.*, Nucl. Inst. Meth. A **875** (2017) 104-110
[3] D. L. Balabanski *et al.*, EPJ Web Conf. **342**, 01002 (2025)

HK 22.6 Wed 15:30 AM 00.021

Studies of the ^{76}Ge level scheme via neutron activation and γ-γ coincidence spectroscopy for germanium-based $0\nu\beta\beta$ decay experiments — •Marie Pichotta[1], Toralf Döring[2], Björn Lehnert[1], Max Osswald[1], Ronald Schwengner[2], Christoph Seibt[1], Steffen Turkat[1], and Kai Zuber[1] — [1]Technische Universität Dresden (IKTP), Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

The still undetected neutrinoless double beta ($0\nu\beta\beta$) decay would prove the Majorana nature of neutrinos and thus provide clear evidence for physics beyond the Standard Model. ^{76}Ge is one of the most promising nuclides for its detection and is employed in several large-scale experiments, such as LEGEND. For a distinct identification of a potential ^{76}Ge $0\nu\beta\beta$ signal, a detailed understanding of all background contributions within the signal region is essential.

In a first experimental campaign at the DT neutron generator of TU Dresden, germanium isotopically enriched in ^{76}Ge was activated with 14 MeV neutrons, and the resulting γ radiation from the β^- decay of ^{76}Ga into excited states of ^{76}Ge was measured. The spectra from multiple irradiation cycles revealed several γ-ray peaks located in the vicinity of the $0\nu\beta\beta$ signal region, of partially unknown origin.

This talk focuses on a follow-up study, where multiple HPGe detectors equipped with active anti-Compton suppression were employed to perform γ-γ coincidence measurements. This enables a detailed reconstruction of decay cascades and aims at identifying unknown γ-ray transitions, thereby closing remaining gaps in the level scheme of ^{76}Ge.

HK 23: Heavy-Ion Collisions and QCD Phases III

Time: Wednesday 13:45–15:45 Location: PHIL C 301

Group Report HK 23.1 Wed 13:45 PHIL C 301

Probing charm and quarkonium dynamics in pp and OO collisions with ALICE — •Samrangy Sadhu, Ankur Yadav, Lubna Al-Rifaie, and Bernhard Ketzer for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn

We present recent and ongoing heavy-flavour measurements with the ALICE experiment at the CERN LHC, focusing on charm production in pp and quarkonium collectivity in OO collisions. We discuss recent open-charm results, including the D^{*+} production cross section in pp collisions at $\sqrt{s} = 5.36$ TeV and D^0 meson–charged particles azimuthal correlations in pp at $\sqrt{s} = 13.6$ TeV. Together, these measurements constrain charm-quark production, fragmentation, and charm-jet properties, and at the same time provide essential baselines for future heavy-ion studies at the corresponding energies. In addition, we present the first J/ψ flow measurement in OO collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV. The observed azimuthal anisotropy offers insight into possible collective behaviour and charm transport in a small, short-lived QCD medium. These results strengthen the understanding of heavy-flavour dynamics across collision systems and support the characterisation of QCD phenomena from pp to intermediate-size nuclei. Supported by BMFTR.

HK 23.2 Wed 14:15 PHIL C 301

Charm-baryon lifetime measurement in pp collisions at $\sqrt{s} =$ 13.6 TeV with ALICE — •Oleksii Lubynets for the ALICE Germany-Collaboration — Heidelberg university, Physics institute

The lifetimes of heavy-flavour hadrons provide a sensitive benchmark for the heavy-quark expansion (HQE) approach, in which the total decay width is expressed as a power series of heavy-quark mass. Different treatments of higher-order terms can lead to sizable variations in predicted lifetimes, making precise measurements of charm-baryon lifetimes crucial for validating and refining HQE approaches.

We present the implementation of a lifetime measurement for the Λ_c^+ baryon reconstructed via its decay channel $pK^-\pi^+$ with data collected at ALICE during Run 3 of the LHC. Charmed hadrons are reconstructed by their decay topology via a Kalman filter algorithm. The measured yield as a function of proper decay time is corrected for detector and reconstruction inefficiencies using dedicated Monte-Carlo simulations implemented with the Geant4 transport model. The effect of feed-down from beauty-hadron decays is corrected in a data-driven way. It allows us to build a corrected proper decay time distribution of prompt Λ_c^+ from which its lifetime is determined.

The described procedure demonstrates the capability of ALICE to deliver a competitive lifetime measurement of charm baryons, contributing to the global effort to constrain HQE parameters and improve theoretical understanding of charm-hadron decays.

HK 23.3 Wed 14:30 PHIL C 301

Measurement of ψ(2S) production at midrapidity in Pb–Pb Collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV with ALICE — •Jinjoo Seo for the ALICE Germany-Collaboration — Heidelberg University

Quarkonium is a sensitive probe of the quark-gluon plasma (QGP) created in ultra-relativistic heavy-ion collisions. In the QGP, color screening leads to the suppression of all charmonium states. However, the large charm production cross-section at LHC energies can also cause enhanced charmonium production at the phase boundary or (re-)generation throughout the QGP evolution. The interplay between suppression and (re-)generation mechanisms reflects the underlying charm-quark dynamics in the QGP and during hadronization. Studying the ψ(2S) is particularly interesting because of its weaker binding energy, larger spatial size, and smaller feed-down contribution compared to the J/ψ. Previous measurements have shown a stronger suppression of ψ(2S) relative to J/ψ and are compatible with both statistical hadronization at the phase boundary as well as a model with continuous breakup and formation in the QGP. To clarify the situation, data at low transverse momentum and midrapidity are necessary. In this contribution, we present the first results of inclusive ψ(2S) production at midrapidity in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.36$ TeV with the ALICE detector, together with the corresponding J/ψ measurements.

HK 23.4 Wed 14:45 PHIL C 301

J/Ψ measurement at midrapidity in Pb−Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV with the ALICE central barrel — •Jonathan Witte for the ALICE Germany-Collaboration — Universität Heidelberg

The interaction of heavy flavour quarks in the quark-gluon plasma has been under investigation for more than two decades. After the melting of bound charmonium states have been firmly established, the focus moved towards regeneration effects at higher collision energies. First results from Pb−Pb collisions at the LHC provided strong support for this picture, offering important experimental constraints for both thermal and transport hadronisation models. The newest ALICE data collected in LHC Run 3 - featuring a new time projection chamber and higher interaction rate - opens the door to precision measurements of J/Ψ production at midrapidity. The J/Ψ is reconstructed in the dielectron decay channel, with the two electrons measured in the central barrel. While the data taking is still in progress, the final analysis is under development. The current focus here is on the optimisation on the electron identification and the description of the background, increased due to the high interaction rates. In the talk I will present the analysis status and show the first stable J/Ψ signals from the Run 3 Pb−Pb data.

HK 23.5 Wed 15:00 PHIL C 301

Charmonium production as a function of multiplicity in pp collisions — •Alexander Tiekötter for the ALICE Germany-Collaboration — Institut für Kernphysik, Münster, Deutschland

Charmonium production happens at different energy scales. $c\bar{c}$ production occurs at perturbative energies, while the hadronization into colorless charmonium is a soft process. Models like the Improved Color Evaporation Model or Non-relativistic QCD describe the charmonium cross-section well, but fail at $p_{\rm T} < 3\,{\rm GeV}/c$. The color glass condensate (CGC) approach extends NRQCD to better describe the low $p_{\rm T}$ regime and implies a non-linear multiplicity dependence of charmonium production.
To investigate this effect, we measure the production of J/ψ and $\psi(2S)$ mesons at $\sqrt{s} = 13.6\,$TeV as a function of charged-particle multiplicity with the ALICE detector at mid-rapidity in the e^+e^- decay channel. The multiplicity is measured by using an iterative Bayesian unfolding algorithm to convert the number of tracks to a charged-particle distribution. Results are presented via self-normalized ratios so that experiment-dependent quantities cancel. Results of the inclusive J/ψ production as function of multiplicity show a stronger-than-linear increase and are in good agreement with the NRQCD+CGC model, while predictions from PYTHIA8 fail to describe the data. Measuring $N_{\psi(2S)}/N_{J/\psi}$ even shows a more complex behavior, where the CGC alone fails. Considering dissociation mechanisms for charmonium can qualitatively explain the shape of the ratio.
Supported by BMFTR

HK 23.6 Wed 15:15 PHIL C 301

J/ψ elliptical-flow v_2 analysis in O-O collisions at mid-rapidity using ALICE Run-3 data — •Ankur Yadav, Samrangy Sadhu, Lubna Al-Rifaie, and Bernhard Ketzer for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen und Kernphysik, Universität Bonn

The Large Hadron Collider (LHC) at CERN had first oxygen-oxygen (O-O) collisions at $\sqrt{S_{NN}} = 5.36$ TeV in 2025. This dataset provides a unique opportunity to study collectivity and quark-gluon-plasma (QGP) signatures in a smaller collision system compared to the heavy-ion systems such as Pb-Pb. The ALICE experiment has recorded this dataset with excellent precision, enabling the investigation of quarkonium production with a focus on the J/ψ meson.

This talk will present the first measurement of the azimuthal-anisotropy coefficient v_2 of inclusive J/ψ in O-O collisions at mid-rapidity. The v_2 values are extracted in several transverse-momentum and centrality intervals using the scalar product method. Comparing this measurement to existing results from larger collision systems allows us to probe the scaling of quarkonium collectivity with system size.

The talk will cover the analysis procedure, including signal extraction, and flow determination, as well as the resulting J/ψ elliptic flow values.

Supported by BMFTR.

HK 23.7 Wed 15:30 PHIL C 301

Collective effects in O-O and Ne-Ne collisions from a hybrid approach — •Lucas Constantin[1], Carl B. Rosenkvist[1], Niklas Goetz[1], and Hannah Elfner[3,1,2,4] — [1]Goethe University Frankfurt, Department of Physics, Institute for Theoretical Physics, 60438 Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum f*ur Schwerionenforschung, 64291 Darmstadt, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, 60438 Frankfurt am Main, Germany

Many features of heavy-ion collisions are well described by hybrid approaches, where the droplet of strongly coupled quark gluon plasma (QGP) is modeled by hydrodynamics and the subsequent dilute stage is performed with a hadronic transport model. Conventionally, the formation of a QGP is well established in larger collision systems like Lead and Gold. However, hints of collectivity were found even in proton-proton collisions, raising the question where the onset of QGP formation lays. This study aims at making predictions for the light ions run at the LHC in July 2025, in order to explore the applicability of hybrid approaches in smaller collision systems. We employ three different models, the SMASH-vHLLE-hybrid approach, the pure hadronic cascade of SMASH and Angantyr to simulate O-O collisions at a center of mass energy of * sNN=5.36TeV. This setup allows us to compare evolutions with and without a hydrodynamic description on an equal basis, while Angantyr serves as a baseline for no collective effects.

HK 24: Heavy-Ion Collisions and QCD Phases IV

Time: Wednesday 13:45–15:45 Location: PHIL A 401

Group Report HK 24.1 Wed 13:45 PHIL A 401

Diquark Properties from First Principles and Their Impact on Color Superconducting Matter — Hosein Gholami[1], •Ugo Mire[2], Fabian Rennecke[2,3], Bernd-Jochen Schaefer[2,3], and Shi Yin[2] — [1]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, Theoriezentrum, Darmstadt, Germany — [2]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, Gießen, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, Gießen, Germany

Recent neutron star observations demand increasingly precise equations of state at extreme densities where exotic phases of matter may appear. An intriguing candidate is color superconductivity, in which quarks pair into diquarks that condense, making a first-principles understanding of diquark dynamics essential for interpreting astrophysical data. In this talk I will present results for the vacuum properties of the scalar diquark in a self-consistent and first-principle approach to QCD. Using the functional renormalization group, I will show how the high energy quark and gluon degrees of freedom can be smoothly integrated resulting in a low-energy description in terms of mesons and diquarks. I will show that our approach predict a scalar diquark bound state, consistent with the quark-diquark picture of the nucleon. Finally, I will demonstrate how these results can constrain low-energy models of color superconductivity, yielding new insights into the equation of state of cold and dense quark matter.

HK 24.2 Wed 14:15 PHIL A 401

Renormalization-Group Invariant Parity-Doublet Model for Nuclear and Neutron-Star Matter — •Mattia Recchi[1], Lorenz von Smekal[1,2], and Jochen Wambach[3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Giessen — [3]Technische Universität Darmstadt, 64289, Darmstadt, Germany

The Parity-Doublet Model (PDM) is a chirally invariant effective theory for nuclear matter that incorporates a chirally invariant mass through opposite-parity partners. We develop a multiplicatively renormalizable mean-field approach to include baryonic vacuum contributions in the grand-canonical potential in a manifestly renormalization-group invariant form. We study the chiral dynamics and equation of state of the model, focusing on the restoration of spontaneously broken chiral symmetry at baryon densities and temperatures relevant for neutron-star astrophysics and heavy-ion collisions. We find that baryonic vacuum fluctuations have a crucial impact on the evolution of the chiral condensate and are essential for a realistic description of neutron-star structure.

HK 24.3 Wed 14:30 PHIL A 401

Neutron Star Properties with Skyrme Potentials from Relativistic Heavy-Ion Physics — •Eleonora Foerster, Sarah Pitz, Selina Kunkel, Ishfaq Rather, and Jürgen Schaffner-Bielich — Goethe Universität, Frankfurt am Main, Germany

The study of ultra-dense matter created in relativistic heavy-ion collisions provides important constraints on the nuclear equation of state (EoS), which is a key input for modeling neutron stars. In this contribution, we explore the mutual interplay between EoS constraints extracted from heavy-ion flow measurements and observational mass-radius constraints of neutron stars. Using a Skyrme-based EoS constrained by heavy-ion data, mass-radius relations for symmetric nuclear matter and pure neutron matter are calculated and compared to current neutron-star observations. The focus is on investigating how specific properties of the nuclear interaction, in particular the nuclear incompressibility K, influence neutron-star observables such as the maximum mass and radius. Variations of K lead to noticeable changes in the predicted maximum mass, demonstrating the connection between neutron star observables and contraints on the EoS by heavy-ion physics.

HK 24.4 Wed 14:45 PHIL A 401

Global Lambda Polarization in Au+Au collisions at 0.8 AGeV measured with HADES — •Florian Alef for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

In heavy-ion collisions, large angular momenta are generated which might translate to a spin polarization of the produced particles. Extracting the spin orientation of an outgoing proton from a weakly decaying Λ hyperon with respect to the reaction plane could probe a global polarization and be a hint for high vorticities in the early stages of the collision. Measurements of the Λ polarization by HADES and STAR collaboration both indicate a strong enhancement towards lower beam energies, reaching $\langle P_\Lambda\rangle(\%) = 4.4 \pm 0.3\,(\text{stat.}) \pm 0.4\,(\text{sys.})$ in Ag+Ag collisions at $\sqrt{s}_{\text{NN}} = 2.55\,\text{GeV}$, which corresponds to the free NN Λ production threshold.
This contribution will report on the status of the Λ polarization in Au+Au collisions at $\sqrt{s}_{\text{NN}} = 2.25\,\text{GeV}$ measured with HADES, which is the first Λ polarization measurement below the production threshold.

HK 24.5 Wed 15:00 PHIL A 401

Strangeness fluctuations in the HADES experiment* — •Athira Sreejith for the HADES-Collaboration — Bergische Universität Wuppertal, Wuppertal, Deutschland

Fluctuations of conserved charges such as baryon number, electric charge, and strangeness are effective probes of the QCD phase diagram. Their higher-order cumulants are particularly sensitive to critical phenomena and remain an important focus of current heavy-ion research.

In this work, an exploratory study of strangeness fluctuations in Ag+Ag collisions at $\sqrt{s_{NN}}$= 2.55 GeV, measured with the High Acceptance Di-Electron Spectrometer (HADES), a fixed-target experiment at GSI, Germany, is presented. Operating in the 1*2A GeV regime, HADES accesses QCD medium at high net-baryon density and low temperature, providing complementary coverage to higher-energy programs. The very low strange-hadron yields at these energies, especially for kaons, necessitate robust particle identification. Therefore, a fuzzy-logic-based probabilistic technique is employed to reconstruct strange-hadron multiplicity moments.

This contribution focuses on the feasibility study of strangeness fluctuations at HADES, including the identification and reconstruction performance for strange particles, and the resulting cumulants of their multiplicity distributions.

*This work is supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P24PX1).

HK 24.6 Wed 15:15 PHIL A 401

Proton and light nuclei yields and E-by-E fluctuations measured at HADES — •Marvin Nabroth — Goethe-University Frankfurt

Low energy heavy-ion collisions in the 1 AGeV regime, as studied by the HADES experiment at SIS18/GSI, allow to probe QCD matter under highest net-baryon densities and moderate temperatures.
In this contribution we present refined efficiency corrected transverse and longitudinal yield spectra of protons, deuterons, tritons, He3 reconstructed from Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV and $\sqrt{s_{NN}} = 2.42$ GeV measured at HADES in 2019. We discuss the spectral shape properties and the coalescence behavior as a function of centrality, as well as the beam-energy dependence. These results contribute to a better understanding of the formation of light nuclear clusters, and help constrain the freeze-out conditions via thermal-model fits. Furthermore, we present an update of the analysis of higher order moments of the e-by-e fluctuations of the proton yields in different rapidity windows. Such fluctuation observables are essential for exploring signs of criticality expected from the conjectured first-order phase transition or critical end point.
This work has been supported by BMBF (05P21RFFC2, 05H24RF5), GSI and HGS-Hire.

HK 24.7 Wed 15:30 PHIL A 401

Lambda reconstruction at SIS18: a mCBM campaign — •Abhishek Anil Deshmukh for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Deutschland

The production of strange hadrons, such as the Λ particle, serves as a standard candle for probing the properties of dense nuclear matter created in heavy-ion collisions at SIS18 energies at GSI, Darmstadt. The mini-CBM (mCBM) experiment, a prototype for the upcoming CBM experiment, allows for these measurements. Its narrow acceptance, combined with the lack of magnetic field present a unique challenge, rendering the reconstruction of multi-particle decay topologies particularly difficult.

This contribution presents the reconstruction of Λ particles via their dominant charged hadronic decay channel $\Lambda \rightarrow p + \pi^-$ (63.9%). The method has been successfully developed, tested, and optimized on Monte Carlo simulations, where its performance and selection criteria have been thoroughly characterized.

The mCBM collaboration conducted beamtime campaigns in 2024 and 2025, collecting a total of six datasets with various beam and energy combinations. This contribution will present the status of applying the validated analysis technique to experimental data from the Ni+Ni collisions at 1.93A GeV. A first look at the Λ signal will be provided, and the preliminary performance of the reconstruction algorithm on real data will be discussed in comparison to the simulation.
*Work supported by BMBF (05P24PX1)

HK 25: Nuclear Astrophysics III

Time: Wednesday 13:45–15:30 Location: PHIL A 602

Group Report HK 25.1 Wed 13:45 PHIL A 602

Collisional Radiative Data for non-LTE Kilonova Radiative Transfer — •Andreas Flörs[1], Ricardo Silva[2], and Gabriel Martínez-Pinedo[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Laboratório de Instrumentação e Física Experimental de Partículas (LIP), Lisboa, Portugal

Recent infrared spectroscopy from the James Webb Space Telescope (JWST) has transformed kilonova studies, with detailed nebular-phase spectra now available for AT 2023vfi, the second spectroscopically observed kilonova and the counterpart to GRB 230307A. Observations reveal rich mid-infrared emission, with features tentatively attributed to r-process elements such as tellurium. These data extend well beyond what was possible for the first kilonova AT2017gfo and highlight the need for robust atomic and collisional data to interpret kilonova spectra in the non-local thermodynamic equilibrium (non-LTE) regime.

Non-LTE radiative transfer modelling of kilonovae relies on comprehensive collisional-radiative datasets, including electron impact excitation and forbidden transitions for heavy ions. In this talk, I will present calibrated large-scale collisional-radiative atomic structure calculations for lanthanide ions, and show how their inclusion in radiative transfer models improves agreement with JWST observations of AT2023vfi. These results enable more robust elemental abundance determinations and provide new constraints on r-process nucleosynthesis.

AF and GMP acknowledge support by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (ERC Advanced Grant KILONOVA No. 885281).

HK 25.2 Wed 14:15 PHIL A 602

Analysis of Coulomb Breakup of Clustered Nuclei for the Determination of Radiative Capture Cross Sections: The case of $\alpha(d,\gamma)^6Li$ — •Monica Sanjinez Ortiz and Pierre Capel — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, D-55099 Mainz, Germany

In the study of nucleosynthesis, the cross section of radiative capture reactions involving charged particles plays a fundamental role. However, the direct experimental measurement of these cross sections is difficult at low energy. Coulomb breakup of nuclei on a heavy target has been considered as an alternative method to infer the low-energy cross sections in an indirect way, as it can be understood as the time reversed process of radiative captures. Two Coulomb breakup experiments to infer the $\alpha(d,\gamma)^6Li$ radiative capture cross section have been performed in the past. With a fully dynamical reaction model, we report here on a new theoretical analysis of these experiments. Our results indicate that the breakup of ^6Li onto ^{208}Pb at 150 A MeV and 26 A MeV is characterized by marked Coulomb-nuclear interferences. Moreover, the analysis points towards a nuclear dominated process at forward angles as Coulomb breakup is suppressed due to the α-d clustered structure of ^6Li. Consequently, extracting radiative capture cross sections from data at these energies is unfeasible. The forward Coulomb breakup suppression may be a general feature of breakup processes involving N=Z clustered nuclei. We underscore the importance of alternative indirect methods for the determination of cross sections for astrophysics such as photodissociation induced by electrons.

HK 25.3 Wed 14:30 PHIL A 602

Simulation and Analysis of Three-α Decay in ^{12}C with Geant4 — •Timo Biesenbach[1], David Werner[1], Peter Reiter[1], Alessandro Salice[1], Joe Roob[1], Konrad Arnswald[1], Maximilian Droste[1], Madalina Enciu[3], Pavel Golubev[2], Hannah Kleis[1], Nikolas Königstein[1], Dirk Rudolph[2], and Luis Sarmiento[2] — [1]University of Cologne, Institute for Nuclear Physics, Cologne — [2]Lund University, Department of Physics, Lund, Sweden — [3]TU Darmstadt, Institute of Nuclear Physics, Darmstadt

The branching ratios of direct and sequential three-α decay modes of the 0_2^+ Hoyle state in ^{12}C provide a sensitive probe of its internal structure and play a key role in our understanding of stellar nucleosynthesis. A high-statistics experiment was conducted at the 10 MV FN Tandem Accelerator at the University of Cologne using inelastic scattering via the $^{12}C(\alpha,\alpha')$ reaction at an incident energy of 27 MeV. The decay products were detected with the Lund–York–Cologne Calorimeter, which combines high angular resolution with large acceptance of Si strip detector arrays. To enable a precise interpretation of the data, the experiment was modelled within the Geant4 Monte Carlo framework. The simulation incorporates the full experimental geometry, detector response, beam characteristics, target properties, and relevant physical processes. By performing a detailed comparison between the measured observables and the simulated decay scenarios, the branching ratio of the direct decay component is extracted. These results provide constraints on the three-body decay dynamics of the Hoyle state.

HK 25.4 Wed 14:45 PHIL A 602

Proof-of-principle neutron photo-dissociation measurement in the ^{7}Li(e,e'n)^{6}Li reaction — •Davud Sokolovic[1], Jan Butz[1], Pierre Capel[2], Tanja Heftrich[1], Michael Heil[3], Carolin Grün[1], Samira Ikerkourn[1], Felix Panholzer[1], and Concettina Sfienti[2] — [1]Goethe-Universität, Frankfurt am Main, Deutschland — [2]Johannes Gutenberg-Universität, Mainz, Deutschland — [3]GSI, Darmstadt, Deutschland

As neutron capture processes are fundamental to our understanding of the element abundance distribution in the universe, measurements of (n, γ) in direct kinematics are essential. For many nuclei, these measurements are not easily accessible due to low reaction rates or strong backgrounds from competing channels. Thus, time-reversed reactions induced by virtual photons provide a complementary approach to determine neutron capture cross sections via detailed balance.

In this talk, the concept and first steps of a proof-of-principle neutron photo-dissociation measurement in the ^{7}Li(e, e′n)^{6}Li reaction at the Mainz Microtron (MAMI) are presented including GEANT4 simulation studies used to map electromagnetic and photonuclear backgrounds and to optimise the placement of a lithium-glass neutron detector.

The kinematic strategy is chosen to mimic an *s*-wave entrance channel into a *p*-wave bound state, favouring an $E1$ transition to the ground state. In view of these requirements, DICEBOX simulations are performed to estimate ground-state branching ratios and identify further target candidates. The status of the analysis will be reported.

HK 25.5 Wed 15:00 PHIL A 602

Investigating BBN cross sections: Characterization of the DT neutron generator in Dresden and the new ASTRO beam line — •Max Osswald[1], Daniel Bemmerer[2], Björn Lehnert[1], Steffen Turkat[1], Frederik Uhlemann[1], and Kai Zuber[1] — [1]TU Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

The Deuterium-Tritium neutron generator of TU Dresden can provide several milliamperes of proton and deuteron beams with energies of up to 350 keV. So far the accelerator was used to generate monoenergetic 14 MeV neutrons for fusion research via the ^{3}H$(d,n)^{4}$He reaction with up to 10^{12} n/s.
This contribution will present the feasibility studies and modifications required to transform this neutron production facility into a laboratory, which in addition will also be used for nuclear astrophysics, i.e. investigations of reactions relevant for Big Bang Nucleosynthesis (BBN). Key parameters such as beam characterization, energy calibration, and operational limits will be reported, providing the basis for future high-precision cross-section measurements. In addition, the new ASTRO beam line and the collaborative effort to use the ELISSA silicon strip detector array in Dresden will be introduced for the first time. These upgrades enable forthcoming studies of the $d(d,p)^{3}$H and $d(d,n)^{3}$He reactions, which currently limit our understanding of the primordial deuterium abundance in BBN models.

HK 25.6 Wed 15:15 PHIL A 602

Geant4 simulation towards the measurements of ^{2}H$(d,p)^{3}$H and ^{2}H$(d,n)^{3}$He reactions at the DT generator of TU Dresden — •Frederik Uhlemann, Björn Lehnert, Max Osswald, Steffen Turkat, and Kai Zuber — Institut für Kern- und Teilchenphysik, TU Dresden

The ^{2}H$(d,p)^{3}$H and ^{2}H$(d,n)^{3}$He reactions are critical for determining the primordial deuterium abundance D/H after Big Bang nucleosynthesis. Improved cross section data for these channels would reduce the uncertainty on the cosmic baryon density $\Omega_b h^2$. The resulting value could reach a precision comparable to that of the CMB, while remaining fully independent. This would improve our understanding of early universe physics and provides a powerful cross-check for entirely independent fields of (astro-)physics.
The Deuterium-Tritium neutron generator of TU Dresden is a unique facility in Europe that was mainly used for fusion research so far. Based on its new ASTRO beam line, this facility will be capable to measure these two reaction channels from 10 keV to 350 keV, which covers the entire energy range relevant for BBN. Measurements of the two deuterium reactions using solid targets are planned. This talk will focus on Geant4 simulations for this campaign, with a focus on the setup, utilized targets and detectors.

HK 26: Instrumentation V

Time: Wednesday 13:45–15:30 Location: PHIL A 301

HK 26.1 Wed 13:45 PHIL A 301

Development of a Scintillating Fiber Hodoscope for the Proton Radius Measurement at AMBER — •Karl Eichhorn[1], Jan Michael Friedrich[1], Jarosław Grzyb[2], Igor Konorov[1], Martin J. Losekamm[3], Tim Maehrholz[1], Felix Mindl[1], Stephan Paul[1], Marcin Stolarski[2], and Frowin Wild[1] — [1]TUM School of Natural Sciences - Technical University of Munich, 85748 Garching, Germany — [2]National Centre for Nuclear Research, 02-093 Warsaw, Poland — [3]European Space Agency, ESTEC, 2201 AZ Noordwijk, Netherlands

The AMBER experiment will measure the proton charge radius using elastic muon-proton scattering at the M2 beam line at CERN. Four Scintillating Fiber Hodoscopes (SFHs) will be used in combination with ALPIDE pixel sensors to reconstruct the incoming beam particles, as well as the muons that have been scattered off the active hydrogen target. Each SFH consists of four 9x9 cm^2 large planes of square scintillating fibers, which are read out individually with SiPM arrays. Keeping the material budget to a minimum, they provide precise timing information using custom readout electronics based on the Citiroc 1A ASIC and the AMBER iFTDC. The first SFH detector was built and successfully tested with a high-energy muon beam in 2025. We will present the results of this beam test and provide an outlook on further developments.

We acknowledge funding from BMBF (grant number 05P24WO1) and MNiSW (grant number 2025/WK/03).

HK 26.2 Wed 14:00 PHIL A 301

Heavy-ion tracking detector at R^{3}B — •Isabelle Brandherm[1], Christoph Caesar[2], Pablo García-Gil[2,3,4], Michael Heil[2], Deniz Savran[2], and Andreas Zilges[1] for the R3B-Collaboration — [1]Institute for Nuclear Physics, University of Cologne, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany — [3]Universidad de Vigo, Vigo, Spain — [4]Institute for Nuclear Physics, Technical University of Darmstadt, Germany

The R^{3}B (Reactions with Relativistic Radioactive Beams) experiment at GSI is a versatile setup that enables kinematically complete measurements. Tracking detectors are used at R^{3}B to reconstruct the trajectories of charged particles as they pass through the magnetic field of the the GSI Large Acceptance Dipole (GLAD) magnet. This allows the magnetic rigidity of the particles to be determined.

This talk presents the design and performance of a position-sensitive scintillation-fiber detector that will be a part of the tracking system for heavy ions. The detector is constructed from ultra-thin scintillation fibers with a thickness of 200μm. Thin fibers are used to minimize the material budget in the particle trajectory and thus reduce straggling within the detector material. The fibers are read out with silicon photomultipliers, allowing the detector to operate in magnetic fields while maintaining high detection efficiency.

Gefördert durch das Ministerium für Kultur und Wissenschaft des Landes Nordrhein-Westfalen

HK 26.3 Wed 14:15 PHIL A 301

Study of a low-temperature SiPM readout system for DarkMESA — •Christian Stoss for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The existence of dark matter remains one of the most significant open questions in particle physics. The DarkMESA experiment aims to search for light dark matter (LDM) in an unexplored mass and coupling regime. This parasitic beam dump experiment will be located downstream of the P2 experiment at the new MESA accelerator in Mainz. It is planned to operate for several thousands of hours in extracted beam mode, using a 150 μA electron beam with an energy of 155 MeV. In the simplest model of LDM, the electrons might produce the dark photon as a massive vector particle via a Bremsstrahlung-like process in the beam dump, which then decay into dark matter particles. If LDM exists within the targeted parameter space, a fraction of the produced LDM will scatter off electrons in one of the calorimeters' Cherenkov crystals, generating a measurable signal.

Given the low probability of such an event, dark counts can significantly overlay the interesting signal. This presentation will focus on a feasibility study for a readout system consisting of one PMT with additional 5 cooled SiPMs per crystal as a small test setup. Initial measurements with a constant overvoltage and temperature dependent breakdown voltage will be presented. The aim is the reduction of dark counts while maintaining high detector efficiency for different temperatures.

HK 26.4 Wed 14:30 PHIL A 301

Feasibility Study on a Backward Angle Sampling Calorimeter for the P2 Experiment at MESA — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], •Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Frank Maas[1,2,3], Antoine Martinet[1], Oliver Noll[1,2], Paul Schöner[1], Christoph Rosner[1], Pierre Vijayan[1], and Sahra Wolff[1] — [1]Helmholtz-Institut Mainz, Mainz, Germany — [2]Institute of Nuclear Physics, Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Mainz, Germany

A sampling calorimeter with SIPM read-out for the detection of high energy particles is under development. Such a calorimeter can be well suited for many experiment applications where space limitations apply. The main focus is on choosing the right material, as well as the right arrangement of active and passive material. Different mechanical options will be explored. The detector prototype design will be prepared by doing detector response simulations to ensure a high energy resolution, as well as a high spatial resolution. A possible application for such a calorimeter is the P2 experiment at the upcoming MESA accelerator in Mainz. The talk will give an update on the progress of this project.

HK 26.5 Wed 14:45 PHIL A 301

A new Liquid Scintillator Veto System for Rare Event Searches — •Michail Kontogoulas for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

In the ongoing search for light dark matter, the DarkMESA and NuDoubt^{++} experiments have combined their efforts to probe a new region of parameter space. DarkMESA is a forthcoming electron beam dump experiment to be located in the new MESA accelerator facility in Mainz, designed to detect light dark matter particles using a PbF_2 crystal calorimeter. The NuDoubt^{++} experiment will utilize an opaque liquid scintillator detector to investigate the double beta decay ($2\beta^+$) and the neutrinoless double beta decay ($0\nu\beta\beta$). Due to the expected rarity of these interactions, exceptional background rejection is crucial for identifying potential events. Therefore, both experiments plan to use passive and active shielding layers against background radiation. This contribution will focus on the development of a liquid scintillator veto prototype for use in both experiments. The prototype will feature a hexagonal geometry with an active volume of approximately $0.351\,\mathrm{m}^3$, filled with a linear alkylbenzene (LAB) scintillator, doped with 0.2wt.% Gadolinium for enhanced neutron tagging. The scintillator will be read out by seven 5-inch PMTs mounted on the top surface of the volume. A comparative analysis will be presented, comparing simulation results with initial tests of the prototype to evaluate veto efficiency, with particular emphasis on neutron rejection, given their significance as a background in dark matter searches.

HK 26.6 Wed 15:00 PHIL A 301

Construction of the crystal Zero Degree Detector for BESIII — •Frederic Stieler, Achim Denig, Peter Drexler, Werner Lauth, Max Lellmann, Jan Muskalla, Jannik Petersen, Saskia Plura, Christoph Florian Redmer, Yasemin Schelhaas, and Hang Zhou — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The crystal Zero Degree Detector (cZDD) is an addition to the BESIII experiment in China. In order to measure hadronic cross sections with the Initial State Radiation (ISR) method for a more precise calculation of the hadronic vacuum polarization contribution to the anomalous magnetic moment of the muon, ISR photons have to be detected. Since these photons are mostly emitted at small angles in relation to the colliding particles, the cZDD will measure these photons at angles of about 1.5 mrad to 10.4 mrad, which are not covered yet by the already existing detectors at BESIII.

Following its installation at BESIII, first commissioning data have been taken. The detector is now being used to perform relative-luminosity measurements, allowing an evaluation of its performance and stability under real experimental conditions.

This contribution discusses the current status of the cZDD, covering its installation, commissioning, and the first results of the relative-luminosity measurements.

HK 26.7 Wed 15:15 PHIL A 301

Studies of Cosmogenic Backgrounds in a Shielded Crystal Calorimeter for DarkMESA — •Shumit Mitra — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

DarkMESA is a planned electron beam-dump experiment at the MESA accelerator facility in Mainz, designed to search for light dark matter particles mediated by a hypothetical dark photon γ' using a compact crystal calorimeter. Due to the extremely low expected interaction rates of beyond-the-Standard-Model processes, efficient background suppression is essential. DarkMESA therefore relies on a combination of passive and active shielding to mitigate cosmogenic and beam-related backgrounds. This contribution presents the development and characterization of a prototype calorimeter composed of 5×5 $PbWO_4$ crystals of dimensions $2\times2\times20\,\mathrm{cm}^3$ with single-sided SiPM readout per crystal. The calorimeter is hermetically surrounded by inner and outer plastic scintillator veto layers and passive lead shielding. The detector performance with respect to cosmogenic muon- and gamma-induced backgrounds in the relevant energy range around 5 MeV and above is discussed and compared to detailed simulations. First results from long-term background measurements with the full detector setup are presented. Possible contributions from cosmogenic neutrons are briefly addressed. Finally, an outlook on the implications of these studies for a $PbWO_4$-based DarkMESA detector is given.

HK 27: Poster Session

Time: Wednesday 16:15–18:30 Location: Redoutensaal

HK 27.1 Wed 16:15 Redoutensaal

Latest Progress Concerning the Front-End Electronics Prototype for the $\overline{\mathrm{P}}\mathrm{ANDA}$ Barrel EMC — •Aniko Tim Fenske, Kai-Thomas Brinkmann, Hans-Georg Zaunick, and Karl Simon Habermehl for the PANDA-Collaboration — 2nd Physics Institute, Justus Liebig University, Giessen, Germany

The barrel section of the PANDA electromagnetic calorimeter (EMC) at the future FAIR facility is designed to precisely measure photon and charged particle energies over a wide dynamic range. Achieving the targeted performance requires not only a carefully engineered detector system but also a detailed understanding of its operational behavior under realistic conditions.

Therefore, recent efforts have concentrated on an in-depth analysis of calibration data and functional tests of the readout and front-end electronics. Building on results from the current prototype setup, a comprehensive evaluation of in-beam measurements and laboratory studies has been carried out, with particular attention to the stability, linearity, and noise characteristics of the system. This contribution summarizes the latest findings of these analyses and discusses their implications for the final configuration of the Barrel EMC.

Supported by the BMFTR, GSI and HFHF.

HK 27.2 Wed 16:15 Redoutensaal

Accessing transverse momentum dependent distribution functions with semi-inclusive deep inelastic single pion and kaon production — •Stefan Diehl[1,2] and Aron Kripko[1] for the CLAS-Collaboration — [1]II. Physikalisches Institut, JLU Gießen, Gießen, Germany — [2]University of Connecticut, Storrs, CT, USA

Semi-inclusive deep inelastic scattering is a well-established tool to study TMDs and fragmentation functions. With the CLAS12 detector at Jefferson Laboratory (JLab), precise, multidimensional measurements of cross sections and asymmetry observables become possible in the valence quark regime for the first time. Based on the new high statistics data, the polarized structure-function ratio $F_{LU}^{sin\phi}/F_{UU}$, as well as the un-polarized cross section modulations $F_{UU}^{cos\phi}$ and $F_{UU}^{cos2\phi}$ were studied for single pion and kaon SIDIS. The contribution will present a comprehensive multidimensional study for all three pions as well as positive kaons and discuss the connection of the observable to

TMDs and the impact of the new data on our understanding of the involved TMDs and their flavour separation. *The work is supported by Deutsche Forschungsgemeinschaft (Project No. 508107918).

HK 27.3 Wed 16:15 Redoutensaal

Correction of the recoil attenuation in a plunger stopper foil — •Deniz Oyan, Volker Werner, Hannes Mayr, Clemens Nickel, Katharina Ide, and Norbert Pietralla — IKP, TU Darmstadt

Measurements applying the recoil-distance Doppler-shift method [1] at high recoil velocities of around 5 % v/c are prone to suffer from partially overlapping stop and flight components, due to the slowing-down process in the stopper. The Doppler-shifted γ-ray energy of the de-excitation is governed by the ion's velocity distribution. Thus, the flight component cannot be distinguished from the Doppler tail of the (usually denoted "unshifted") component from ions having reached the stopper by simple Gaussian fits. To disentangle both components a simulation using the DSAM analysis software APCAD [2] is performed.

Accurate knowledge on lifetimes of excited states of ^{104,106,108}Pd is necessary to precisely determine E2 transition strengths and g factors in this region of the nuclear chart. Therefore, our simulation is conducted on a dataset of the Pd isotopes from WNSL, Yale University [3]. This contribution presents the applicability of our method to correct for the attenuation in the stopper foil.

[1] A. Dewald *et al.*, Prog. Part. Nucl. Phys. **67**, 786-839 (2012)
[2] C. Stahl *et al.*, Comput. Phys. Commun. **214**, 174-198 (2017)
[3] V. Werner *et al.*, J. Phys.: Conf. Ser. **366**, 012048 (2012)

HK 27.4 Wed 16:15 Redoutensaal

The young High Energy Physicists Association (yHEP) — Farah Afzal[1], Judita Beinortaite[2], Julian Gethmann[3], Simran Gurdasani[4], Meike Küssner[1,5], •Michael Lupberger[5,6], Leonel Morejon[7], Leoniedas Reschke[8], and Srijan Sehgal[7] — [1]Ruhr University Bochum — [2]DESY — [3]Karlsruhe Institute of Technology — [4]University of Berlin — [5]University of Bonn — [6]University of Freiburg — [7]University of Wuppertal — [8]University of Giessen

The young High Energy Physicists Association(yHEP) represents non-permanent scientists within the German and international particle, astroparticle, hadron, nuclear, and accelerator physics communities. Its members range from bachelor and master students to PhD candidates, postdocs, and junior group leaders. The association works to improve working conditions, research support, and career perspectives for early-career researchers. yHEP strengthens the involvement of young scientists in scientific and political decision-making processes, aiming to build broad consensus and to ensure that every voice is heard. This poster introduces the structure and goals of yHEP and provides information on how interested researchers can engage with the community. Meet your yHEP management board representatives at the poster to discuss your topics or to hear what yHEP does for you and how you can get involved.

HK 27.5 Wed 16:15 Redoutensaal

Triple Nuclear Collisions in SMASH — •Luis Miguel Vélez[2], Lucas Constantin[2], and Hannah Elfner[1,2,3,4] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [2]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [3]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, Max-von-Laue-Strasse 12, 60438 Frankfurt am Main, Germany

One goal of binary heavy-ion collisions is to study strongly interacting matter under extreme conditions e.g. at a high baryon density. Nevertheless, an even higher density can be accomplished by colliding three nuclei instead of two in a Triple Nuclear Collision (TNC). In this work, the process of simulating a TNC with the use of the hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) is presented. Furthermore, the observables for particle production of central Pb+Pb+Pb TNCs at energies between 3 GeV and 20 GeV are examined. Simultaneously, these findings are compared with those of binary Pb+Pb collisions with the same respective energy and centrality. Finally, it is shown that a TNC leads to a higher baryon and energy density than in binary collisions, thus exposing a promising method to better understand QCD matter.

HK 27.6 Wed 16:15 Redoutensaal

Advances in Readout Electronics and Calibration for the PANDA Micro Vertex Detector — •Marvin Peter[1], Kai-Thomas Brinkmann[1], Raphael Ratz[1], Hans-Georg Zaunick[1], Michele Caselle[2], Daniela Calvo[3], and Giovanni Mazza[3] for the PANDA-Collaboration — [1]2nd Physics Institute Justus Liebig university Giessen — [2]Karlsruhe Institute of Technology — [3]Istituto Nazionale di Fisica Nucleare - Sezione di Torino

The Micro Vertex Detector (MVD) forms the innermost tracking layer of the PANDA experiment, positioned closest to the interaction point. Silicon strip sensors are read out by the Torino Amplifier for silicon Strip detectors (ToASt) ASIC, a 64-channel self-triggered chip based on the Time-over-Threshold principle, developed by INFN Turin. In this contribution, we present recent advancements including the implementation of a new test bench and a comprehensive calibration framework for the ToASt ASIC based on the readout system provided by KIT. Results from calibration measurements with radioactive sources are discussed. *Supported by BMFTR.*

HK 27.7 Wed 16:15 Redoutensaal

Simulation study of π^0 flow contribution to direct photon HBT measurement — •Luis Escalante — Institut für Kernphysik, Goethe-Universität Frankfurt

In heavy-ion collisions at the CERN-LHC, a new state of matter, the quark-gluon plasma (QGP), can be created to examine its properties, such as the temperature and spatio-temporal evolution. One approach to probe these properties is the measurement of Bose-Einstein correlations of direct photons using HBT interferometry. The measurement of direct-photon HBT correlations, however, requires a highly accurate determination of background contributions. Previous studies have shown that one of the dominant background sources is contamination from the elliptic flow (v_2) of π^0 mesons. Providing a reliable estimate of this flow contribution is therefore essential for extracting the direct-photon signal.

In this poster, a simulation framework for assessing flow-induced correlations of decay photons originating from π^0 mesons is presented. The study incorporates measured π^0 yields and flow coefficients from ALICE Pb-Pb data and investigates the centrality dependence of flow contributions from decay photons. In addition, the impact of flow using the Bertsch-Pratt parametrization is explored. Based on the findings of these studies, an optimized description of mixed-event is proposed, for which the current status is presented.

Supported by BMFTR and the Helmholtz Association.

HK 27.8 Wed 16:15 Redoutensaal

Conceptual Design of a Fragment Separator for Producing Positron-Emitting Light-Ion Beams in Hadron Therapy — •Suraj Kumar Singh[1,2], Bernhard Franczak[1], Christoph Scheidenberger[1,2,3], Daria Kostyleva[1], Emma Haettner[1], and Sivaji Purushothaman[1] for the Super-FRS Experiment-Collaboration — [1]GSI Helmholtzzentrum for Schwerionenforschung GmbH, Darmstadt — [2]II. Physikalisches Institut, JLU, Gießen — [3]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen

Recent advances in hadron therapy have stimulated growing interest in the use of light, positron-emitting ion beams as an alternative to conventional heavy ions such as ^{12}C. These radionuclides-produced efficiently through projectile fragmentation and in-flight separation-offer half-lives and production yields well suited for in-beam positron emission tomography (PET), enabling improved real-time verification of beam range during treatment. In this poster, a conceptual design for a fragment separator optimized to deliver such therapeutic positron-emitting light ions will be presented. The system integrates a production target with a sequence of dipole and quadrupole magnets, energy-loss degraders, and time-of-flight diagnostics to perform Bρ-ΔE-ToF particle identification and achieve high beam purity and tunability. This design provides a flexible platform capable of supplying a range of clinically relevant positron-emitting isotopes, supporting enhanced imaging-guided dose delivery and paving the way for more precise and adaptive cancer treatment modalities.

HK 27.9 Wed 16:15 Redoutensaal

New Rutherford Backscattering Spectrometry chamber for experimental nuclear astrophysics in Cologne — •Benedikt Machliner, Martin Müller, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

Understanding the formation of the elements in the universe is one of the ultimate objectives of nuclear astrophysics. In order to gain a more profound understanding of the complex processes involved in nucleosynthesis, it is crucial to consider the input from all constituents of this highly interdisciplinary field. Key observables, that experimental nuclear physics can contribute, include cross sections and reaction rates, which are indispensable for constraining model calculations.
In order to experimentally determine absolute reaction cross sections, it is necessary to know the number of target nuclei per unit area with sufficient precision. A method that is frequently utilized to determine the areal density - i.e. the target thickness - is Rutherford Backscattering Spectrometry (RBS). This work presents the new RBS chamber of the Institute for Nuclear Physics at the University of Cologne, which can be attached to both of the institute's accelerators, namely the 10 MV FN Tandem and 6 MV Tandetron accelerator [1]. The recent experimental campaign demonstrates a substantial enhancement in efficiency, attributable to the advanced instrumentation, without any compromise in precision, as suggested by preliminary data.
Supported by the DFG (ZI 510/12-1).
[1] A. Dewald *et al.*, Nucl. Instrum. Methods B **294** (2013) 18-23

HK 27.10 Wed 16:15 Redoutensaal

Improving the ALPACA particle-gamma spectrometer for telescope based particle identification — •Nick Marx, Markus Müllenmeister, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

Studying nuclear reactions requires precise particle identification (PID) [1], especially when multiple particles are generated in similar energy regions. The current work assesses the capabilities of Passivated Implanted Planar Silicon (PIPS) detectors operating in a telescope configuration, similar to the setup used in the SONIC@HORUS array [2]. The objective is to determine whether it is capable of accurately distinguishing between protons, deuterons, and tritons and whether the resolution is improved by new thin detectors. The detector performance was tested using deuteron beams at 10*MeV and 18*MeV at the FN Tandem accelerator of the University of Cologne. Measurements included both scattering and nuclear reactions on a ^{197}Au target in the ALPACA scattering chamber [3] to evaluate energy resolution and particle identification under realistic experimental conditions. First results demonstrate the achievable energy resolution and PID performance. These findings allow a direct comparison and evaluation of the improved detector setup for upcoming experiments.
[1] G. F. Knoll, *Radiation Detection and Measurement*, 4th ed., Wiley, Hoboken (2010).
[2] S. G. Pickstone et al., Nucl. Instr. and Meth. A **875** (2017) 104.
[3] G. Huppelsberg, Master*s thesis, University of Cologne (2024).

HK 27.11 Wed 16:15 Redoutensaal

Investigation of the decay $\chi_{c2} \to K^+K^-\eta'$ and search for the exotic K_1^* at the BESIII Experiment — •Anna Tsias, Achim Denig, and Nils Huesken — Johannes Gutenberg-Universität Mainz

The BESIII experiment provides an opportunity to investigate χ_{cJ} decays occurring in radiative $\Psi(2S)$ transitions, thanks to its large data sample of $(2259.3 \pm 11.1) \times 10^6$ $\psi(2S)$ events. Motivated by evidence for exotic mesons like the $\pi_1(1600)$, this analysis investigates χ_{c2} decays to search for exotic resonances in the strange sector. In the $K\eta'$ subsystem, there is the possibility to observe the hypothesized K_1^*, a strange member of the exotic hybrid nonet with quantum numbers $J^{PC} = 1^{-+}$. This is motivated by the observation of analogous states such as the $\pi_1(1600)$ and $\eta_1(1855)$ in similar charmonium decays. This decay channel is further of interest because it enables the study of higher-mass f_2 and f_4 mesons in the K^+K^- subsystem, several of which were last reported in the 1990s and have not been revisited with modern datasets. Additionally, the f_2 resonances observed in the K^+ K^- system are possible tensor glueball candidates, making this analysis a potential starting point for their identification.

HK 27.12 Wed 16:15 Redoutensaal

Results from parabolic flight campaigns using a compact scintillation detector — •Roman Bergert, Dzmitry Kazlou, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — 2nd Physics Institute, Justus Liebig University Giessen

A compact, low-power scintillation detector designed for environmental radiation monitoring and dosimetry applications will be presented. The detector utilizes an EJ-276D plastic scintillator, which possesses good pulse-shape discrimination (PSD) characteristics, thereby facilitating effective particle identification. The detector signal readout is performed using a Red Pitaya STEMLab 125-14 platform serving as a high-speed digitizer (125 MS/s, 14 bits resolution), combined with a bespoke high.voltage bias supply and a dual-channel silicon photomultiplier (SiPM) analog front-end readout. The two-channel analog front-end provides a high-gain path that is optimized for high resolution in the low-energy range, as well as a low-gain path that covers the high-energy range, thereby ensuring a higher dynamic range.
The fully integrated system is lightweight (<1 kg), compact (12 cm x 9 cm x 6 cm), and low-power (<8 W), rendering it highly suitable for portable, battery-powered, or autonomous operation. The detector assembly performance was evaluated during multiple parabolic flight campaigns, during which the detector operated autonomously in mixed radiation fields, acquiring complete signal waveforms for subsequent offline PSD analysis. The results are taken to discuss the feasibility of our compact, PSD-capable detector for future radiation monitoring and dosimetry missions.

HK 27.13 Wed 16:15 Redoutensaal

Double-Sided Strip LGAD Detector Performance Study in Beam Operation — •Yevhen Kozymka[1], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Matthias Kausel[5,6], Mladen Kis[3], Wilhelm Krüger[1], Sergey Linev[3], Jan Michel[3], Jerzy Pietraszko[3], Christian Joachim Schmidt[3], Michael Träger[3], Michael Traxler[3], Felix Ulrich-Pur[5], Matteo Centis Vignali[7], Ashish Bisht[7], Alfons Dehe[8], and Yuanji Tian[8] — [1]Technische Universität Darmstadt — [2]Marietta Blau Institute for Particle Physicsof the Austrian Academy of Sciences — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]EBG MedAustron — [7]Fondazione Bruno Kessler, Centre of Materials and Microsystems — [8]Hahn-Schickard-Gesellschaft für angewandte Forschung e.V.

Strip low-gain avalanche diode (LGAD) detectors have demonstrated an excellent timing and spatial resolution, making them attractive for high energy physics applications, ion computed tomography and beam diagnostics. Double-sided readout is expected to increase the tracking accuracy in medical applications with no timing precision loss, while further reducing the material budget of the system.

We present our results from performing extensive diagnostics on a double-sided LGAD with parallel strip orientation, both with self-correlation as well as using single-sided LGADs as reference, performed with proton, helium and carbon beams of varying energies.

HK 27.14 Wed 16:15 Redoutensaal

Development of a Scintillating Fiber Tracker as a Beam Monitor for Sub-Therapy Particle Rates at the Marburger Ion Beam Therapy Center — Theresa Heinz[1,2], Kai-Thomas Brinkmann[1], •Lara Dippel[1], and Hans-Georg Zaunick[1] — [1]2nd Physics Institute, Justus Liebig University Giessen, Germany — [2]D-PHYS, Institute for Particle Physics and Astrophysics (IPA)

This work presents the characterization and development of a scintillating fiber detector intended to be used as a beam monitoring system at the Marburg Ion Beam Therapy Center (MIT) for sub-therapy particle rates, where the in-house monitoring systems fail. The central focuses are the investigation of primary particle rate limitation and detector dead times, which were studied through dedicated measurements. These measurements provide performance benchmarks for future integration into various experimental setups which require lower particle rates.

Additionally, the development of the next detector version which contains more fibers and improves spatial resolution will be presented. Preparations for an FPGA-based readout system are carried out, enabling on-board logic for versatile detector operation. Geant4 simulations were carried out to validate the new detector design.

HK 27.15 Wed 16:15 Redoutensaal

Bringing Particle Physics to Metal Festivals: Impressions from the Music Forge Festival — •Aniko Tim Fenske[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Marvin Peter[1], Christian Klein-Boesing[2], and David Borgelt[2] for the Netzwerk Teilchenwelt-Collaboration — [1]2nd Physics Institute, Justus Liebig University, Giessen, Germany — [2]Institut für Kernphysik in Münster

The decreasing trust of modern society in science and scientists (becoming especially prominent during Covid pandemic) pushes scientists to find new ways of rebuilding that trust and making themselves visible and approachable. In our opinion, this task must be tackled via two main approaches. On the one hand, we as scientists should be using understandable language and motivating communication in conversations with non-scientists or those outside of our own field of expertise. On the other hand, we should visit places and events where science is rarely encountered and recognized.

This was the reason for us to start a cooperation with the Netzwerk Teilchenwelt group from Münster and the Music Forge Festival in the village of Lich, near Gießen, in 2024. In 2025, this cooperation was continued and we used the three days of the festival to communicate with a broad audience in and around a booth on the festival ground.

Additionally, some games and activities such as a "particle wall of death" and a soap volcano using dry ice were presented to attract the target group.

This contribution will show a selection of impressions from our outreach activities at the Music Forge Festival 2025.

HK 27.16 Wed 16:15 Redoutensaal

Super-FRS Ion Catcher - Overview and Progress — •Jamie Harkin for the Super-FRS Experiment-Collaboration — Justus-Liebig-Universität Gießen

At the Super-FRS-IC, the exotic nuclei produced at relativistic energies and separated in-flight will be thermalized in the Cryogenic Stopping Cell (CSC). The new CSC for the Super-FRS, currently under construction, features a High Areal Density Orthogonal (HADO) design, achieving an areal density of cryogenic helium (He) exceeding 25 mg cm^(-2) - a four-fold increase over existing systems. The stopping cell chamber (split into stopping and extraction regions), will be nested inside a larger insulating vacuum chamber. The beam will be delivered through air and two thin (100 micron) aluminium beam windows. Investigations into the deformation caused by the pressure differential between the regions; resulting energy deposition difference relative to beam position in the beam windows; optimizing thermal coupling between the cryo-coolers and the cryo-cell; ideal potentials of the DC push electrodes in the stopping region have been conducted. This poster presents these results, and the status of construction.

HK 27.17 Wed 16:15 Redoutensaal

Particle Track classification using Object Condensation at MAGIX — •Nils Hesse for the MAGIX-Collaboration — JGU Mainz

Machine Learning has been a part of modern physics for many years now, aiding with denoising, particle identification and even being used for generating particle events. However, a general limitation lies in the fact that neural networks have a fixed number of inputs and outputs, making classification of an unknown number of particle tracks not just more complex, but also inefficient.

Object Condensation is a loss function developed by Jan Kieseler in 2020, it solves this problem by transforming the input data into a learned condensation space and clustering in said space. This work explores the application of Object Condensation to the Prototype TPC of the MAinz Gas Injection target eXperiment (MAGIX) at the Mainz Energy-Recovering Superconducting Accelerator (MESA). Preliminary results are presented alongside an overview of the underlying principles of the Object Condensation approach.

HK 27.18 Wed 16:15 Redoutensaal

A Comparative Study of Baryon Stopping Models: SMASH and ANGANTYR — •Manou P. Engel[1], Carl B. Rosenkvist[1,3], and Hannah Elfner[2,1,3,4] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [3]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, Max-von-Laue-Strasse 12, 60438 Frankfurt am Main, Germany

In SMASH, a hadronic transport model, particle formation is modeled through hadronic resonances as well as *string* excitation and fragmentation, handled by PYTHIA8. Leading hadrons can interact earlier than newly produced, not yet fully formed hadrons. This mechanism reproduces baryon stopping in experimental data well at *low collision energies*, while it tends to overestimate stopping at *high energies*.

ANGANTYR, PYTHIA8's default Glauber-based heavy-ion model, models stopping through multiple nucleon interactions and provides a more realistic description of baryon stopping at LHC energies.

In this work, these two approaches will be compared to identify possible avenues to improve the description of baryon stopping in SMASH across collision energies. Specifically, we study their rapidity distributions and transverse-mass spectra as functions of centrality and collision energy. The results are compared to heavy-ion data from the LHC and from the STAR experiment at RHIC.

HK 27.19 Wed 16:15 Redoutensaal

Status of the CBM Micro Vertex Detector Simulations* — •Julio Andary for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt am Main

CBM's Micro Vertex Detector (MVD) will help identify rare particles emitted in violent heavy ion collisions at FAIR and supplements the main tracker (STS) with high-precision pointing capability close to the target. This places, besides outstanding radiation hardness, high demands on the material budget of the detector which in turn has an impact on the performance of the detector. Thus, the detector was optimized w.r.t. multiple scattering and adding unwanted background tracks originating from external conversion of photons.

The focus of this contribution is on the gain in tracking performance enabled by the MVD, also considering alternative detector geometries. Currently, there are two distinct variants of the MVD geometry - a vertexing geometry and a tracking geometry, adjusted to optimize either secondary vertexing of rare particles or particle tracking in a high multiplicity environment, together with the STS detector.

*This work has been supported by BMFTR (05H24RF5), GSI and HFHF.

HK 27.20 Wed 16:15 Redoutensaal

PID using unsupervised clustering methods and pulse shape discimination in a Phoswich detector — •Simon Glennemeier-Marke[1,2], Kai-Thomas Brinkmann[1,2] und Lara Dippel[1,2] — [1]2nd Physics Institute, Justus-Liebig-University, Gießen — [2]LOEWE Research Cluster for Advanced Medical Phzsics in Imaging and Therapy (ADMIT)

On this poster, we present a workflow for particle identification (PID) in a Phoswich detector, which consists of a fast plastic scintillator optically coupled to a thicker barium fluoride (BaF) scintillator. The dissimilarity in the scintillation characteristics of both materials enables pulse shape discrimination (PSD) between different particle species. We use a dataset obtained at Marburg Ion Beam Therapy Center (MIT) using 300 MeV/u carbon ions impinging on a water target. Feature engineering and unsupervised clustering methods are applied to categorize new observations, unseen during training, even in high rate environments where signal pile-ups occur. Classified detections can then be used to determine the relative abundances. This project is part of the ADMIT consortium under Project Part A, which focuses on estimating spectral neutron fluxes for flash therapy in tumor treatment applications. This project is financed with funds of LOEWE - Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 2: LOEWE-Schwerpunkte.

HK 27.21 Wed 16:15 Redoutensaal

Thermal triggering of superconducting nanowires for a potential electron tagger at KATRIN — •Christian Gönner[1,2], Juan Navarro Arenas[1], Carsten Schuck[1], and Christian Weinheimer[2] — [1]Department for Quantum Technology, University of Muenster, Germany — [2]Institute for Nuclear Physics, University of Muenster, Germany

The neutrino mass experiment KATRIN has effectively collected 1000 days of tritium beta decay data, allowing to achieve a sensitivity for an upper limit on the electron neutrino mass of m < 300 meV at 90% C.L.. After searching for sterile keV neutrinos with the TRISTAN detector at KATRIN a potential next generation experiment labeled KATRIN++ aims to go beyond this limit and probe the inverted mass ordering range down to neutrino masses m < 50 meV. Besides the necessary development of an atomic tritium source, achieving the required sensitivity requires a new differential method with sub-eV energy resolution. This may be possible through direct time-of-flight spectroscopy of beta-decay electrons. This approach requires detection of electrons when entering the KATRIN spectrometer with minimal change of its energy. The feasibility of a detector based on superconducting nanowires as is already used in single-photon detectors (SNSPDs) is investigated. It could offer the required sensitivity and timing resolution by exploiting the disruption of the superconducting state, while a 2D membrane interaction medium for beta electrons, yielding quasi-discrete excitations to detect via the superconducting nanowires. This work is supported by BMFTR under contract number 05A23PMA.

HK 27.22 Wed 16:15 Redoutensaal

Feasibility studies for the measurement of collective phenomena with multiparticle azimuthal correlations and cumulants in CBM at FAIR — •Ante Bilandzic for the CBM-Collaboration — Technical University of Munich, TUM School of Natural Sciences, Department of Physics, Garching, Germany

In non-central heavy-ion collisions, the initial volume containing the strongly interacting nuclear matter is anisotropic in the coordinate space, due to the leading-order ellipsoidal geometry of non-central collisions. Multiple interactions within this anisotropic volume cause the anisotropy to be transferred from the coordinate space into the momentum space via the thermalized medium, resulting in the anisotropic flow phenomenon. Anisotropic flow is a sensitive probe of the equation of state and transport properties of produced matter, particularly of its shear viscosity.

In this contribution, the status of feasibility studies for measuring collective anisotropic flow with multiparticle azimuthal correlations and cumulants is presented for data-taking conditions in the CBM experiment at FAIR.

HK 27.23 Wed 16:15 Redoutensaal

Lifetime determination of first excited 0+ state of 52Cr — •Steffen Meyer[1], Thorsten Kröll[1], Anna-Lena Hartig[1], Martin von Tresckow[1], Ruxandra Borcea[2], Stefana Calinescu[2], Adina Coman[2], Cristian Costache[2], Irina Dinescu[2], Razvan Lica[2], Nicu Marginean[2], Constantin Mihai[2], Sorin Pascu[2], Sebastian Toma[2], Andrei Turturica[2], Kalin Gladnishki[3], Diana Kocheva[3], Georgi Rainovski[3], Margarita Efstathiou[4], and Pavlos Koseoglou[4] — [1]TU Darmstadt — [2]IFIN-HH, Magurele, Romania — [3]University of Sofia, Bulgaria — [4]University of Athens, Greece

For 52Cr a coexistence of a spherical ground and deformed excited 0+ state can be expected. A recent measurement for the the first excited 0+ state determined the E0/E2 branching ratio to the 0+ ground and the first 2+ state. In order to determine the absolute value of the E0 strength the lifetime of the first excited 0+ state is required.

To determine this lifetime a DSAM experiment was performed in 2024 using the ROSPHERE detector array at the tandem accelerator at IFIN-HH in Magurele, Romania. It was noted that the lifetime is outside the sensitivity range of DSAM. To follow up on this experiment a plunger measurement was performed in 2025 with the IFIN-HH plunger device. Now the lifetime will be determined using the RDDS method, which is suitable to determine lifetimes in the suspected range.

The current state of the analysis with preliminary values is presented.

This work is supported by EURO-LABS grant No. 101057511.

HK 27.24 Wed 16:15 Redoutensaal

Fast detector simulation with machine learning for ALICE 3 — •Nils Meurer — Goethe-Universität Frankfurt am Main

High-energy physics experiments rely on simulations to correct measured collision data for detector effects. Performing these simulations causes high demands in computing resources. Machine learning (ML) models are considered a fast alternative for traditional simulation approaches.

In this poster, a conceptual study of ML-based detector response models using simulation data of the future ALICE 3 experiment is presented. The tracking performance and reconstruction efficiency for inclusive charged particles are compared to the full detector simulation and different ML approaches are explored. The current status of the project will be presented.

Supported by BMFTR and the Helmholtz Association.

HK 27.25 Wed 16:15 Redoutensaal

ϕ Production at subthreshold energies at HADES — •Felix Fritzemeier — Max-von-Laue-Straße 1, 60438 Frankfurt am Main

HADES explores the region of the phase diagram of strongly interacting matter with the highest net-baryon densities accessible in heavy-ion collisions. In this regime, sub-threshold strangeness production is a particularly sensitive probe of the energy sharing inside the fireball. The ϕ-meson is especially interesting at deep subthreshold energies: the ϕ/K^- ratio is observed to increase towards lower $\sqrt{s_{NN}}$, and a successful reconstruction of ϕ mesons in Au+Au at $\sqrt{s_{NN}} = 2.24$ GeV (well below the free production threshold of $\sqrt{s_{NN}} = 2.90$ GeV) would provide the lowest-energy ϕ data point measured so far.

The analysis is highly challenging, but as a first step we achieve good agreement between same-event and mixed-event invariant-mass distributions, demonstrating control over the combinatorial background. This establishes a solid basis for further studies with the next-generation calibrated data set and an improved signal-to-background ratio through enhanced charged-kaon identification.

HK 27.26 Wed 16:15 Redoutensaal

Prospect of hypernuclei flow measurements with HADES in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV — •Christopher Grimm for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

The hyperon-nucleon (Y-N) interaction plays an important role in the equation of state (EOS) of nuclear matter at high baryon densities, crucial for the understanding of neutron stars. To this end, the measurement of hypernuclei, in particular their collective behavior, offers unique insights. On earth we can produce hypernuclei in heavy-ion collisions and detect them with detectors like the High Acceptance Di-Electron Spectrometer (HADES) located at the GSI Helmholtz Centre for Heavy-Ion Research in Darmstadt, Germany. HADES combines a nearly complete azimuthal coverage with a high mass resolution and is therefore able to reconstruct hypernuclei in a significant number.

The HADES collaboration presented the first observation of ${}^{3}_{\Lambda}H$ and ${}^{4}_{\Lambda}H$ in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV, emitted around mid-rapidity, yielding approximately 1000 ${}^{3}_{\Lambda}H$ and 4000 ${}^{4}_{\Lambda}H$ signal candidates. In this work we estimate if this multiplicity is sufficient to measure, for the first time, the directed (v_1) and elliptic (v_2) flow components of hypernuclei. Additionally, we present predictions for the elliptic flow of hypernuclei (v_2) using a coalescence model.

HK 27.27 Wed 16:15 Redoutensaal

Hydrodynamic attractors in periodically driven weakly and strongly coupled systems — •Martin Vrdoljak[1], Sören Schlichting[2], Alexas Mazeliauskas[3], Louis Onwuka[4], Simon Schneider[5], and Toshali Mitra[6] — [1]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [2]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [3]Institut für Theoretische Physik, Universät Heidelberg, D-69120 Heidelberg, Germany — [4]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [5]Fakultät für Physik, Universität Bielefeld, D-33615 Bielefeld, Germany — [6]Institut für Theoretische Physik, Universät Heidelberg, D-69120 Heidelberg, Germany

This research investigates equilibration processes and hydrodynamic reactions within systems subjected to periodic one-dimensional expansion. By employing a multi-faceted approach, incorporating strongly coupled holographic models, weakly coupled kinetic theory, and various hydrodynamic frameworks, we analyze the shear response to periodic driving across a range of amplitudes and frequencies. Unlike the standard monotonic Bjorken expansion, these systems do not converge toward thermal equilibrium or traditional Navier-Stokes behavior. In the regime of low drive frequencies and small amplitudes, we observe a universal late-time cyclic attractor that is consistent across different frameworks and accurately characterized by Müller-Israel-Stewart (MIS) theory. Conversely, high-amplitude driving triggers non-linear heating, which causes a continuous drift in both the fundamental system properties and the resulting attractor dynamics.

HK 27.28 Wed 16:15 Redoutensaal

Radon concentration monitoring for future liquid xenon radon removal systems — •Sakuntha Nirodana Prathapage, Lutz Althueser, Robert Braun, David Koke, Volker Hannen, Christian Huhmann, Ying-Ting Lin, Philipp Schulte, Patrick Unkhoff, Daniel Wenz, and Christian Weinheimer — University of Münster, Germany

In next generation dark matter experiments, such as XLZD, it is important to maintain a low radioactive background inside the detector as the dark matter events are extremely rare and mimicked by background signals. The intrinsic radioactive noble isotope Radon-222, which is continuously emanating from detector materials and its decay progenies contribute to an unshieldable background inside liquid xenon detectors. Continuous cryogenic distillation reduces the radon level by exploiting radon's lower volatility relative to xenon, thereby trapping it within the distillation column where it subsequently decays with a 3.8-day half-life. As a part of the LowRAD project an in-column radon detector is designed and constructed, that exploits the inherent enrichment of radon in the distillation column, which enhances the sensitivity for measuring low initial radon concentrations via scintillation light detection. This will allow the online monitoring of the radon concentration inside the distillation column and in turn the radon concentration of the whole experiment. This poster highlights the design of a 16-PMTs detector within the radon column to continuously monitor radon events in enriched xenon. This work is supported by the EU through the ERC AdG 'LowRad' (101055063).

HK 27.29 Wed 16:15 Redoutensaal

Tracking performance studies for the ALICE 3 detector using ACTS — •Maria Gabriela Gomes and Klaus Reygers for the ALICE Germany-Collaboration — Heidelberg University, Heidelberg, Germany

The ALICE 3 experiment is a proposed next-generation detector for heavy-ion collisions at the LHC, with a physics programme based on observables that require charged-particle tracking with high efficiency and a wide pseudorapidity coverage. In this presentation, simulation-based studies of the tracking performance of the ALICE 3 detector using the ACTS (A Common Tracking Software) framework are presented. The tracking geometry is based on silicon pixel sensors arranged in cylindrical layers and forward disks, allowing performance studies up to *η*=4. The results focus on the reconstruction efficiency and transverse momentum resolution, with particular emphasis on the performance of the outer tracking system and its impact on the reconstruction of low-momentum particles. The results are obtained from Monte Carlo simulations of heavy-ion collision events and are compared for different reconstruction configurations. These studies illustrate the capabilities and limitations of ACTS in the ALICE 3 environment and provide essential input for the optimisation of the detector layout and reconstruction strategies.

HK 27.30 Wed 16:15 Redoutensaal

Exploring the particle emission source in proton-proton collisions via collective expansion — •Sebastian Wind — Technical University of Munich

While the formation of Quark-Gluon Plasma (QGP) and associated collective behavior are well-established in heavy-ion collisions, their existence in proton-proton (pp) collisions remains unknown. Recent femtoscopic measurements have observed assumed signatures of collective behavior in pp collisions, challenging our understanding of small system collisions.

In this poster, we investigate the m_T-scaling behavior via collective expansion using the analytically solvable hydrodynamical Gubser solution. By comparing our predictions to ALICE collaboration data and contrasting them with free-streaming model calculations, we try to understand whether the observed m_T-scaling behavior can be related to the collective expansion. This work provides insights into potential QGP formation in small system collisions and the applicability of hydrodynamics in describing pp collisions.

HK 27.31 Wed 16:15 Redoutensaal

Development of Low-Cost and Compact Radiation Monitoring, Long-Range Data Transmission and Tracking Systems for Stratospheric Balloon Missions — •Nico Krug, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — 2^{nd} Physics Institute Justus Liebig University Giessen

A cost-effective readout and monitoring system based on a Raspberry Pi and designed for integration into ongoing stratospheric balloon missions will be presented.
The Strato project consists of a series of stratospheric balloon experiments relying on commercial-off-the-shelf (COTS) components. It features a custom low-power printed circuit board (PCB) built around a Raspberry Pi Zero, incorporating the in-house developed MuonPi detector as well as commercial environmental sensors connected via a generic I^2C interface. The system uses the long-range LoRaWAN communication protocol to maintain contact throughout the entire flight for data transmission and tracking. It can be optionally extended with a telemetry beacon or a cellular communication module to ensure reliable message reception near ground level.
The poster will discuss the performance and robustness of the integrated system under the challenging conditions of near-space environments. Initial environmental and detector measurements as well as data transmission results obtained during past flights are presented and evaluated.

HK 27.32 Wed 16:15 Redoutensaal

Gamma rays in r-process sites — Lucas de Borba Flesch, •Almudena Arcones, Jan Kuske, and Giacomo Ricigliano — Institut für Kernphysik, Technische Universität Darmstadt, Schlossgartenstr. 2, Darmstadt 64289, Germany

The rapid neutron capture process (r-process) synthesizes heavy elements, but its astrophysical sites remain partially unconfirmed. Identifying delayed gamma-ray emission from unstable r-process nuclei is crucial for site verification. This study models time-dependent gamma-ray spectra from r-process nucleosynthesis in varied conditions, including those found in supernovae and neutron star mergers, using the WinNet nuclear reaction network. Focusing on long timescales relevant to galactic remnants, we identify key long-lived isotopes dominating the flux across all three r-process peaks, as well as certain actinide decay chains. We assess the observability of these lines by calculating light curves and Doppler broadened spectra against current and future detector sensitivities (e.g., NuStar and GammaTPC). A prominent high-energy gamma line (661.66 keV) is the most promising signature, potentially visible up to 500 years. Furthermore, we predict that low-energy emission lines should be detectable in existing supernova remnants. These results provide critical guidance for upcoming gamma-ray telescopes seeking to localize the astrophysical origin of heavy elements.

HK 28: Invited Talks

Time: Thursday 11:00–13:00 Location: MED 00.915

Invited Talk HK 28.1 Thu 11:00 MED 00.915

Toward the Island of Stability — •Khuyagbaatar Jadambaa — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Superheavy elements with extremely large atomic numbers remain one of the central and interdisciplinary research topics in modern science. In nuclear physics, one of the major goals is to explore the properties of superheavy nuclei (SHN) in the region of Z = 114-126 and N=184, where the next shell closures are predicted to occur. Superheavy nuclei in this region are expected to exhibit significantly longer spontaneous fission half-lives than their neighboring ones. Consequently, the fission landscape of SHN, in terms of half-life, has been envisioned as an Island of Stability surrounded by a sea of instability. Intensive research programs dedicated to probing the shell structure and fission stability of SHN are ongoing worldwide, including those conducted with the gas-filled recoil separator TASCA at GSI, Germany. I will present/discuss the current status of studies on the fission-landscape of SHN toward the Island of Stability.

Invited Talk HK 28.2 Thu 11:30 MED 00.915

From stars to underground labs: Nuclear astrophysics measurements at Felsenkeller — •Eliana Masha — Helmholtz-Zentrum Dresden-Rossendorf (HZDR)

Nuclear reactions in stars take place at very low energies and are characterized by extremely small cross sections. To reproduce these conditions in the laboratory, high-intensity ion beams and low background environments are required. Underground accelerator laboratories provide such conditions by suppressing cosmic-ray induced background, enabling direct measurements at relevant astrophysical energies. This approach was pioneered by the LUNA experiment at Gran Sasso and has since been extended to other underground facilities worldwide. Among them, the Felsenkeller laboratory in Dresden offers new opportunities for precision nuclear cross-section measurements for different astrophysical scenarios. This talk will introduce the connection between nuclear processes in stars and underground laboratory experiments, and present selected science cases from the Felsenkeller laboratory.

Invited Talk HK 28.3 Thu 12:00 MED 00.915

Hunting exotic mesons in the light-quark sector at GlueX — •Farah Afzal for the GlueX-Collaboration — Ruhr University Bochum, Bochum, Germany

The detailed understanding of the hadron spectrum is currently one of the biggest open issues in the field of hadron physics. Most of the observed states are classified as quark-antiquark mesons or three-quark baryons. However, quantum chromodynamics (QCD) allows for a much richer spectrum with more complex, non-conventional configurations, such as multi-quark states, hybrid mesons and glueballs. Hybrid mesons, which manifest gluonic degrees of freedom, serve as an ideal testing ground for the non-perturbative regime of QCD and understanding the role of gluons in hadron formation.

The main goal of the GlueX experiment is to search for exotic hybrid mesons and to map out their spectrum in the light-quark sector. The experiment is located in Hall D at Jefferson Lab, USA, and uses a linearly polarized photon beam with energies of up to 12 GeV incident on a liquid hydrogen target and consists of a high-acceptance spectrometer with excellent charged as well as neutral particle detection capabilities. This allows us to study the production mechanisms and decays of a wide range of hadronic resonances.

This talk gives an overview of the ongoing search for exotic mesons in the light-quark sector at GlueX.

Invited Talk HK 28.4 Thu 12:30 MED 00.915

Dispersive analyses of Primakoff reactions with kaons — •Bastian Kubis — Helmholtz-Institut für Strahlen- und Kernphysik (Theorie), Universität Bonn, Nussallee 14-16, 53115 Bonn

The scattering of a charged-kaon beam off the Coulomb field of a heavy nucleus, as planned at the AMBER experiment at CERN, allows one to investigate photon-kaon reactions to various final states, so-called Primakoff processes. We investigate two important such reactions. First, we analyse $\gamma K \to K\pi$ and show how dispersion theory provides access to both the chiral anomaly and radiative resonance couplings in a unified manner. Second, from Compton scattering on the kaon, electric and magnetic polarisabilities can be extracted, which provide fundamental structure information about the lightest strange hadrons. We discuss similarities and differences to the analogous COMPASS analysis with charged pions, and show how the effects of the $K^*(892)$ resonance, seemingly impeding the polarisability determination, can be included model-independently.

HK 29: Hadron Structure and Spectroscopy V

Time: Thursday 13:45–15:30 Location: PHIL C 301

Group Report HK 29.1 Thu 13:45 PHIL C 301

Measurement of the cross section for $\gamma p \to \phi\pi^+\pi^-p$ and search for the $Y(2175)$ in photoproduction with the GlueX experiment — •Klaus Götzen[1] and Frank Nerling[1,2] for the GlueX-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Goethe-Universität Frankfurt, Germany

The $Y(2175)$, recently renamed to $\phi(2170)$, is discussed to be a strange partner state of the famous charmonium-like exotic vector state $Y(4260)$. The former has originally been observed in initial-state radiation by the BaBar experiment in 2006. Meanwhile, it has been reported in different e^+e^- annihilation experiments. Based on the first measurement of the differential cross section for the exclusive reaction $\gamma + p \to \phi(1020)\pi^+\pi^-p$, we have performed a search for this strangeonium-like exotic candidate $\phi(2170) \to \phi\pi^+\pi^-$ in the GlueX data [1]. It is addressed here for the first time in a photoproduction experiment. We do not find evidence for this state at the resonance parameters quoted by the Particle Data Group and provide upper limits on the photoproduction cross section. Instead, we find a structure at a mass of $m(\phi\pi^+\pi^-) = 2.24\,\mathrm{GeV}/c^2$ with a statistical significance of about $5\,\sigma$. The parameters of this structure differ from those quoted by the Particle Data Group for the $\phi(2170)$ and are consistent with a previous observation in e^+e^- annihilation. In addition, there is evidence for a second structure at $1.82\,\mathrm{GeV}/c^2$.

[1] GlueX Collab., subm. to PRL, Dec 2025; arXiv:2512.04136 [hep-ex]

HK 29.2 Thu 14:15 PHIL C 301

Weak Decay of Ω^--Dibaryons — •Emili Hill, Ishfaq Ahmad Rather, and Jürgen Schaffner-Bielich — Goethe Universität, Frankfurt am Main, Germany

We study the weak decay of Ω^- dibaryons within SU(3) flavor symmetry and chiral perturbation theory. These exotic states, carrying strange quarks, are relevant for understanding hyperon-hyperon interactions in dense neutron star matter. We examine mesonic and non-mesonic decay modes of the $\Omega^-\Xi^-$ and $\Omega^-\Xi^0$ systems using a pole-model framework. The decay pattern shows a strong sensitivity to the binding energy ϵ. For small values of the binding energy, mesonic decays dominate and the behavior resembles the decay of a free hyperon. As ϵ increases, non-mesonic channels overtake the mesonic ones. The crossover appears near $\epsilon \approx 2.7\,\mathrm{MeV}$ for $\Omega^-\Xi^-$ and $\epsilon \approx 3.8\,\mathrm{MeV}$ for $\Omega^-\Xi^0$.
These results identify the non-mesonic modes as promising channels for future searches. The study also points to the need for improved theoretical input, especially for the maximally strange $\Omega^-\Omega^-$ system, to understand its possible impact on neutron stars and heavy-ion collisions.

HK 29.3 Thu 14:30 PHIL C 301

Search for the spin-exotic $\pi_1(1600)$ in a three-pion system with GlueX data — •Ilia Belov and Farah Afzal for the GlueX-Collaboration — Institut für Experimentalphysik I, Ruhr-Universität Bochum, 44801 Bochum, Germany

The GlueX experiment in Hall D at Jefferson Lab is designed for studies of the light meson spectrum with an emphasis on searches for hybrid mesons that have exotic quantum numbers and therefore cannot be classified as conventional hadrons. The experimental facility exploits a linearly polarized tagged photon beam in the energy range from 8.2 to 8.8 GeV. The photon beam is incident on a liquid hydrogen fixed target. The detector setup consists of a spectrometer with a nearly 4π angular coverage, which has excellent capabilities for reconstruction of charged particle tracks, reconstruction of electromagnetic showers, and charged particle identification. Advanced searches for spin-exotic mesons are performed through the application of Partial Wave Analysis techniques.

The $\pi_1(1600)$ hadron with 1^{-+} quantum numbers is predicted to have a considerable decay width to a three-pion system. In this talk, I present studies towards a Partial Wave Analysis of the $\pi^+\pi^-\pi^-$ system produced in the $\gamma p \to \pi^+\pi^-\pi^-\Delta^{++}(\to p\pi^+)$ reaction with a polarized beam.

HK 29.4 Thu 14:45 PHIL C 301

Search for Y state in $e^+e^- \to \gamma\eta_c$ at BESIII — •Yu Gang[1,2], Klaus Götzen[1], Frank Nerling[1,2], and Klaus Peters[1,2] — [1]GSI, Darmstadt — [2]Goethe Universität Frankfurt

The BESIII experiment is operating since 2008 and it is well suited for charmonium spectroscopy. Since 2003, dozens of charmonium-like states have been discovered in experiment, however, their properties do not match the prediction of the charmonium quark model and the nature of these so-called XYZ states is still unknown. The most famous vector charmonium-like state $Y(4260)$ has been discussed to be a hybrid or a tetra-quark state. In a hybrid meson, the extra gluonic degree of freedom allows for an $M1$ transition without spin-flip, the partial decay width $\Gamma(Y_{hyb} \to \gamma\eta_c)$ is considerably larger than conventional vector-to-pseudoscalar transition. In phenomenology, the cross sections of exclusive $\gamma\eta_c$ production up to NNLO in electron-positron collision with center-of-mass energy ($\sqrt{s}$) from 4.0 to 5.5 GeV has been predicted. The NNLO result prefers the enhancement in $e^+e^- \to \gamma\eta_c$ for center-of-mass energies between $\sqrt{s} = 4.23$ GeV and 4.36 GeV, originating from decays of the exotic particle candidate $Y(4260)$.

Preliminary results of the energy dependent cross section measurement of $e^+e^- \to \gamma\eta_c$ to search for $Y \to \gamma\eta_c$ decays is presented.

HK 29.5 Thu 15:00 PHIL C 301

Femtoscopic study of the proton-proton and proton-deuteron systems in heavy-ion collisions at the LHC — •Wioleta Rzesa for the ALICE Germany-Collaboration — Technische Universität München, München, Germany

This work presents femtoscopic correlations of proton−proton (p−p) and proton−deuteron (p−d) pairs measured in Pb−Pb collisions at a center-of-mass energy of $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV by the ALICE Collaboration. The p−p correlation functions allow the extraction of a precise power-law dependence of the nucleon femtoscopic radius on the pair transverse mass ($m_{\rm T}$), as well as a linear dependence on the average charged-particle multiplicity. These dependencies are studied across three centrality intervals (0−10%, 10−30%, 30−50%) of Pb−Pb collisions. The measured p−d correlations are well described by both two-body and three-body calculations. This indicates that the femtoscopic observable in Pb−Pb collisions is not sensitive to short-distance features of the p−(p−n) interaction, owing to the relatively large interparticle distances created in the heavy-ion environment at the LHC. Moreover, the proton $m_{\rm T}$-scaling obtained for the p−p and p−d systems is compatible within one standard deviation of the experimental uncertainties. These findings provide new input for fundamental studies of the production and behavior of light (anti)nuclei under extreme conditions.

HK 29.6 Thu 15:15 PHIL C 301

Selection and Resonant Structures in Semileptonic $B \to D\pi\mu\nu$ Decays at LHCb — •Piet Nogga and Sebastian Neubert — University of Bonn

Semileptonic B decays provide a powerful environment to study the strong interaction, as the hadronic system is produced in isolation from the leptonic system. This offers a clean setting for investigating hadronic resonances, free from interference with the leptonic part of the decay. However, the presence of an undetected neutrino makes the reconstruction of these decays experimentally challenging and introduces substantial background contamination.

The LHCb experiment records large and high-quality samples of B mesons, making it an excellent environment to study such semileptonic processes. This talk presents the analysis of the decay $B \to D\pi\mu\nu$, with a focus on the development and optimization of the selection processes required to reconstruct this challenging final state. A combination of simulation and data-driven processes is necessary to maximize signal purity, and the talk will cover the corresponding selection strategy. These optimizations allow us to investigate the hadronic system in detail, including possible intermediate resonances and their potential molecular nature.

HK 30: Hadron Structure and Spectroscopy VI

Time: Thursday 13:45–15:45 Location: PHIL A 401

Group Report HK 30.1 Thu 13:45 PHIL A 401

Inclusive measurement of R — Thomas Lenz, •Weiping Wang, and Achim Denig for the BESIII-Collaboration — Johannes Gutenberg-Universität Mainz, Germany

The inclusive measurement of R, which is the ratio of the leading-order cross sections between inclusive hadronic events and a pair of muon leptons, is of great importance in the precision test of the Standard Model. For example, the determination of quantum electrodynamics running coupling constant at the Z pole, the evaluation of the anomalous magnetic moment of muon, and search and study of exotic hadron states. In this presentation, we will introduce the inclusive measurement of R at BESIII, including the published results and ongoing efforts based on the conventional energy-scan method. In addition, we will present a novel approach for R measurement that combines the advantages of the initial-state radiation technique with the inclusive method. This approach enables an inclusive determination of R over the energy range from 0.3 to 2.0 GeV, which is of significant interest to the community.

Group Report HK 30.2 Thu 14:15 PHIL A 401

Experimental input to HVP from the BESIII collaboration — •Riccardo Aliberti, Achim Denig, Christoph Redmer, and Weiping Wang for the BESIII-Collaboration — JGU Mainz

The time-like pion (vector) Form Factor (FF), i.e. the cross section for the process $e^+e^- \to \pi^+\pi^-$, is the most important input to the dispersive evaluation of the Hadronic Vacuum Polarization (HVP) contribution to the anomalous magnetic moment of the muon a_μ. Decades of pion FF, and in general hadronic cross section, measurements have allowed the muon g-2 theory initiative to publish in 2020 a SM prediction for a_μ with sub-percent accuracy on the HVP contribution. This value is in strong tension (more than 5σ) with the latest experimental results reported by the muon g-2 collaboration. Despite such a tension would be a clear sign of new Physics, recent ab-initio calculations of HVP from lattice QCD have reached an accuracy competitive with the dispersive approach and their results lead to a SM value for a_μ, which is well in agreement with the direct measurements. At the same time, a new measurement of the pion FF by the CMD-3 collaboration shows a systematical deviation from previous results which would cover the discrepancy between the dispersive evaluation of HVP and the results from lattice QCD. In this talk, we will present the experimental efforts on going within the BESIII collaboration to provide new inputs to the dispersive evaluation of HVP with particular emphasis on a new high-precision measurement of the pion FF.

HK 30.3 Thu 14:45 PHIL A 401

Amplitude Analysis of the decay $\Lambda_b^0 \to \Lambda_c^+ \bar{D}^0 K^-$ — •Ellinor Eckstein, Kai Sebastian Habermann, and Sebastian Neubert — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

Understanding the internal structure of exotic hadrons remains one of the central challenges in hadron physics over the past two decades. Many of these unconventional states have been observed in decays of b-flavored hadrons, which are produced in large quantities at the LHCb experiment located at the LHC. A precise description of such decay processes requires a detailed modelling of the various resonant contributions that arise in hadronic two-body subsystems. The full decay amplitude must account for all relevant decay topologies as well as the interference between overlapping resonances.

In this talk, I will present the first amplitude analysis of the decay $\Lambda_b^0 \to \Lambda_c^+ \bar{D}^0 K^-$, observed with the LHCb experiment. The decay channel is dominated by D_s resonances in the intermediate state decaying to $\bar{D}^0 K^-$ and also recieves contributions from Ξ_c resonances in the $\Lambda_c^+ K^-$ subsystem. Particularly interesting is the $\Lambda_c^+ \bar{D}^0$ subsystem, because it consists of the same valence quark content as the well established pentaquark states observed in the $J/\psi p$ system of the decay $\Lambda_b^0 \to J/\psi p K^-$. Studying the possible coupling of these pentaquark states to the $\Lambda_c^+ \bar{D}^0$ system offers a new avenue to probe their internal structure and gain deeper insight into the nature of exotic hadrons.

HK 30.4 Thu 15:00 PHIL A 401

First measurement of the K^*–K_S^0 correlation function in pp collisions at ALICE in Run 3 — •Nils Konert for the ALICE Germany-Collaboration — James-Franck-Straße 1, 85748 Garching b. München

The recent discovery of the T_{cc^+} by LHCb, together with the growing number of unconventional hadronic states, has highlighted clear tensions with the traditional valence-quark picture. Several resonances do not fit naturally into the expected $q\bar{q}$ spectrum. Among them, the $f_1(1420)$ and $f_1(1510)$ have been discussed as potential tetraquark candidates, although their internal structure remains unsettled.

Femtoscopy provides a powerful tool to probe such questions. By measuring correlations between two decay products, femtoscopic techniques are sensitive to the underlying hadron-hadron interaction, and therefore to possible structural differences of the parent resonance. Both $f_1(1420)$ and $f_1(1510)$ decay into K^* and K_S^0, making this pair a promising system for investigating exotic configurations.

This contribution presents the first measurement of the K^*–K_S^0 correlation function using data collected by the ALICE experiment in pp collisions at $\sqrt{s} = 13.6$ TeV during LHC Run 3. The unprecedented statistics of Run 3 enable a significantly improved sensitivity to the interaction dynamics of this system, offering new insight into the possible exotic nature of the associated axial-vector states.

This project has been funded by the DFG under Germany‘s Excellence Strategy - EXC2094 - 390783311 and by BMFTR Verbundforschung (05P24WO4 ALICE).

HK 30.5 Thu 15:15 PHIL A 401

First measurement of the Λ–ϕ correlation function with data taken by ALICE in Run 3 — •Christopher Klumm for the ALICE Germany-Collaboration — James-Franck-Straße 1, 85748 Garching b. München

Neutron stars are among the densest objects in the observable universe and play a crucial role in advancing our understanding of dense hadronic matter. One of the central open questions is the so-called hyperon puzzle. In general, the relationship between the mass and radius of a neutron star is determined by its equation of state (EoS). Due to the extreme densities and pressures in the stellar core, the conversion of neutrons into hyperons is expected. However, this conversion leads to a softening of the EoS, preventing it from reproducing astrophysical observations. To counteract this effect, repulsive contributions to the hyperon–hyperon interaction are required. One proposed mechanism is the exchange of ϕ mesons between Λ hyperons, which could produce such a repulsion. With the transition to Run 3 of the LHC, the ALICE detector now benefits from a substantial increase in luminosity and statistics, enabling new insight into the baryon–baryon interaction using the femtoscopic method. Leveraging these improved capabilities, this contribution presents the first measurements of the two-body correlation between Λ and ϕ particles, using data collected by the ALICE experiment in pp collisions at $\sqrt{s} = 13.6$ TeV during Run 3 of the LHC. This project has been funded by the DFG under Germany*s Excellence Strategy - EXC2094 - 390783311 and by BMFTR Verbundforschung (05P24WO4 ALICE).

HK 30.6 Thu 15:30 PHIL A 401

Track Reconstruction Performance Studies of Electrons at the BESIII Experiment — •Silas Benedikt Debus, Achim Denig, and Christoph Florian Redmer — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The investigation of hadron production in two-photon collisions at e^+e^- colliders is essential to provide further input to the data-driven calculations of the hadronic Light-by-Light (HLbL) contribution to the anomalous magnetic moment of the muon a_μ. In order to provide reliable information as a function of the momentum transfer, excellent knowledge of the tracking efficiency of the scattered electrons is mandatory.

The BESIII experiment, located at the Institute of High Energy Physics in Beijing, China, has collected more than 20 fb$^-1$ of e^+e^- collision data at a center-of-mass energy of 3.773 GeV, which is perfectly suited to study two-photon reactions at momentum transfers of $\mathcal{O}(1\,\mathrm{GeV}^2)$. Since these processes predominantly occur at small scattering angles, we report in this presentation a combined study of track reconstruction and particle identification efficiencies for electrons in the relevant angular region of the BESIII detector, using the process $e^+e^- \to e^+e^-\gamma$ as reference reaction. — Supported by DFG FOR5327

HK 31: Structure and Dynamics of Nuclei VII

Time: Thursday 13:45–15:45 Location: AM 00.011

Group Report HK 31.1 Thu 13:45 AM 00.011

Studying Exotic Nuclei with the FRS Ion Catcher: Recent Results and Developments — •Meetika Narang for the Super-FRS Experiment Collaboration-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany.

At the Fragment Separator (FRS) of GSI/FAIR, exotic nuclei are produced at relativistic energies via projectile fragmentation or fission and are separated in-flight. The fragments are subsequently thermalized in the Cryogenic Stopping Cell (CSC) and delivered to the multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), which features a high resolving power of up to one million and mass accuracies down to 10^{-8} in short cycle times of a few tens of milliseconds.

A wide range of nuclides has been studied at the FRS Ion Catcher. Direct mass measurements of neutron-deficient isotopes near the $N = Z$ line below ^{100}Sn and neutron-rich nuclei close to the $N = 126$ shell closure below ^{208}Pb have been performed, providing new insights into the evolution of nuclear structure in these key regions. Mass measurements of fission products from a ^{252}Cf spontaneous fission source have shown evidence for shape phase transitions around $N \approx 90$ ($Z = 56$–63) and enabled the direct determination of independent isotopic fission yields (IIFYs). Recent proof-of-principle experiments were performed focusing on multi-nucleon transfer reactions and the study of fundamental laws of nature by employing radioactive molecules.

This contribution presents an overview of the experimental setup, technical developments, recent experimental highlights, and prospects for upcoming experiments.

Group Report HK 31.2 Thu 14:15 AM 00.011

Multinucleon transfer experimental campaigns at GSI — •Ali Mollaebrahimi for the Super-FRS Experiment Collaboration-Collaboration — FAIR facility, Darmstadt, Germany — GSI facility, Darmstadt, Germany

Studying exotic nuclei exhibiting an extreme ratio of neutrons to protons is one of the primary means for better understanding of fundamental nuclear properties, which is crucial to comprehend the formation and existence of heavy elements in our universe. Nevertheless, it is well understood that nuclei from certain regions on the chart of nuclei, e.g., neutron-rich actinides, will not be efficiently produced in commonly used fission and fragmentation production methods. The MultiNucleon Transfer (MNT) reaction mechanism is considered the most promising and more efficient pathway to reach this region.

The Super-FRS experiment collaboration is performing MNT experiments at GSI using beams at near Coulomb barrier energies. This is performed with primary and secondary slowed-down relativistic beams at the FRS with the FRS Ion Catcher [1] and with primary beams at the UNILAC. The ultimate goal of the MNT program is to conduct future experiments at Super-FRS at FAIR. This contribution will present the plans and preliminary results obtained with ^{238}U beam and the first test with ^{236}U secondary beam on a Bi target and identification via mass measurements at the FRS Ion Catcher; plus general description of experiments with α-spectroscopy and TOF-ΔE-E methods after the UNILAC.

[1] A. Mollaebrahimi et al., Nuclear Physics A 1057, 2025

HK 31.3 Thu 14:45 AM 00.011

Measurements of the reaction cross sections of neutron-rich Sn isotopes at the R^{3}B setup — •Eleonora Kudaibergenova[1], Thomas Aumann[1,2,3], Igor Gasparic[4], Andrea Horvat[4], Ivana Lihtar[5], Lukas Ponnath[1], and Dominic Rossi[1,2] for the R3B-Collaboration — [1]Institut für Kernphysik, TUDa, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Helmholtz Forschungsakademie HFHF — [4]Rudjer Boskovic Institute, Zagreb, Croatia — [5]Facility for Rare Isotope Beams, MSU, USA

Constraining the parameters of the nuclear Equation of State (EoS) is one of the central issues in nuclear physics, especially since the slope parameter L is still poorly constrained experimentally. It has been identified that a precise determination of the neutron-removal cross section in neutron-rich nuclei, which correlates with the neutron-skin thickness, would provide constraints on L. To this end, an experiment was performed at the R^{3}B setup at GSI as a part of the FAIR Phase-0 program. The reactions are studied in inverse kinematics with neutron-rich tin isotopes in the mass range A=124-134 on carbon targets of different thicknesses. In this communication the total reaction, charge-changing and charge-exchange analysis of ^{124}Sn+ ^{12}C at 900 MeV/u is presented.

The project was supported by the BMFTR via Project No. 05P24RD1, the Helmholtz Research Academy Hessen for FAIR and the GSI-TU Darmstadt cooperation agreement.

HK 31.4 Thu 15:00 AM 00.011

Simulation of nucleon knockout reactions in a semiclassical eikonal approach — •Stefan Typel — TU Darmstadt, Fachbereich Physik, Institut für Kernphysik — GSI Helmholtzzentrum für Schwerionenforschung, Theorie

Nucleon knockout reactions are a valuable tool to study atomic nuclei, in particular their single-particle structure and neutron skin thickness. At beam energies of a few hundred MeV per nucleon, the reaction cross section can be calculated conveniently in the eikonal approach using the imaginary part of nucleus-nucleus or nucleus-nucleon optical potentials. These are obtained from recently improved parameterizations of nucleon-nucleon scattering cross sections including their angular distribution and Pauli-blocking effects. Cross sections of various processes, e.g., one- and two-nucleon removal or charge-changing reactions are calculated using nuclear structure input from a relativistic energy density functional. The reaction process is described in a Monte-Carlo simulation to take higher-order effects into account. Results for various reactions will be presented.

Supported by the Helmholtz Forschungsakademie Hessen für FAIR (HFHF).

HK 31.5 Thu 15:15 AM 00.011

Production cross-sections of N≈126 fragments from 1 GeV/u ^{208}Pb at FRagment Separator FRS — •Suraj Kumar Singh for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability are crucial for understanding nuclear reactions and nuclear structure, with implications ranging from fundamental physics to nuclear astrophysics and applications. In particular, neutron-rich nuclei near the N = 126 shell closure play a key role as potential waiting-point nuclei in the rapid neutron-capture (r-) process, strongly influencing the formation of the heaviest elements in the universe. Accessing these isotopes requires reliable predictions of production rates, which in turn depend on accurate production cross-sections. Since theoretical calculations in this region remain challenging, experimental cross-section measurements provide essential input for planning future studies of these exotic nuclides and for improving reaction models.

In this contribution, cross-section measurements from 1 GeV/u ^{208}Pb projectiles on a ^{9}Be target, performed at the Fragment Separator (FRS) at GSI will be presented. The new data provide insights into the underlying production mechanisms and serve as important benchmarks for state-of-the-art theoretical models used to predict yields of yet-unmeasured isotopes.

HK 31.6 Thu 15:30 AM 00.011

Production cross section measurements with a 170Er beam at the GSI FRS — •Justus Eder for the Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung — Justus-Liebig Universität Giessen

New production cross section results are presented from the FAIR Phase-0 experiment *"Structure of neutron-rich, rare-earth nuclei far from stability"* (G-22-00100), performed at the GSI Fragment Separator (FRS) using the newly developed 1080 MeV/u ^{170}Er beam on a beryllium target. The measurements probe the exotic, highly deformed nuclear region near Z=68, employing both the $B\rho - \Delta E - B\rho$ separation and $B\rho - \Delta E^{*} - TOF$-identification techniques. Particle identification has been significantly improved through refined delay-line corrections in the tracking detectors TPCs, which enhance position resolution, as well as position-dependent timing corrections in the scintillators, leading to more accurate time-of-flight measurements. Preliminary production cross sections obtained with these refinements are reported. Remaining corrections, systematic uncertainties, and prospects for further refinement are briefly discussed. These developments support future high-precision cross section studies, which are of relevance for reliable yield predictions for future NUSTAR experiments at FAIR.

HK 32: Heavy-Ion Collisions and QCD Phases V

Time: Thursday 13:45–15:45 Location: PHIL C 601

Group Report HK 32.1 Thu 13:45 PHIL C 601

Investigating the properties of (anti-)hypernuclei with the ALICE detector at the LHC — •Carolina Jauch for the ALICE Germany-Collaboration — Universität Heidelberg

Among the thousands of particles produced in high energy heavy-ion collisions at the LHC, light (anti-)hypernuclei are of particular interest. Studying their internal structure provides a unique opportunity to probe the strong interaction between hyperons and nucleons. The lightest known (anti-)hypernucleus, the (anti-)hypertriton, is a bound state of a proton, a neutron, and a Λ hyperon. Several groundbreaking results on its production and properties were reported by ALICE in recent years. The upgraded ALICE detector and the large data sample collected during the ongoing LHC Run 3 enable more precise measurements and the study of rare observables.

This contribution presents the latest ALICE results on (anti-)hypernuclei and outlines prospects for future investigations. In particular, the first measurement of the anti-hypertriton transverse momentum spectrum in pp collisions allows to test different assumptions on its wavefunction. Moreover, the first reconstruction of the (anti-)hypertriton three-body decay in ALICE pp collisions and the measurement of its relative branching ratio, R_3, offer insight into its internal structure. The precision of the recently published measurement of heavier (anti-)hypernuclei, the hyperhydrogen-4 and hyperhelium-4, including the very first observation of the antihyperhelium-4, can be improved using the Run 3 heavy-ion data sample, and a more detailed study of their properties will be feasible.

HK 32.2 Thu 14:15 PHIL C 601

Sexaquark Search in ALICE — •Andrés Bórquez for the ALICE Germany-Collaboration — Heidelberg University

In 2017, G. Farrar proposed the sexaquark, a hypothetical six-quark state with the quark content *uuddss*. This particle is characterized by being neutral, compactly bound, and cosmologically stable within certain mass limits. These unique properties make it a compelling dark matter candidate.

Despite its elusive nature, several experimental collaborations have searched for evidence of its existence. This contribution presents an update on the ongoing search for the sexaquark within the ALICE experiment at the LHC. The strategy focuses on identifying displaced strangeness production caused by the annihilation of anti-sexaquarks with detector material following their potential production in Pb-Pb collisions during LHC Run 2.

HK 32.3 Thu 14:30 PHIL C 601

Measurement of higher-order net-proton fluctuations with ALICE — •Ilya Fokin for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

Fluctuations of conserved charges, such as the baryon number, are a unique tool to study the phase diagram of strongly interacting matter. Cumulants of distributions of conserved charges in heavy-ion collisions can be related to the equation of state in lattice QCD (LQCD) and thus make the calculations from first principle accessible in the experiment. Starting from the fourth-order, these calculations predict a significant difference between the baryon number susceptibilities using the full QCD partition function on the lattice and a hadron resonance gas model.

For a quantitative comparison, correlations from local baryon number conservations must be considered in the theoretical baseline and additional contributions from volume fluctuations must be quantified.

In this contribution, measurements of the higher-order cumulants of the net-proton number up to fourth order in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV with the ALICE detector at the LHC are presented as a function of the pseudorapidity acceptance and centrality.

HK 32.4 Thu 14:45 PHIL C 601

Universal scaling of transport coefficients near the QCD critical point — •Johannes Roth[1], Yunxin Ye[2], Sören Schlichting[3], and Lorenz von Smekal[1,4] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Theoretisch-Physikalisches Institut, Abbe Center of Photonics, Friedrich-Schiller-Universität Jena, 07743 Jena, Germany — [3]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen

Near a critical point, including the one conjectured in the QCD phase diagram at finite baryon chemical potential, the slow dynamics of long-wavelength modes is expected to become universal. I will review the argument for the associated dynamic universality class being that of Model H in the Halperin-Hohenberg classification, i.e., that of a liquid-gas critical point. Based on a novel real-time formulation of the functional renormalization group, I will present results for universal scaling functions of the thermal diffusivity and the shear viscosity, and discuss their relevance in the ongoing search for the QCD critical point.

HK 32.5 Thu 15:00 PHIL C 601

Out-of-equilibrium scaling in driven first-order phase transitions — •Leon Sieke[1], Jessica Fuchs[1], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Gießen, Germany — [2]Helmholtz

Forschungsakademie Hessen für FAIR (HFHF), Campus Gießen, 35392 Gießen, Germany

First-order and critical phase transitions behave qualitatively different under nearly adiabatic conditions. The former proceed through nucleation and growth, and are accompanied by metastability and hysteresis, while the latter feature diverging correlations and universal scaling. When transitions occur in finite time, non-equilibrium effects gain relevance, and this sharp distinction becomes blurred.

We investigate the real-time dynamics of a Z_2-symmetric scalar field theory in the dynamic universality class of Model A in driven phase transitions across the first-order line using classical-statistical lattice simulations. We find that universal non-equilibrium scaling can emerge even in the first-order region, provided the driving is fast enough to avoid nucleation but slow enough for correlations to form. The resulting scaling behavior is analogous to the Kibble-Zurek mechanism and we compute the associated universal scaling functions for the order parameter.

Our results clarify how universal behavior can arise in driven first-order phase transitions and delineate the conditions under which nucleation, scaling, or trivial mean-field behavior dominate.

HK 32.6 Thu 15:15 PHIL C 601

Critical Behavior of $O(N)$ Model G in the large-N Limit — •Jonas Hirsch[1], Johannes V. Roth[1], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, 35392 Giessen, Germany

The chiral phase transition of QCD in the limit of two massless quark flavors is widely believed to be of second order in the $O(4)$ universality class. Since the work of Rajagopal and Wilczek, its dynamic universality class is then expected to be an $O(4)$ extension of the original Model G by Halperin and Hohenberg. The characteristic feature of this dynamic model is the reversible mode coupling between the conserved iso-(axial-)vector charges and the chiral condensate as the order parameter field which all relax at equal rates due to *strong dynamic scaling* [1]. In this talk, we will consider Model G with a generalized N-component order parameter, for which we perform the limit $N \to \infty$. We show exact results for the universal spectral function in the symmetric phase by using large-N counting rules for Dyson-Schwinger equations. Furthermore, we discuss an extension to the broken phase and a nonzero external source, which corresponds to a non-vanishing quark mass. Lastly, we investigate the loss of the strong-scaling fixed point, and how it could be recovered by NLO correction.

[1] J.V. Roth, Y. Ye, S. Schlichting, L. von Smekal, *Dynamic critical behavior of the chiral phase transition from the real-time functional renormalization group*, JHEP, vol. 01, 2025, p. 118

HK 32.7 Thu 15:30 PHIL C 601

Critical dynamics with the analytically continued functional renormalization group — •Patrick Niekamp[1], Johannes Roth[1], and Lorenz Von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, 35392 Giessen, Germany

Euclidean approaches such as the functional renormalization group (FRG) have been abundantly and successfully used to study the universal static critical behavior of various physical systems near continuous phase transitions. For the study of critical dynamics, on the other hand, one usually relies on real-time methods. Our research aims to connect and relate the two approaches by comparing analytically continued (aFRG) and real-time FRG on the closed time path. In particular, we investigate the dynamic critical behavior of a dissipative open quantum system near equilibrium in the spirit of the Caldeira-Leggett model with the aFRG and compare that with real-time results for the dynamic universality class of the corresponding Model A (according to the classification by Halperin and Hohenberg). The long-term goal of this project is to understand the merits and limitations of studying more complicated critical dynamics, including conservation laws and reversible mode couplings as relevant for QCD, with analytically continued Euclidean versus real-time approaches.

HK 33: Nuclear Astrophysics IV

Time: Thursday 13:45–15:45 Location: PHIL A 602

HK 33.1 Thu 13:45 PHIL A 602

Systematic Study of EOS Effects in BNS Mergers — •Maximilian Jacobi — Friedrich-Schiller-Universität, Jena, Germany

Observations of binary neutron star (BNS) mergers are among the most promising opportunities to constrain the nuclear equation of state (EOS) at intermediate to high density with multi-messenger astronomy. Vice versa, it is crucial to understand how observables such as gravitational waves and the ejection of matter depend on the EOS. However, most BNS merger simulation studies employ a relatively small number of EOS models chosen in an arbitrary fashion due to the limited availability of EOS models. Therefore, derived relations between observables and EOS properties are usually given in terms of single parameters such as the tidal polarizability or the radius of a cold neutron star of a characteristic mass. In this talk I will present a set of BNS merger simulations employing a set of microphysical EOS with systematically varied properties. This approach allows us to study the impact of the EOS properties at high and intermediate densities independently and derive a more detailed understand of the interplay between BNS mergers and nuclear physics.

HK 33.2 Thu 14:00 PHIL A 602

Binary neutron stars: multi-messenger analyses to constrain equation of state — •Giulia Huez — Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität Jena, 07743, Jena, Germany

Binary neutron star mergers are exceptional laboratories for probing the properties of nuclear matter at supranuclear densities. To extract the physical parameters of these systems and gain insights into the underlying physics, Bayesian parameter estimation techniques have been extensively employed in multi-messenger observations of gravitational waves, kilonovae, and gamma-ray bursts. In this talk, I will present results from a joint and coherent multi-messenger analysis of GW170817, the first observed binary neutron star merger. This comprehensive approach enables tighter constraints on the extrinsic parameters of the system, such as distance and inclination, while also incorporating numerical-relativity-informed relations that connect observable quantities to the intrinsic binary properties. Through this kind of analysis, we achieve improved precision in the inference of neutron star equation of state. Furthermore, I will discuss how these results highlight key areas where future numerical-relativity simulations should focus to improve our phenomenological models, particularly for kilonovae, postmerger gravitational waves, and numerical-relativity-informed relations, thereby enhancing the accuracy and robustness of future analyses.

HK 33.3 Thu 14:15 PHIL A 602

Quantifying uncertainties for the nuclear equation of state in β-equilibrium — •Hannah Göttling[1,2], Luis Hoff[1,2], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Planck-Institut für Kernphysik, Heidelberg

The nuclear equation of state (EOS) characterizes the properties of matter as a function of density, temperature, and proton fraction, and thus connects microscopic strong interaction calculations with descriptions of compact objects in astrophysics. Focusing on the low-density regime, chiral effective field theory (EFT) provides a systematically improvable description of nuclear systems. With Gaussian processes (GPs) we construct an emulator to realize non-parametric evaluations of the EOS considering correlations among independent variables and calculate derivatives to provide thermodynamic quantities. Moreover, we employ GPs for a statistical description of chiral expansion coefficients and apply Bayesian statistics to assess the EFT truncation errors. This leads to a range of the EOS for nuclear matter in β-equilibrium with propagated EFT truncation uncertainties.

Funded by the LOEWE Top Professorship LOEWE/4a/519/05.00.002 (0014)98.

HK 33.4 Thu 14:30 PHIL A 602

Probing Energetic Supernovae Through Nebular Phase Modeling — •Giacomo Ricigliano — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, Heidelberg 69117, Germany

Energetic supernovae are promising sites for heavy element nucleosynthesis and exhibit a wide range of explosion mechanisms, yet the observational signatures of these processes remain difficult to interpret. In particular, the presence of r-process material in non-merger transients is still uncertain, and the physical engines powering the most energetic stripped-envelope supernovae (such as central engine activity or ejecta-CSM interaction) are not yet well constrained. Nebular phase observations offer a direct way to address these questions, as they probe the inner ejecta where nucleosynthesis products and explosion physics are most clearly imprinted. We model optically thin nebular plasmas in full NLTE, including compositions extending up to the third r-process peak. We find that even modest amounts of heavy neutron-rich material generate distinct forbidden fine-structure emission in the near- to mid-IR, making this wavelength range highly sensitive to r-process signatures. In parallel, we examine how variations in ionization structure, line strengths, and line profiles can serve as diagnostics of central engine activity or ejecta-CSM interaction. Together, these results highlight the diagnostic potential of late-time IR and optical spectroscopy for uncovering both heavy element production and the physical mechanisms driving extreme stellar explosions.

HK 33.5 Thu 14:45 PHIL A 602

Role of composition and neutrino spectra in the collapse of massive stars — •Justin Schäfer[1,2], Gabriel Martínez-Pinedo[1,2], and Oliver Just[2] — [1]Institut für Kernphysik (Theoriezentrum), TU Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The collapse of massive stars after iron core formation is determined by electron captures on a broad range of nuclei. To understand this, a description of electron captures and accurate determination of the composition is crucial. In this work we aim to explore the impact of compositional changes on the deleptonization rate, most important nuclei, and neutrino luminosities. We show that different treatments of partition functions, which govern the distribution of nuclear states at given temperatures and densities, influence the individual composition, and thus most important nuclei, substantially. However, the deleptonization rate and therefore the evolution of the collapsing star is rather unaffected by the detailed composition of matter, leading to similar neutrino luminosities. It turns out that the neutrino spectra, rather than precise rates, determine the final conditions in the core. This work is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245, and MA 4248/3-1 and the European Research Council (ERC) under the European Union*s Horizon 2020 research and innovation programme (ERC Advanced Grant KILONOVA No.885281).

HK 33.6 Thu 15:00 PHIL A 602

Super-FRS Ion Catcher - Overview and Progress — •Jamie Harkin for the Super-FRS Experiment-Collaboration — Justus-Liebig-Universität Gießen

The Super-FRS Ion Catcher (Super-FRS-IC) setup will enable the measurements of beta-delayed (multiple-)neutron emission probabilities (Pxn) i.e., data for r-process nucleosynthesis models that is lacking the most. Moreover, the setup will study multi-nucleon transfer (MNT) reactions driven by secondary beams as a promising method for accessing the unexplored heavy neutron-rich nuclei. These topics will be in focus in the Early- and First-Science programs at the Super-FRS at FAIR. The Super-FRS-IC will also provide thermalized, low emission beams to the LaSpec and MATS experiments. With the Super-FRS-IC, the exotic nuclei produced at relativistic energies and separated in-flight will be thermalized in the Cryogenic Stopping Cell (CSC), transported over a radio frequency quadrupole (RFQ) beamline and analyzed in the Multiple-Reflection Time-Of-Flight Mass-Spectrometer (MR-TOF-MS). This contribution presents the status of the construction of the Super-FRS-IC and an outlook to the experiments to be performed.

HK 33.7 Thu 15:15 PHIL A 602

The DT neutron generator in Dresden: Fusion reactor studies, neutron activation analyses and nuclear astrophysics — •Steffen Turkat[1], Toralf Döring[2], Axel Klix[3], Björn Lehnert[1], Max Osswald[1], Frederik Uhlemann[1], and Kai Zuber[1] — [1]Institut für Kern- und Teilchenphysik, TU Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf — [3]Institut für Neutronenphysik und Reaktortechnik, Karlsruher Institut für Technologie

The Deuterium-Tritium neutron generator of TU Dresden delivers proton and deuteron beams of several milliamperes with energies of up to 350 keV. So far, its primary application was focused on the generation of 14 MeV neutrons via the ^{3}H(d,n)^{4}He reaction, achieving rates of up to 10^{12} neutrons per second. It is therefore Europe's most intense facility of its kind, dedicated mainly to fusion reactor research and neutron activation analyses.

In addition, the laboratory's scope extends to an even broader range of activities, including cross-section measurements, implantation studies, nuclear astrophysics, neutrino physics and others. This contribution will focus on the facility's relevance for fusion reactor studies, but also trace its past, present, and future, as it transitions into a multi-purpose laboratory.

HK 33.8 Thu 15:30 PHIL A 602

Background radiation measurements and muon simulations for nuclear astrophysics in the new low seismic lab of the DZA — •Simon Vincent[1,2], Daniel Bemmerer[3], Günther Hasinger[1,2], Michèle Heurs[4,2,5], Mike Lindner[2], and Konrad Schmidt[3] — [1]TU Dresden — [2]Deutsches Zentrum für Astrophysik (DZA) — [3]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [4]Leibniz-Universität Hannover — [5]DESY Zeuthen

The German center for astrophysics (DZA, Deutsches Zentrum für Astrophysik) plans to build, among other projects, a 200 m deep underground facility. The facility is called the Low Seismic Lab (LSL) and will be placed in Lusatia, at a precise location still to be determined. Here we report on studies relevant to future nuclear and astroparticle experiments in LSL, in order to estimate the remaining cosmic-ray induced radiation background. The specific natural radioactivity of samples of several ~250 m deep drill holes called DZA02, DZA03, and DZA05, respectively, has been determined using γ-ray spectroscopy at the Felsenkeller underground lab (Dresden), with a non-destructive technique including sample geometry modelling. In addition, GEANT4-based simulation studies of cosmic muon propagation have been performed to calculate the muon and neutron flux in LSL.

HK 34: Fundamental Symmetries I

Time: Thursday 13:45–15:00 Location: AM 00.021

Group Report HK 34.1 Thu 13:45 AM 00.021
The P2 experiment at MESA — Sebastian Baunack[1], Maarten Boonekamp[4], Boris Gläser[1], Shruti Gudla[1], Jayanta Naik[1], Rahima Krini[1], Frank Maas[1,2,3], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], Siddharth Thakker[1], and •Malte Wilfert[1] — [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 — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

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 an accuracy of 0.15% at a low four-momentum transfer of $Q^2 = 4.5 \cdot 10^{-3}\,\mathrm{GeV}^2$. In combination with existing measurements at the Z pole with comparable accuracy, this comprises a test of the standard model with a sensitivity towards new physics up to a mass scale of 50 TeV. The experiment is being set up at the MESA accelerator in Mainz. In this talk, the motivation and challenges for this measurement will be discussed together with the current status of the construction of the P2 experiment.

Group Report HK 34.2 Thu 14:15 AM 00.021
The Mu2e experiment at Fermilab: a status report in view of the first data taking phase — •Anna Ferrari, Stefan E. Mueller, Oliver Knodel, and Reuven Rachamin for the Mu2e-Collaboration — Helmholtz- Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently entering the final installation phase at the Fermi National Accelerator Laboratory in USA, will search for the charged-lepton flavor violating neutrino-less conversion of negative muons into electrons in the field of an aluminum nucleus. A conversion signal would require physics beyond the Standard Model, and the aim of Mu2e is to reach a single-event sensitivity four order of magnitude better than previous experiments. This can be achieved through an efficient production and transport of the muon beam, a rigorous control of all backgrounds that could mimic the monoenergetic conversion electrons, and an accurate normalization of the signal events. The present status of the Mu2e experiment will be presented, while the main detector subsystems has been installed at their final locations inside the Mu2e hall, and the strategies of the first data taking period have been defined.

HK 34.3 Thu 14:45 AM 00.021
High-precision Q-value measurements for neutrino physics using the JYFLTRAP Penning trap — •Jouni Ruotsalainen[1], Elina Kauppinen[1], Anu Kankainen[1], Tommi Eronen[1], Maxime Mougeot[1], Vikas Kumar[1], Jouni Suhonen[1,2], Jenni Kotila[2,3], Zhuang Ge[1], and Marek Stryjczyk[1] — [1]University of Jyväskylä, Department of Physics, Accelerator Laboratory, P.O. Box 35(YFL) FI-40014 University of Jyväskylä, Jyväskylä, Finland — [2]International Centre for Advanced Training and Research in Physics (CIFRA), P.O. Box MG12, 077125 Bucharest-Măgurele, Romania — [3]Finnish Institute for Educational Research, University of Jyväskylä, P.O. Box 35, Jyväskylä FI-40014, Finland

In this contribution, I will present the results and conclusions of the precise Q-value measurements of the $^{110}\mathrm{Ag}^m$ beta decay, and ^{104}Ru and ^{122}Sn double-beta decays, and the utilized JYFLTRAP double Penning trap system at the University of Jyväskylä, Finland. These nuclides are possible candidates for future experiments studying the mass of the neutrino and whether the neutrino is its own antiparticle. In collaboration with the nuclear theory group at the University of Jyväskylä, the half-lives of the decays were calculated to determine the feasibility of observing these decays. While the $^{110}\mathrm{Ag}^m$ was determined to be a suitable candidate for neutrino mass measurements, the half-lives of ^{104}Ru and ^{122}Sn neutrinoless double-beta decay were estimated to be too long for the decays to be observed with current experimental sensitivity.

HK 35: Instrumentation VI

Time: Thursday 13:45–15:45 Location: PHIL A 301

Group Report HK 35.1 Thu 13:45 PHIL A 301
First-level Event Selector of CBM — Jan de Cuveland[1,2], Dirk Hutter[1,2], and •Andreas Redelbach[1,2] for the CBM-Collaboration — [1]Frankfurt Institute for Advanced Studies — [2]Goethe University Frankfurt, Germany

In the upcoming CBM experiment at GSI/FAIR very high interaction rates with multiple free-streaming triggerless detectors create huge amounts of data which must be processed in real-time. The First-level Event Selector (FLES) serves as the central event selection system of CBM. It functions as a high-performance computer cluster performing the online analysis of physics data, including full event reconstruction, at the incoming design data rate. Combining data from approximately 5000 input links to self-contained, overlapping processing intervals and distributing them to compute nodes form the basis for subsequent steps of online reconstruction and event selection. Timeslice intervals can be built efficiently over a high-throughput InfiniBand network and distributed to online computing resources for full online event reconstruction and analysis in a heterogeneous HPC cluster system. This also includes specialized algorithms for efficient processing of timeslice intervals in 4-D, and finally selecting the events relevant for storage. This presentation summarizes the status of the CBM FLES project. A particular focus will be on the underlying design combining maximum performance and flexibility with minimum memory consumption. Also recent developments will be shown that have been successfully tested at the CBM predecessor experiment mCBM.

This work is supported by BMBF (05P21RFFC1).

HK 35.2 Thu 14:15 PHIL A 301
Implementation of the DOGMA DAQ for the P371 Experiment at CERN — •Huagen Xu and Michael Traxler for the DOGMA-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The P371 experiment at CERN investigates whether antiprotons are initially polarized during production in high-energy proton collisions with an unpolarized target. To test this hypothesis, a dedicated measurement was prepared at the T11 beamline in the East Area of the CERN PS. Assuming an analyzing power of approximately 4.5% in the CNI (Coulomb-Nuclear-Interference) region of antiproton-proton elastic scattering, the polarization can be detected by measuring the left-right asymmetry of elastic events at scattering angles around 10 mrad using a 3.5 GeV/c antiproton beam. The measurement concept is to use a liquid hydrogen target as an analyzer, with incident and scattered particle tracks reconstructed using tracking detectors, including straw tubes and microfibers, upstream and downstream of the target. Scattered antiprotons are identified and distinguished from background using a DIRC system for offline particle identification.

To fulfill this measurement, a new data acquisition system, DOGMA, was implemented for the first time, handling roughly 1800 readout channels. DOGMA is a modular DAQ board offering 32 input channels with an integrated amplifier (maximum gain of 30), discriminator, and TDC. The performance of the DOGMA system for the beam time will be presented.

HK 35.3 Thu 14:30 PHIL A 301
High throughput cluster finding on the readout FPGA for the CBM-TRD — •David Schledt for the CBM-Collaboration — Goethe University Frankfurt am Main, Germany

The CBM experiment at FAIR/GSI in Darmstadt, will measure rare diagnostic probes of the QCD phase diagram at interaction rates of up to 10 MHz with high sensitivity and statistics. The CBM DAQ is based on self-triggered readout electronics resulting in large amount of data, which has to be processed in real time. The SPADIC readout

ASIC transmits the full pulse shape information and features forced neighbor readout. Therefore, the initially produced data volume is relatively high, which lends itself for processing on the readout FPGA. The first processing step to reduce the data volume is to extract the information encoded in the pulse shape, ie. the energy and time. The next step to further reduce the data volume before the online processing is to combine adjacent channel hits into clusters. As CBM runs without a trigger system the hits need to be grouped in time and space in real time. Therefore, a fast high throughput cluster finding algorithm is necessary to process the data without data losses. This work will present how such an algorithm can be implemented on the readout FPGA, with a particular focus on the implementation with high-level-synthesis (HLS).

Supported by: German BMFTR-grants 05P24PM1 and 05P24RF2

HK 35.4 Thu 14:45 PHIL A 301

Investigations of the integrating readout system of the P2 experiment at MESA — Sebastian Baunack[1], Michael Gericke[3], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,4], Jayanta Naik[1], •Moran Neher[1], Tobias Rimke[1], Siddharth Thakker[1], and Malte Wilfert[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]Department of Physics and Astronomy, University of Manitoba, Winnipeg, Canada — [4]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The P2 experiment aims for a high precision measurement of the weak mixing angle, a fundamental parameter of the Standard Model. The weak mixing angle will be extracted from the parity-violating asymmetry in elastic electron-proton scattering at low momentum transfer, with an expected raw asymmetry of $A_{\mathrm{raw}} = 0.2403 \times 10^{-7}$. The central component of the detector system is an integrating Cherenkov ring detector, which measures the flux of scattered electrons. The flux depends on the helicity of the electron beam and gives rise to the production of Cherenkov light.

The detector modules consist of a photomultiplier tube, the P2 voltage divider and pre-amplifier and the P2 sampling ADC. In this presentation, the P2 experiment is introduced and the current status of the readout system is presented.

HK 35.5 Thu 15:00 PHIL A 301

Trigger system based on time-spatial correlations for SiPM-RICH detectors — •Jesús Peña-Rodríguez for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

Future experiments in high-energy physics work on new detection technologies with higher time and spatial resolution. This will enhance data quality to search for specific decay channels or interaction products. Detectors employed for particle identification use different technologies, geometries, and algorithms. Ring Imaging Cherenkov (RICH) detectors are one of them; they record Cherenkov rings from charged particles traversing a radiator medium and discriminate between particles depending on the angle of the Cherenkov emission. New RICH techs explores Silicon Photomultipliers (SiPMs) as photon detectors. SiPMs provide high time resolution, spatial granularity, magnetic field immunity, mechanical robustness, and low material budget. Nevertheless, high dark count rates and low radiation tolerance challenge the implementation of SiPMs in RICH detectors. We explore a trigger system that exploits Cherenkov ring features: spatial correlation (circular/ellipsoidal shape) and time coincidence (picosecond arrival time) of Cherenkov photons. This approach rejects most of the fake events caused by DCR, saving buffer and bandwidth. We performed MC simulations to generate realistic SiPM noise and Cherenkov rings. These signals were injected into the digital implementation (FPGA Lattice ECP5) of the trigger system to evaluate its signal-to-noise ratio and detection efficiency.

HK 35.6 Thu 15:15 PHIL A 301

An Automated Test Setup for Pipeline ADC Characterization — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Harald Deppe[2], Holger Flemming[2], Ravi Gowdru Manjunata[1], •Alexander Lehnen[1], Frank Maas[1,2], Oliver Noll[1], Paul Schöner[1], Christoph Rosner[1], Peter Wieczorek[2], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

An analog-to-digital converter (ADC) chip is being developed at the GSI Darmstadt for the readout of the electromagnetic calorimeter of the PANDA detector. To enable characterization of this chip, a test setup was designed and implemented at the Helmholtz Institute Mainz. The setup allows fully automated measurements over a wide range of clock frequencies and input signal frequencies. This enables systematic investigation of both calibration behavior and dynamic performance. Its modular design provides flexibility, allowing extensions and improvements as needed. An implemented server allows multiple users to connect simultaneously and control measurements remotely. This architecture, combined with full automation, allows for reproducible testing of current and future ADC chips.

HK 35.7 Thu 15:30 PHIL A 301

Further Development of the Calibration Routine for the High-Voltage Regulation PCB for the P̄ANDA Barrel Electromagnetic Calorimeter (EMC) — •Karl Simon Habermehl, Kai-Thomas Brinkmann, Hans-Georg Zaunick, and Aniko Tim Fenske for the PANDA-Collaboration — 2nd Physics Institute, Justus Liebig University, Giessen, Germany

The barrel section of the electromagnetic calorimeter (EMC) of the PANDA experiment at the future FAIR accelerator is designed to achieve excellent photon energy resolution over a wide dynamic range. To reach this level of precision, the various calorimeter subsystems (in particular the readout and front-end electronics) require careful optimization.

One of the most important components is the high-voltage distribution electronics (HVD), which supplies the avalanche photodiodes (APDs) with the bias voltages and therefore defines their gain. Since the performance of the HVD is temperature dependent and the operating temperature cannot be predicted accurately, it must be calibrated over a wide temperature range. For this purpose, a routine for series calibration of the HVD-PCBs has been developed. This contribution will give an impression of the currently running calibration procedure and foreseen improvements as well as some of the calibration results.

Supported by BMFTR, GSI and HFHF.

HK 36: Instrumentation VII

Time: Thursday 13:45–15:45 Location: PHIL B 302

Group Report HK 36.1 Thu 13:45 PHIL B 302
The Silicon Tracking System for the CBM Experiment: Series Production and Detector Performance Evaluation — •Lady Maryann Collazo Sanchez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) investigates strongly interacting matter at high baryon densities. Its core tracking subsystem, the Silicon Tracking System (STS), provides charged–particle tracking and momentum reconstruction at interaction rates up to 10 MHz within a free–streaming data acquisition scheme, reconstructing around 10^3 charged tracks per nucleus–nucleus collision. The STS consists of eight tracking stations equipped with 876 double-sided silicon microstrip modules mounted on low-mass carbon–fiber ladders to minimize material budget. Prototype STS components were tested in beam experiments within the mini–CBM (mCBM) setup at SIS18 and in the E16 experiment, validating detector performance, free–streaming readout, and online reconstruction.

This report summarizes the current status of the STS project. Series production of modules and ladders is ongoing, and detector construction is in progress. It describes the full sequence of electrical, mechanical, and performance qualification procedures for modules, ladders, and half-unit assemblies. It presents results from comprehensive beam–based performance studies, detector controls, and the final readout chain.

HK 36.2 Thu 14:15 PHIL B 302
Aluminum strip-lines on pCVD diamond carriers* — •Evadhidho Taka[1], Franz A. Matejcek[1], Christian Müntz[1], and Joachim Stroth[1,2,3] — [1]Goethe-Universität Frankfurt — [2]GSI Darmstadt — [3]Helmholtz Forschungsakademie Hessen für FAIR

The present work focuses on the aluminum metallization of pCVD (polycrystalline Chemical Vapor Deposition) diamond substrates and patterning of strip-lines. This is a generic research project with the goal of producing lightweight, vacuum compatible modules to minimize multiple scattering, highly appealing for micro-vertexing applications. Conductive traces, to perform the readout and control of silicon sensors, are introduced directly on the carrier thus obtaining pCVD diamond carriers with expanded functionalities: adding electrical connectivity along with mechanical stability and efficient heat management.

This application requires trace thicknesses up to the order of micrometers. Since combining trace sharpness, thickness homogeneity, and a process with dependable reproducibility poses a challenge, a method consisting of consecutive deposition steps is proposed. A thin Aluminum seed layer is initially sputtered into a prepped pCVD diamond surface. The layer is then precisely patterned utilizing mask-less photolithography, and the so produced lines are subsequently thickened in an electrodeposition process. This contribution introduces the method and presents first results.

*This work is affiliated with the ERuM-Pro Si-D Consortium, supported by BMFTR (05H24RF1).

HK 36.3 Thu 14:30 PHIL B 302
Update on the Developments in Optimization and Characterization for the ToASt-based Silicon-Strip-Detectors of the $\overline{\text{P}}$ANDA MVD — •Raphael Ratz[1], Kai-Thomas Brinkmann[1], Marvin Peter[1], Hans-Georg Zaunick[1], Giovanni Mazza[2], Michele Caselle[3], and Daniela Calvo[2] for the PANDA-Collaboration — [1]2nd Physics Institute, Justus Liebig University, Giessen — [2]Istituto Nazionale di Fisica Nucleare - Sezione di Torino, Turin — [3]Karlsruhe Institute of Technology, Karlsruhe

The Micro Vertex Detector (MVD) of the $\overline{\text{P}}$ANDA experiment consists of silicon strip detectors, read out by the Torino Amplifier for silicon Strip detectors (ToASt) ASIC. Each ToASt employs a multitude of parameters, some of which affect the Signal-to-Noise Ratio (SNR) of the Time-over-Threshold (ToT) measurement. Thus, an optimization and an energy calibration for the measured ToTs is favorable.

After establishing the parameters that most affect SNR, they were optimized pairwise using a grid search method with the integrated testpulser of the ToASt. As the analysis of the correlation matrix suggests multiparameter effects on the SNR, a Bayesian optimization algorithm was investigated. While covering more than two parameters simultaneously, this approach also decreases the time needed compared to a grid search, allowing each sensor channel to be optimized individually.

In addition, a calibration between the measured ToT and the deposited charge, and subsequently the deposited energy, was achieved. Lastly, a web-based user interface for configuring sensors and online analysis of measurements was developed. *Supported by BMFTR.*

HK 36.4 Thu 14:45 PHIL B 302
The Assembly and Integration of a Half-unit of the Silicon Tracking System (STS) Detector — •Gnana Sindhu Subramanya for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) investigates strongly interacting matter at high net-baryon densities. Its Silicon Tracking System (STS) provides precise tracking of charged particles in heavy-ion collisions, where tracking efficiency and vertex resolution are crucial for rare probes such as open charm and di-leptons, directly linking detector performance to CBM's physics goals.

This presentation describes the STS half-unit and the development and verification of a reliable assembly and integration protocol. Prototype components were used to simulate mechanical assembly and ensure safe handling before working with sensor modules and electronics. The protocol defines the placement of mechanical and electronic components, including ladders with Front-End Board (FEB) boxes housing front-end electronics (FEEs). Cable routing and power connections between FEBs and the readout chain were verified. Mechanical constraints were checked to prevent interference during module assembly and integration into the full STS.

HK 36.5 Thu 15:00 PHIL B 302
Amplification Based Radiation Damage Compensation in Diamond Detectors — •Yevhen Kozymka[1], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Matthias Kausel[5,6], Mladen Kis[3], Wilhelm Krüger[1], Sergey Linev[3], Jan Michel[3], Jerzy Pietraszko[3], Christian Joachim Schmidt[3], Michael Träger[3], Michael Traxler[3], Felix Ulrich-Pur[5], Matteo Centis Vignali[7], and Ashish Bisht[7] — [1]Technische Universität Darmstadt — [2]Marietta Blau Institute for Particle Physicsof the Austrian Academy of Sciences — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]EBG MedAustron — [7]Fondazione Bruno Kessler, Centre of Materials and Microsystems

Diamond detectors are widely used for beam monitoring and time zero applications due to their high timing precision, detection efficiency and radiation hardness. However, the accumulated radiation damage from heavy-ion beams eventually drops the charge collection efficiency below the detectable threshold, resulting in loss of efficiency.

Diagnostics are performed on a pcCVD diamond sensor that saw heavy use in the mCBM experiment and has an efficiency hole in the center, utilizing LGADs as reference detectors. We demonstrate the use of a two-stage amplification circuit and conversion from strip to pad readout for restoring the efficiency of a highly damaged diamond sensor with a 73 AMeV helium beam.

HK 36.6 Thu 15:15 PHIL B 302
The Super-FRS beam intensity monitor — •Chiara Nociforo[1], Matteo Alfonsi[1], Tobias Blatz[1], Joshua Alvaro Galvis Tarquino[1], Rainer Haseitl[1], Rainer Hettrich[1], Christos Karagiannis[1], Mladen Kiš[1], Martin Kumm[2], Rolf Lonsing[2], Rahul Singh[1], and Michael Träger[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Fulda University of Applied Sciences, Fulda, Germany

The beam diagnostics at the entrance of the Super-FRS, under installation at FAIR for the production of in-flight radioactive ion beams, is used to tune the separator and provide the necessary measures for machine protection and online monitoring. In addition, the high intensity of the primary SIS ion beams delivered up to the target must be stored to normalise the measured rates and extract the production cross sections of the new secondary ion beams. The main design challenge is to cope with the high intensities and the expected background radiation, since the detecting system should survive for extended periods of operation without hands-on maintenance. Two complementary CVD diamond detectors with excellent radiation resistance were built as reference counting detectors up to few MHz particle rate, overlapping with the standard intensity monitors at FAIR. Customised electronics with large dynamic range developed for the readout of the diamond analogue signals was coupled to the detector and tested at the pre-assembled target vacuum chamber. The design of the Super-FRS intensity monitor and its peculiarity will be presented and the latest achievements of the performed tests will be reported.

HK 36.7 Thu 15:30 PHIL B 302

Development and performance of the readout board of the STS detector for the CBM experiment — •Patryk Semeniuk for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany — Goethe University Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany — AGH University of Krakow, Mickiewicza 30, 30-059 Kraków, Poland

The Silicon Tracking System (STS) of the CBM experiment requires a high-bandwidth readout chain operating under strict spatial and performance constraints. A new generation of STS Readout Boards (STS-ROB), developed as the successor to the CROB, forms the concentrator stage between the front-end electronics and the CRI-based backend. Each STS-ROB integrates three GBTx ASICs, a Versatile Link optical interface, and connectivity optimized for AC-coupled 320-Mb/s LVDS E-Links from front-end ASICs at different sensor bias potentials.

Recent work focused on commissioning and integration of the STS-ROB into the readout chain using the CBM Common Readout Interface (CRI) and the self-developed Readout-Powering Board (RPoB). Stable GBTx initialization, reliable optical and electrical communication, and robust power delivery were demonstrated, confirming that the STS-ROB meets the system's operational requirements.

In the final detector, the STS will comprise several hundred STS-ROB units with dedicated addon and powering boards; the concept, integration results, and current status of the STS-ROB will be presented.

HK 37: Hadron Structure and Spectroscopy VII

Time: Thursday 16:15–18:00 Location: PHIL C 301

Group Report HK 37.1 Thu 16:15 PHIL C 301

Measurements of two-photon scattering reactions at the BESIII experiment as inputs to the Hadronic Light-by-Light contribution to $(g-2)_\mu$ — Achim Denig, Max Lellmann, Jan Muskalla, and •Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

While recently agreement between the direct measurements and the Standard Model prediction of the anomalous magnetic moment of the muon was reported, further improvement of the prediction is required to match the precision of the measurement. The prediction is limited by the knowledge of the hadronic contributions, which can be calculated from data-driven approaches. One of these contributions is the hadronic Light-by-Light scattering. It depends on the knowledge of transition form factors of light pseudoscalar, scalar, axial, and tensor mesons as well as the coupling of multi-meson systems to two photons, which are accessible in e^+e^- collisions.

The BESIII experiment, operated at the BEPCII accelerator in Beijing, China, has collected the world's largest data sets of e^+e^- collisions in the τ-charm region between 2 GeV and 5 GeV. The recently completed $20\,\mathrm{fb}^{-1}$ data set at 3.773 GeV is ideally suited to study the momentum-transfer dependence of transition form factors at space-like momentum transfers of $Q^2 \approx 1\,\mathrm{GeV}^2$, which is of special relevance in the context of a_μ. In this presentation we discuss recent results, ongoing projects, and future prospects of the measurements at the BESIII experiment. — Supported by DFG FOR5327

HK 37.2 Thu 16:45 PHIL C 301

Probing hyperon-hyperon interactions with CBM at FAIR — •Gandharva Appagere for the CBM-Collaboration — Stockholm University, Stockholm, Sweden

Hyperons play a central role in the composition of dense baryonic matter and are expected to emerge in the cores of neutron stars at supra-nuclear densities, influencing the equation of state. A quantitative understanding of hyperon-hyperon interactions, governed by non-perturbative QCD, is therefore essential for constraining the properties of dense matter. In this contribution, recent studies of multi-strange baryon interactions are presented with the framework of the Compressed Baryonic Matter (CBM) experiment at FAIR as a part of "QCD at FAIR" initiative. Using realistic CBM simulation data for high-rate proton-proton collisions, we investigate $\Lambda\Lambda$ and $\Sigma^+\Sigma^+$ systems. We emphasize on interaction signatures such as cusp effects and near-threshold structures, explored using dispersion-relation-based approaches based up on Monte Carlo simulations of exclusive reaction channels. The presented results establish a solid methodological foundation for future measurements with CBM and illustrate its potential to provide crucial experimental constraints on hyperonic interactions relevant for neutron-star matter.

HK 37.3 Thu 17:00 PHIL C 301

Measurement of the chiral anomaly at COMPASS — •Jan Friedrich for the COMPASS-Collaboration — Physik-Department, Technische Universität München, Garching

Using the Primakoff technique for 190 GeV pions on nuclear targets, we have determined the chiral anomaly in the process $\pi\gamma \to \pi\pi^0$ with unprecedented precision. We report on the challenges of background subtraction, radiative corrections and the luminosity determination.

HK 37.4 Thu 17:15 PHIL C 301

The GSI pion beam program: QCD-driven studies of hadron structure and dynamics — •Marvin Kohls — GSI Helmholtzzentrum für Schwerionenforschung GmbH

We present plans for the upcoming pion beam program at GSI from 2027 on. This program leverages secondary pion beams (< 2 GeV/c) in combination with the HADES spectrometer to address fundamental questions in strong QCD physics with a focus on precision studies in the fields of baryon spectroscopy and structure. We will determine baryon-meson coupling constants and electromagnetic transition form factors in the time-like region. With the planned beam intensities we expect to collect enough statistics to enable detailed partial wave analyses and the study of rare decay channels. These measurements are crucial for understanding hadron structure and for modeling dilepton emission in heavy-ion collisions. As a complementary focus, we study vector meson properties in cold nuclear matter through dielectron spectroscopy. The program will investigate in-medium modifications of vector mesons and their relation to chiral symmetry restoration. This program represents a principal component of the broader QCD-driven roadmap at GSI/FAIR (QCD at FAIR), bridging nuclear, hadron, and heavy-ion physics communities while complementing photon beam facilities worldwide.

HK 37.5 Thu 17:30 PHIL C 301

Physics performance studies of the CBM Neutron Calorimeter (NCAL) — •Dachi Okropiridze[1,2], Dieter Grzonka[2,3], and James Ritman[2,1,3] for the CBM-Collaboration — [1]Ruhr-Universitat Bochum (RUB), Bochum, Germany — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Julich (FZJ), IKP-1, Julich, Germany

The Compressed Baryonic Matter (CBM) experiment at FAIR aims to explore the QCD phase diagram at high net-baryon densities. Event characterization and centrality determination are currently provided by the Forward Spectator Detector (FSD), which measures charged projectile spectators. To include neutral spectators, a forward neutron calorimeter (NCAL) based on segmented plastic scintillators is proposed. This upgrade is expected to improve impact-parameter reconstruction and constrain collective flow observables.

In addition to heavy-ion reactions, NCAL enables a vibrant program in elementary reactions using the same experimental setup. We present Monte Carlo studies of channels with final-state neutrons to explore the detector's physics reach. Standalone Monte Carlo simulations characterize the NCAL response, focusing on detection efficiency and energy deposition over the relevant energy range. By propagating simulated events through the model, we obtain detector-level observables. Taken together, these studies provide first estimates of NCAL's performance for spectator measurements in heavy-ion collisions and neutron-sensitive spectroscopy in elementary channels.

HK 37.6 Thu 17:45 PHIL C 301

Performance studies of the CBM Forward Spectator Detector for (pp and) dp-reactions — •Ruijia Yang[1], Frank Goldenbaum[1,2], and Petr Chaloupka[3] for the CBM-Collaboration — [1]Bergische Universität Wuppertal — [2]GSI — [3]Czech Technical University

The Forward Spectator Detector (FSD) of the CBM (Compressed Baryonic Matter) experiment plays a crucial role in both heavy-ion and proton-proton (pp) collisions. In pp interactions, the FSD is designed to identify events with small momentum transfer, typically dominated by elastic or quasi-elastic scattering, where the outgoing protons retain most of their energy and are deflected at very small angles. This contribution presents recent simulation studies performed to optimize the granularity and geometry of the FSD. With the full CBM geometry, the impact of the FSD module size, beam-pipe shape and material budget on the spatial resolution and detection efficiency has been systematically investigated. In addition, two event generators – a Fritiof (FTF) event generator and a PLUTO-based generator – have been implemented to simulate deuteron-proton (dp) reactions in CBM, in order to investigate the capability of CBM to study quasi-free pp and proton-neutron (pn) reactions. Integration of these generators into the CBM simulation is ongoing, and first results – together with updated FSD performance studies – will be presented at the conference.

HK 38: Hadron Structure and Spectroscopy VIII

Time: Thursday 16:15–18:00 Location: PHIL A 401

Group Report HK 38.1 Thu 16:15 PHIL A 401

Studies of $\Lambda(1405)$ photoproduction at BGOOD — •Antonio Joao Clara Figueiredo for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The $\Lambda(1405)$ has long been considered a prime candidate for an unconventional hadronic state, with strong evidence supporting a dynamically generated meson-baryon molecular structure. To clarify the nature of the $\Lambda(1405)$, precise measurements of its line shape and differential production cross sections are essential.

The BGOOD experiment at the ELSA facility provides an ideal environment for the investigation of $\Lambda(1405)$ photoproduction at low momentum transfer. BGOOD combines a central electromagnetic calorimeter for neutral meson reconstruction with a forward magnetic spectrometer for charged particle identification, enabling access to very low momentum transfer kinematics which may be sensitive to molecular production mechanisms.

I will report on the current status of the $\Lambda(1405)$ investigation at BGOOD in the photoproduction reaction $\gamma p \to K^+\Lambda(1405)$. Measurements of line shapes and differential cross sections will be presented, with particular emphasis on the $\Sigma^0\pi^0$ decay channel and ongoing studies of the predicted two-pole structure of the $\Lambda(1405)$.

HK 38.2 Thu 16:45 PHIL A 401

η' beam asymmetry at threshold using the BGOOD experiment — •Leoni Lutter for the BGOOD-Collaboration — Physikalisches Institut

The unexpected nodal structure of the beam asymmetry reported by the GRAAL collaboration in η' photoproduction very close to threshold could be explained by a previously unobserved very narrow resonance. BGOOD is one of the few experiments worldwide which is able to verify this result. The experiment is composed of a central calorimeter for neutral meson decays and a forward spectrometer for charged particle identification. Close to threshold the $\gamma p \to \eta' p$ reaction can be reconstructed over all centre-of-mass angles from proton identification at forward angles. A linearly polarised photon beam produced via coherent bremsstrahlung off a diamond radiator makes it possible to measure the η' beam asymmetry. Preliminary results of the $\gamma p \to \eta' p$ beam asymmetry will be presented.

HK 38.3 Thu 17:00 PHIL A 401

Investigation of the reaction $pp \to ppK^+K^-$ at 4.5 GeV with HADES detector — •Valentin Kladov[1,2], Johan Messchendorp[2], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum, Bochum, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Jülich GmbH, Jülich, Germany

This study presents an exclusive analysis of the $pp \to ppK^+K^-$ reaction using data collected with the HADES detector with a 4.5 GeV proton beam. The event selection is based on a neural-network particle identification employing a domain-adversarial approach. Together with a kinematic refit imposing four-momentum conservation, the purity of the final sample reaches $S/B \approx 30$. Clear contributions from $\phi(1020) \to K^+K^-$ and $\Lambda(1520) \to pK^-$ are observed, with masses and widths consistent with the PDG data. S-wave final-state interactions are investigated by extracting the pK^- and K^+K^- scattering-length parameters. This talk focuses on the particle identification performance studies, systematic uncertainties, and several new results, including improved angular analysis for the spin alignment of the $\phi(1020)$ resonance and a coupled-channel analysis of $\Lambda(1405) \to \Sigma^0\pi^0/pK^-$ decays.

HK 38.4 Thu 17:15 PHIL A 401

Feasibility Studies for hidden-charm Pentaquark searches with CBM — •Ralf Kliemt for the CBM-Collaboration — Ruhr-Universität Bochum, Bochum, Germany — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

We investigate the feasibility to measure the direct production of pentquark-like states at the CBM experiment at FAIR in proton-proton collisions. For these, we performed feasibility studies by evaluating the performance assuming the three LHCb-discovered pentaquark states. Using GEANT4-based simulations we analyzed the reaction to ppJ/ψ in the e^+e^- decay channel of the J/ψ at a beam energy of 29 GeV. The study demonstrates CBM's excellent capabilities with an invariant mass resolution for the pJ/ψ system below 7 MeV/c^2 and signal acceptance × efficiency exceeding 10% whilst reducing background by $\mathcal{O}(10^{-9})$. Our results confirm CBM can provide high-precision measurements of pentaquarklike state properties through an independent production mechanism, offering crucial complementary data to the inclusive measurements and significantly advancing understanding of exotic hadronic states.

HK 38.5 Thu 17:30 PHIL A 401

Study of exclusive η meson production in proton-proton collisions with the HADES spectrometer — •Szymon Treliński[1,2], James Ritman[2,3,4], and Izabela Ciepał[1] for the HADES-Collaboration — [1]IFJ PAN Krakow — [2]Ruhr-Universität Bochum — [3]GSI Helmholtzzentrum — [4]Forschungszentrum Jülich

Proton–proton collisions at a center-of-mass energy of 3.46 GeV, measured in February 2022 with the HADES detector at GSI, provide great opportunity to study exclusive η meson production. This energy lies in the transition region between near-threshold energies, described by effective Lagrangian models, and the soft regime, where Regge phenomenology is applied. Measurements in this range help to bridge these descriptions and contribute to a more coherent understanding of nonperturbative QCD dynamics.

The analysis focuses on the exclusive reaction $pp \to pp\eta \to pp\pi^+\pi^-\pi^0$, with the η reconstructed in its $\pi^+\pi^-\pi^0$ decay channel. This channel provides high statistics due to its large branching ratio combined with good reconstruction efficiency. The study considers different event topologies to extend the accessible phase space.

The talk will present the event selection strategy, the application of the kinematic fit, the background subtraction procedure, and the multidimensional unfolding technique, together with early-stage results on the total and differential cross sections for exclusive η production.

HK 38.6 Thu 17:45 PHIL A 401

Recent Measurements of the $\Lambda(1670)$ Differential Cross Section At the BGOOD Experiment — •David Kowalk and Thomas Jude for the BGOOD-Collaboration — Physikalisches In-

stitut, Universität Bonn

The lighter $\Lambda(1405)$ resonance is commonly interpreted as a $\overline{K}N$ bound state. It is therefore to be investigated if the heavier $\Lambda(1670)$ may also exhibit this molecular structure. Forward angle K^+ identification is therefore essential. The BGOOD photoproduction experiment is ideal for these studies. It consists of a central calorimeter, ideal for the identification of hyperon decays, and a forward spectrometer for K^+ identification. I will present preliminary measurements of the $K^+\Lambda(1670)$ photoproduction differential cross section, identified via different $\Lambda(1670)$ decay modes.

HK 39: Structure and Dynamics of Nuclei VIII

Time: Thursday 16:15–18:00 Location: AM 00.011

HK 39.1 Thu 16:15 AM 00.011

Electron-Induced Fission at the S-DALINAC - Status and Objectives — •Diandra Richter, G. Steinhilber, N. Pietralla, J. Birkhan, B. Hesbacher, T. Ramaker, O. Möller, M. Arnold, and J. Isaak — IKP, Darmstadt, Germany

The origin of heavy chemical elements in the Universe remains a major open question. One of the main production mechanisms is the rapid neutron capture process. It takes place in neutron star mergers and terminates in the r-process fission cycle along very neutron-rich nuclei [1]. In the actinide region, neutron captures compete with nuclear fission, producing fragments that serve as neutron-rich r-process seeds. Accurate r-process models therefore require detailed fission data, but experimental information on fission from different excitation energies of transuranium actinides is scarce. At TU Darmstadt, a new setup for electron-induced fission is currently being developed, using electron beams from the superconducting linear accelerator S-DALINAC [2]. Silicon strip detectors will measure energies and timing of both fission fragments, while scattered electrons will be detected in coincidence using the QCLAM spectrometer. This arrangement will allow measurements of fission fragment masses as a function of excitation energy and momentum transfer. An overview of the current status will be presented in this contribution. This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under project-ID Nos. INST 163/754-1 FUGG and 499256822 GRK 2891 "Nuclear Photonics". [1] J. J. Cowan et al., Rev. Mod. Phys. 93, 015002 (2021); [2] N. Pietralla, Nucl. Phys. News 28, 4 (2018)

HK 39.2 Thu 16:30 AM 00.011

Relative ^{232}Th(γ,f) and ^{234}U(γ,f) Cross-Sections using Quasi-Monoenergetic γ-ray Beams — •Thorben Witzel[1], Dimiter Balabanski[4], Mihai Cuciuc[4], Joachim Enders[1], Sean W. Finch[2], Alf Göök[3], Calvin R. Howell[2], Annabel Ibel[1], Ronald C. Malone[7], Maximilian Meier[1], Forrest Q.L. Friesen[2], Andreas Oberstedt[4], Stephan Oberstedt[5], Marius Peck[1], Norbert Pietralla[1], Anthony P.D Ramirez[6], Jack A. Silano[6], Alexandru State[4], Gerhart Steinhilber[1], Anton P. Tonchev[6], Werner Tornow[2], and Vincent Wende[1] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [3]Uppsala Universitet, Uppsala, Sweden — [4]ELI-NP, IFIN-HH, Magurele, Romania — [5]EC-JRC Geel, Belgium — [6]Lawrence Livermore National Laboratory, Livermore, CA, USA — [7]U.S. Naval Academy, Annapolis, MD, USA

Precise and reliable data on photofisson cross-sections are essential for modeling of the r-process as well as technical applications of nuclear fission. Although fission cross-sections have been studied for over 80 years, there are still some discrepancies in the nuclear data libraries for some actinides. We analyzed count rates from ionisation chamber experiments using quasi-monochromatic γ-ray beams ranging from 6 to 12.8 MeV, investigating the shape of the cross-sections of ^{232}Th(γ,f) and ^{234}U(γ,f) using ^{238}U(γ,f) as a well known reference.
*This work is supported by the Deutsche Forschungsgemeinschaft (DFG) Project-ID 499256822 GRK 2891 Nuclear Photonics.

HK 39.3 Thu 16:45 AM 00.011

In-gas-jet laser ionization spectroscopy of the $K = 8^-$ isomer in ^{254}No — •Premaditya Chhetri for the JetRIS-Collaboration — Johannes Gutenberg Universität, Mainz, Germany

Decay and in-beam spectroscopy have provided extensive information on the level structure of heavy nuclei, but often cannot unambiguously determine the underlying single-particle structure of the nucleus. This limitation is particularly evident for the long-lived $K^\pi = 8^-$ isomer in ^{254}No, whose quasiparticle structure has remained disputed for almost two decades. In fusion-evaporation experiments, the rotational band built of this isomer is only weakly populated preventing a reliable measurement of key observables such as M1/E2 branching ratios and g-factors. Consequently, previous configuration assignments mainly relied on indirect decay patterns and comparisons with nuclear models.

Here, we report on in-gas-jet laser ionization spectroscopy measurements of the $K = 8^-$ isomer in ^{254}No performed with the JetRIS setup at the SHIP velocity filter at GSI. After stopping and neutralization in argon gas, the atoms are re-ionized in a supersonic gas jet using a two-step laser ionization scheme. The resulting hyperfine structure provides direct, nuclear-model-independent access to the magnetic dipole moment, electric quadrupole moment, and isomer shift of the $K = 8^-$ state. The deduced intrinsic g-factor allowed an unambiguous assignment of configuration of the isomer, resolving a long-standing ambiguity in the nuclear structure of ^{254}No.

HK 39.4 Thu 17:00 AM 00.011

Evolution of changes in mean-square charge radii in californium isotopes — •Kenneth van Beek for the RADRIS-Collaboration — Technische Universität Darmstadt, Deutschland — GSI Helmholtzzentrum für Schwerionenforschung, Deutschland

The experimental determination of atomic and nuclear properties such as atomic energy levels, ionization potentials, electromagnetic moments, trends in mean-square charge radii, and isotope shifts for nuclei in the region of heavy elements ($Z \gtrsim 100$) remains difficult. The main challenges are low production rates at accelerator facilities and unfavorable half-lifes of the fusion products. This necessitates the use of highly efficient and selective laser spectroscopy techniques. At GSI-FAIR in Darmstadt, Germany, the **RA**diation **D**etected **R**esonance **I**onization **S**pectroscopy (RADRIS) apparatus has been succesfully used to study aforementioned properties in $^{245,246,248-250,254}$Fm and $^{252-255}$No. The employed detection of laser ions via their α-decay became impractical for nuclei with half-lives on the order of several tens of hours using a single detector. Thus, a more versatile detector design was developed to increase the method's reach towards longer-lived nuclei. In a recent measurement campaign, the new setup was used to investigate isotope shifts in a long isotopic chain in the element californium, including ^{246}Cf with a half-life of $t_{1/2} = 35.7$ h. This talk will present laser spectroscopic results in ^{240,241,242,244,246}Cf and the extracted information for trends in changes of mean-square charge radii, complementing former investigations of $^{249-253}$Cf at the RISIKO mass separator of the Johannes Gutenberg-University Mainz, Germany.

HK 39.5 Thu 17:15 AM 00.011

First Limits on Double Alpha Decay of Ra-224 — •Makar Simonov[1] and Heinrich Wilsenach[2] for the Double Alpha at FRS Ion Catcher-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]The Hebrew University of Jerusalem, Jerusalem, Israel

The simultaneous emission of two alpha particles was proposed as an exotic way for heavy nuclei to decay about 45 years ago, and the initial conservative estimate for the branching ratio was less than 10^{-20}. Recent microscopic calculations have yielded an experimentally accessible estimate of 10^{-8} for radium isotopes with mass numbers $A = 220, 222, 224$, and an experiment to search for double alpha decay of Ra-224 was conducted at the FRS Ion Catcher, GSI, Germany.

Over four months of data taking, a 34 kBq radioactive source of Th-228 was used to produce Ra-224 ions. These ions, filtered from other Th-228 descendants by a radio-frequency quadrupole and electrostatically focused, were delivered to a thin carbon implantation foil. Two double-sided silicon strip detectors were used to record alpha and beta particles. The number of registered alpha decays of Ra-224 was approximately 10^9, which should be sufficient to verify the theoretical estimate.

This report will provide final assessments of the time and energy resolution of the detector system. The main focus is the evaluation of the random-coincidence background to set a limit on the branching ratio of the double alpha decay of Ra-224.

HK 39.6 Thu 17:30 AM 00.011

Evidence for $M1$ scissors mode states in ^{242}Pu from nuclear resonance fluorescence — •M. Beuschlein[1], J. Birkhan[1], J. Kleemann[1], O. Papst[1], N. Pietralla[1], R. Schwengner[2], S. Weiss[2], V. Werner[1], U. Ahmed[1], T. Beck[1,3], I. Brandherm[1], A. Gupta[1], J. Hauf[1], K. E. Ide[1], P. Koseoglou[1], H. Mayr[1], C. M. Nickel[1], K. Prifti[1], D. Savran[4], T. Stetz[1], and R. Zidarova[1] — [1]IKP, Darmstadt, Germany — [2]HZDR, Dresden, Germany — [3]FRIB, East Lansing, MI, USA — [4]GSI, Darmstadt, Germany

The availability of nuclear structure information on transuranium actinides supports stellar nucleosynthesis modeling and isotope-selective material inspection via photonuclear reactions. However, experimental data in this region remain scarce. The first nuclear resonance fluorescence (NRF) experiment on ^{242}Pu was conducted at the S-DALINAC at TU Darmstadt to probe its low-energy dipole response. A 1 g sample of $^{242}PuO_2$ was irradiated with bremsstrahlung up to an endpoint energy of 3.7 MeV. By comparing NRF spectra with the sample activity and natural background, photo-excited $J = 1$ states of ^{242}Pu were identified. From the assignment of the intrinsic projection quantum number K based on measured decay branching ratios, evidence was found for five fragments of the $M1$ scissors mode as well as for low-lying $E1$ excitations. Experimental details, γ-ray spectra, and measured transition strengths of newly observed ^{242}Pu states will be presented.

This work is supported by the DFG through the research grant GRK 2891 “Nuclear Photonics,” Project-ID No. 499256822.

HK 39.7 Thu 17:45 AM 00.011

Excitation-Energy Dependence of Fission Fragment Observables in the ^{234}U(γ,f) Reaction — •Vincent Wende[1], Dimiter Balabanski[4], Mihai Cuciuc[4], Joachim Enders[1], Sean W. Finch[2], Alf Göök[3], Calvin R. Howell[2], Annabel Ibel[1], Ronald C. Malone[7], Maximilian Meier[1], Forrest Q.L. Friesen[2], Andreas Oberstedt[4], Stephan Oberstedt[5], Marius Peck[1], Norbert Pietralla[1], Anthony P.D Ramirez[6], Jack A. Silano[6], Alexandru State[4], Gerhart Steinhilber[1], Anton P. Tonchev[6], and Werner Tornow[2] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [3]Uppsala Universitet, Uppsala, Sweden — [4]ELI-NP, IFIN-HH, Magurele, Romania — [5]EC-JRC Geel, Belgium — [6]Lawrence Livermore National Laboratory, Livermore, CA, USA — [7]U.S. Naval Academy, Annapolis, MD, USA

Advancing the microscopic understanding of the nuclear fission process relies on high-precision experimental data. This contribution shows results of an experimental campaign at HIγS, using linearly-polarized quasi-monochromatic photon beams between 6.2 and 13 MeV in the entrance channel. Mass, total kinetic energy, and angular distributions of fission fragments have been measured simultaneously using a position-sensitive twin Frisch-grid ionization chamber, exploring the dependence of fragment observables on the excitation energy.

*This work is supported by the Deutsche Forschungsgemeinschaft (DFG) - Project-ID 499256822 - GRK 2891 'Nuclear Photonics'.

HK 40: Heavy-Ion Collisions and QCD Phases VI

Time: Thursday 16:15–18:00 Location: PHIL C 601

HK 40.1 Thu 16:15 PHIL C 601

Machine-learning-based modeling of particle production in pp collisions measured by ALICE — •Maria Calmon Behling, Mario Krüger, Jerome Jung, and Henner Büsching — Institut für Kernphysik, Goethe Universität Frankfurt

During the data-taking campaigns Run 1 and Run 2 at the LHC, the ALICE collaboration recorded a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a data-driven approach to capture the multidimensional dependence of particle production on fundamental observables like the charged-particle multiplicity (N_{ch}), the transverse momentum (p_{T}) and $\sqrt{s}$.

In this talk, ALICE measurements of N_{ch}- and p_{T}-dependent inclusive charged-particle spectra at various center-of-mass energies are parametrized with DNNs. Together with a DNN-based particle composition, this is used to provide particle-differential predictions for a wide range of energies. The DNN predictions are compared to existing measurements as well as to commonly used event generators. The results allow estimating the transverse energy of the final-state particles, which is directly related to the initial energy density of the collisions.

Supported by BMFTR and the Helmholtz Association.

HK 40.2 Thu 16:30 PHIL C 601

Measurement of η mesons in pp collisions at $\sqrt{s}$ =13.6 TeV with ALICE at a magnetic field of B = 0.2 T — •Laura Gans-Bartl for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt am Main

The ALICE experiment at CERN investigates the properties of the Quark Gluon Plasma (QGP). One key probe to study the QGP, dileptons, offers direct access to the medium's temperature. At low transverse momentum (p_{T}), the dilepton spectrum is dominated by η meson Dalitz decays, making an accurate description of the low-p_{T} η yield essential for precise dilepton measurements.

The low-p_{T} region is experimentally challenging for η reconstruction due to large combinatorial background and low reconstruction efficiency. In ALICE, the accessible p_{T} range can be extended by reducing the magnetic field strength from $B = 0.5$ T to $B = 0.2$ T, which significantly improves the reconstruction of very low-p_{T} tracks.

This talk addresses the ALICE Run 3 analysis of η meson production in pp collisions at $B = 0.2$ T, measured via the Dalitz decay channel. Photons are reconstructed using the Photon Conversion Method (PCM), while the electrons are reconstructed as primary tracks. The current status of the analysis will be presented.

Supported by BMFTR and the Helmholtz Association.

HK 40.3 Thu 16:45 PHIL C 601

Measurement of π^0 and η mesons in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV using ML-based photon identification — •Isabel Kantak for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

Neutral pions and η mesons serve as sensitive probes of the quark-gluon plasma (QGP) formed in heavy-ion collisions. In the low p_{T} region, light mesons provide insight into hadronisation processes and the evolution of the QGP. High p_{T} measurements, on the other hand, are essential for studying the mechanism of parton energy loss mechanism and the resulting suppression of light mesons in the QGP medium. Furthermore, precise measurements of π^0 and η mesons are indispensable for direct-photon analyses, as they constitute the dominant sources of decay photons.

Photons are reconstructed via the Photon Conversion Method (PCM). A machine learning-based photon identification method has been implemented. The BDT method enhances photon purity without compromising efficiency, thereby improving statistical significance of the reconstructed meson spetra. In this contribution, I will discuss the performance of ML-based photon identification and the current status of π^0 and η mesons in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.36 TeV. I will present invariant yield measurements as a function of centrality and compare the results to those obtained with standard cut-based techniques.

HK 40.4 Thu 17:00 PHIL C 601

ML-based direct photon and neutral meson measurement in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV in the ALICE experiment at LHC — •Abhishek Nath for the ALICE Germany-Collaboration — Ruprecht Karl University of Heidelberg, Heidelberg, Germany

The ALICE experiment at LHC-CERN aims to analyze the properties of the quark-gluon plasma (QGP) formed during heavy-ion collisions. Neutral meson yields determine R_{AA} and constrain parton energy loss, whereas direct photons from thermal and hard-scattering sources probe the QGP temperature. However, large photon backgrounds from neutral meson decays hinder direct-photon extraction, causing significant loss of precision at low p_T in Run 2 heavy-ion Pb–Pb data. To overcome this limitation, we introduce a machine learning-based approach for photon candidate selection within the Photon Conversion Method (PCM). An XGBoost classifier trained on Monte Carlo simulations anchored to the Run 2 Pb–Pb $\sqrt{s_{NN}} = 5.02$ TeV dataset replaces traditional cut-based selections to provide data samples with simultaneously optimized photon efficiency and purity.

In this talk, I will present the application of this ML-enhanced PCM analysis, showing updated transverse momentum spectra for π^0, η, and direct photons. The resulting R_{AA}, η/π^0 ratio, and direct photon excess ratio (R_γ) are then compared with the traditional cut-based measurements as well as with state-of-the-art theoretical model predictions.

HK 40.5 Thu 17:15 PHIL C 601

Study of neutral meson production in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV as a function of centrality — •Anna Pishchaeva for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

Photons that are produced throughout the spacetime evolution of quark-gluon plasma (QGP) are an ideal probe to study its characteristics, since they do not interact with the medium. To access the information carried by the photons that come directly from QGP, one must subtract the background of photons from neutral mesons decays (mainly π^0, η). Furthermore, the energy loss of partons traversing the QGP medium in the high p_T region can be studied with a nuclear modification factor of π^0 and η.

In this cut based analysis, photons are reconstructed using the photon conversion method (PCM). Neutral pions and η mesons are identified as peaks in the two-photon invariant mass at their corresponding rest mass. This talk presents results for Run 3 on the neutral pions and η meson production in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV. The obtained invariant differential yields of π^0 and η in the current analysis are presented and compared to charged pions at $\sqrt{s_{NN}} = 5.02$ TeV.

HK 40.6 Thu 17:30 PHIL C 601

Hadron-photon correlations in pp collisions in ALICE — •Julius Kinner for the ALICE Germany-Collaboration — Universität Münster

Ultrarelativistic proton and heavy-ion collisions are measured with ALICE at the LHC, allowing the study of quantum chromodynamics and the quark-gluon plasma. Two interesting observables are jets, collimated hadrons created by a hard scattering, and direct photons, created directly in the collision and not stemming from particle decays.

The production of direct photons and inclusive photons in jets, and their relations, can be studied via angular two-particle correlations using the $\Delta\varphi$ and $\Delta\eta$ of trigger and associated particles. High-p_T charged particles are used as triggers and proxies for jets, and electromagnetic probes as associated particles.

Correlation functions of associated γ and π^0 are calculated with the photon conversion method and an invariant mass analysis of $\pi^0 \to \gamma\gamma$, using ALICE data from pp collisions at $\sqrt{s} = 13.6$ TeV, which is a work in progress. This is done as the continuation of a phenomenological study with PYTHIA simulations, which was carried out in the context of a possible measurement of angular jet-direct-photon correlations with the subtraction method (subtracting the decay-photon contribution from inclusive photons) to study the electromagnetic structure of jets.

Supported by BMFTR

HK 40.7 Thu 17:45 PHIL C 601

Measurement of radius dependent jet suppression in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with a novel mixed-event approach — •Nadine Alice Grünwald for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

The Quark-Gluon Plasma (QGP) is produced in heavy-ion collisions where quarks and gluons are deconfined and new physics phenomena emerge. The ALICE experiment is dedicated to measure heavy-ion collisions at the LHC where the QGP can be studied using jets from partons, which are produced in the early stage of the collisions.

In this talk mixed events as a new approach to describe the uncorrelated background in jet measurements in heavy-ion collisions in ALICE are presented.

The resulting charged-particle jet R_{AA} measurements have high precision over a broad kinematic range, reaching significantly lower jet p_T values as compared to the traditional analyses. Various jet resolution parameters are studied to measure the radius dependence of the jet energy loss and thereby the redistribution of the lost energy to the surrounding QGP medium. Comparison of these measurements to theoretical calculations including the medium response will provide new insight into jet quenching phenomenology and its underlying mechanism.

HK 41: Heavy-Ion Collisions and QCD Phases VII

Time: Thursday 16:15–18:00 Location: PHIL A 602

Group Report HK 41.1 Thu 16:15 PHIL A 602

Dielectron production in pp and Pb−Pb collisions with ALICE in LHC Run 3 — •Emma Ege for the ALICE Germany-Collaboration — Goethe Universität, Frankfurt, Germany

Dielectrons are ideal probes to study the properties of strongly-interacting matter, produced in relativistic heavy-ion collisions, as they are created in all stages of the collision and do not interact strongly with the medium. However, at LHC energies, the thermal dielectrons emitted in the early stages from the quark-gluon plasma (QGP) are overshadowed by correlated e^+e^--pairs from semi-leptonic decays of heavy-flavor (HF) hadrons. Since the decay length of HF hadrons is much larger than that of prompt contributions, such as from the thermal radiation, dielectrons can be topologically separated based on their distance-of-closest approach (DCA) to the primary vertex of the collision. DCA measurements in pp collisions enable the search for prompt sources in small systems and can be used as a baseline for heavy-ion studies to identify the thermal radiation of the QGP. The improved pointing resolution of the upgraded ALICE detector for Run 3 leads to a better topological separation of prompt thermal radiation and non-prompt e^+e^--pairs from HF hadron decays.

In this talk, an overview of the latest results regarding the dielectron production in pp collisions at $\sqrt{s} = 13.6$ TeV and Pb−Pb collisions at $\sqrt{s_{NN}} = 5.36$ TeV in Run 3, recorded with the ALICE detector, is given. A special focus is set on the topological separation with DCA, and the impact of the detector upgrades on the dielectron analysis.

HK 41.2 Thu 16:45 PHIL A 602

Performance of soft dielectron measurement in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE in Run 3 — •Belana Lubinski for the ALICE Germany-Collaboration — Goethe University Frankfurt

Low-mass dielectrons are an exceptional tool to deepen our understanding of strongly interacting matter produced in hadronic and nuclear collisions. As they are produced during all stages of the collision and are unaffected by the strong interaction, they keep the information of their original production mechanism. This allows dielectrons to probe even the soft regime of QCD which is often unaccessible otherwise.

At the Intersecting Storage Rings (ISR) at CERN, an enhancement of e^+e^- pairs over the expectation from know dielectron sources had been measured at low invariant mass and small pair momenta in pp collisions at $\sqrt{s} = 63$ GeV. A similar kinematic regime can be accessed with ALICE by reducing the magnetic field of the central barrel solenoid. First results from Run 2 indicate an excess also at LHC energies, albeit with a significance of 1.6σ. With the upgrade of the ALICE detector for Run 3 much higher data-acquisition rates can be achieved increasing the event statistics by a factor of 400 compared to Run 2.

In this talk, a first look at pp collisions at $\sqrt{s} = 13.6$ TeV recorded with a reduced ALICE magnetic solenoid field will be presented and their potential to address the excess observed in Run 2 will be discussed.

HK 41.3 Thu 17:00 PHIL A 602

Dielectron performance of the CBM experiment — •Adrian Meyer-Ahrens for the CBM-Collaboration — Institut für Kernphysik Münster, Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed-target experiment currently under construction at FAIR in Darmstadt which will explore the QCD phase diagram at high net-baryon densities using heavy-ion beams in the kinetic energy range of 2-11 AGeV provided by the SIS100 accelerator complex. Dielectrons serve as versatile probes for properties of the hot and dense medium created in the collisions, since they do not interact strongly and escape the fireball undisturbed. Dielectron analysis depends on a reliable estimation of of the combinatorial background, dominated by π^0 decays, misidentified hadrons as well as electrons from photon conversions in the target or detector material. In this talk, simulation results concerning the dielectron performance of CBM in Au-Au collisions will be presented, with a discussion of background estimation techniques and the extraction of the thermal signal.

This project has received funding from NRW Netzwerke (NW21-024-E).

HK 41.4 Thu 17:15 PHIL A 602

Preliminary study for dilepton flow analysis with CBM — •Simon Neuhaus for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Deutschland

Dileptons enable the study of the early phases of the quark-gluon-plasma formed in heavy-ion collisions, as they escape the medium without QCD interactions. Their particle flow characterized by flow coefficients v_n $(n = 1, 2, ...)$ allows us to probe azimuthal anisotropies of these early phases. While dilepton flow has already been investigated in experiments including HADES, no corresponding studies exist yet for the upcoming CBM experiment.

This talk will present the preliminary study of the reconstruction of the dilepton flow at the upcoming CBM experiment. CBM is a fixed-target heavy-ion experiment currently under construction at FAIR/GSI. Additionally, we evaluate the impact of electron identification purity on the physics case of flow reconstruction. This study is based on simulations of Au-Au collisions generated with SMASH at 8 AGeV collision energy.

*Work supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia, and BMBF 05P24PX1.

HK 41.5 Thu 17:30 PHIL A 602

Combined description of thermal and vacuum contributions to the dilepton spectrum — •Jessica Vogel[1], Tetyana Galatyuk[1,2], Florian Seck[1], and Joachim Stroth[2,3] — [1]Technische Universität Darmstadt — [2]GSI, Darmstadt — [3]Goethe-Universität Frankfurt

Dileptons give access to the hot and dense matter created in heavy-ion collisions, as they escape the reaction zone largely unaffected by strong interactions. Measurements of such penetrating probes provide insight into the properties of the created fireball. High baryon densities are reached at beam energies of a few GeV which lead to significant in-medium modifications on the spectral functions of vector mesons.

Because the short-lived ρ meson mainly decays inside the fireball, it primarily produces thermal dileptons. However, the longer-lived ω meson decays partly outside the fireball and thus contributes with a mix of thermal and vacuum rates to the dilepton spectrum.

This work introduces a framework that models the dilepton spectrum by describing the vacuum decays via the shining method and determines the thermal contribution using a coarse-graining microscopic transport approach. This joined approach gives accurate predictions of the invariant mass spectrum in collisions within the few GeV regime. We examine how the relative contribution of thermal and vacuum rates varies with transverse momentum and how the collision centrality influences the results.

This work has been supported by the DFG through grant CRC-TR 211.

HK 41.6 Thu 17:45 PHIL A 602

Dielectron reconstruction in the HADES Au+Au Beam Energy Scan — •Henrik Flörsheimer for the HADES-Collaboration — Technische Universität Darmstadt

Heavy-ion collisions at relativistic energies create a hot and dense medium whose microscopic properties can be studied using electromagnetic probes. Dileptons are especially valuable for this purpose, as they do not interact strongly with the surrounding matter, allowing them to carry undisturbed information about the QCD matter produced throughout the reaction.

The beam energy scan features Au+Au collisions at four energies, 200, 400, 600, and 800 AMeV, which allows for the investigation of energy-dependent properties of created QCD matter.

In this contribution, the key steps of the dielectron analysis will be outlined and the first results will be presented.

This work is supported by: BMFTR- 05P24RD6 and HGS-HIRe

HK 42: Fundamental Symmetries II

Time: Thursday 16:15–17:30 Location: AM 00.021

Group Report HK 42.1 Thu 16:15 AM 00.021

The Search for Electric Dipole Moments of Charged Particles in Storage Rings — •Achim Andres — GSI, Darmstadt, Germany

Electric dipole moments (EDMs) are probes of physics beyond the Standard Model and are closely related to the search for new sources of CP violation required to explain the matter-antimatter asymmetry of the universe. Permanent EDMs violate time-reversal and parity symmetries and, assuming the CPT theorem, imply CP violation. In addition, axions and axion-like particles (ALPs), proposed to solve the strong CP problem and as candidates for dark matter, are predicted to induce oscillating EDMs.

The COoler SYnchrotron (COSY) at Forschungszentrum Jülich provided polarized deuteron beams and was an ideal starting point for the JEDI Collaboration to develop storage-ring-based EDM searches. Over recent years, several milestones were achieved at COSY, including high-precision spin-tune measurements, spin-coherence times exceeding 1000 s, and operation of radio-frequency (rf) devices for spin manipulation. These achievements enabled the first direct measurement of the deuteron's permanent EDM in a storage ring and the first search for oscillating EDMs, both observed through the build-up of vertical polarization. This presentation summarizes the experimental results obtained and discusses upcoming steps toward high-precision storage-ring EDM measurements.

Group Report HK 42.2 Thu 16:45 AM 00.021

Status report of the free neutron lifetime experiment τ**SPECT** — •Martin Fertl for the tauSPECT-Collaboration — Institute of Physics, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The accurate determination of the free neutron lifetime τ_n is of particular interest in low-energy precision particle physics. The Standard Model relates the neutron lifetime τ_n to the CKM matrix element V_ud and the ratio $\lambda = g_\mathrm{V}/g_\mathrm{A}$ through precisely calculated radiative corrections. A neutron-based determination of V_ud provides a nuclear-structure free input to the test of the CKM matrix unitarity. The τSPECT experiment pursues the approach of suspending ultracold neutrons in a three-dimensional fully-magnetic trap with the goal to determine τ_n with an uncertainty of < 0.3 s. Magnetic storage minimizes experimental systematic uncertainties related to neutron losses on material walls. We present the status of τSPECT currently operated at the Paul Scherrer Institute (PSI) in Switzerland. We address the optimization of UCN loading, systematic studies, and comparisons with simulations. Ideas for experimental developments for future improvements below will < 0.3 s be presented.

HK 42.3 Thu 17:15 AM 00.021

Status of the neutron decay experiment PERC — •Lilli Löbell — School of Natural Sciences, Technische Universität München, Germany

The decay of free neutrons is a powerful tool for precision tests of the Standard Model of particle physics. Correlation coefficients - such as the beta asymmetry A and the Fierz interference term b - serve as input for the determination of the CKM matrix element V_ud and for searches for (effective) scalar and tensor as well as right-handed couplings.

The neutron decay spectrometer PERC (Proton Electron Radiation Channel), which is set up at the research reactor FRM II in Garching, Germany, aims to improve the accuracy of several correlation coefficients by up to one order of magnitude. PERC consists of a 12 m long superconducting magnet system, in which the neutron beam is contained by a non-depolarizing neutron guide. The magnetic field guides electrons and protons produced in the neutron decay towards the main detector, which will initially be a scintillation detector with photomultiplier tube readout and later be upgraded to a silicon detector. A second detector system, which consists of a scintillator read out by silicon photomultipliers, is installed in the upstream area of PERC and allows to identify backscatter events. First measurements are planned for the end of 2026 after the restart of the FRM II.

The talk gives an overview of PERC and presents the current status.

PERC was supported by the Priority Program SPP 1491 of the DFG and the cluster of excellence "Origin and Structure of the Universe".

HK 43: Computing and Outreach

Time: Thursday 16:15–17:00 Location: PHIL B 604

HK 43.1 Thu 16:15 PHIL B 604

Application of the Millepede II algorithm to the NeuLAND time-position calibration — •Yanzhao Wang[1], Luca Flandoli[1], Igor Gasparic[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany

The New Large-Area Neutron Detector NeuLAND, as part of the R^3B experiment at FAIR, aims to provide a high detection efficiency and spatial-temporal resolution of neutrons generated from high-intensity radioactive beams[1]. In this talk, we introduce a new calibration method for the NeuLAND detector, based on an adaptation of the Millepede II algorithm. This new method simplifies analysis procedures and, unlike the current method, does not require the reconstruction of cosmic tracks. Major obstacles during the adaptation, such as the rank deficit, limitations on the linear calibration relation and distortion due to noises will also be addressed in the talk.

Supported by BMBF (project 05P24PK1).

[1] K. Boretzky *et al.*, Nucl. Instrum. Methods Phys. Res. A1014 (2021) 165701

HK 43.2 Thu 16:30 PHIL B 604

From Stars to Life: Astrophysics as a Science Communication Vehicle for Nuclear Physics — •Jona Dreier and Christian Klein-Bösing for the Netzwerk Teilchenwelt-Collaboration — Institut für Kernphysik, Universität Münster

Physics and nuclear/particle physics in particular face the challenge of presenting their complex research methods and abstract findings to a broad audience. It is not only a responsibility to report activities and results to the public, but also essential to build trust in sustained investment in science and to engage the next generation, opening pathways into physics.

While there is a multitude of highly informative formats, which are mostly accessible to already interested individuals, more easily approachable formats are relatively scarce. Astrophysics and astrobiology offer a promising opportunity to combine a topic that resonates with a broad audience with sophisticated physics research. We present and discuss a concept of workshops and interventions for different age groups that connect stellar evolution with conditions for the emergence of intelligent life. Convection experiments illustrate underlying physical principles, while numerical simulations are used to determine stellar lifetimes.

Supported by NRW-FAIR.

HK 43.3 Thu 16:45 PHIL B 604

Discover the $Z_c(3900)$ - a BESIII Masterclass — •Nils Hüsken, Achim Denig, Thomas Lenz, Saskia Plura, and Heike Vormstein — Johannes Gutenberg-Universität Mainz

An electron-positron collider like BEPCII provides clean collisions with a small number of particles in the final state. These can be measured and identified with a detector like BESIII applying just a few general principles that are common to many modern particle physics experiments. At the same time, one of the high-profile results of more than 15 years of running BESIII - the discovery of the exotic hadron $Z_c(3900)$ - really only requires to separate leptons from pions and use energy-momentum conservation to obtain a sizable signal. In combination, our experiment is thus ideally suited for outreach activities. In this talk, we will discuss a new Masterclass using data from the BESIII experiment to (re-)discover the $Z_c(3900)$, highlighting a modern breakthrough in hadron spectroscopy from one of the leading experiments in the field.

HK 44: Instrumentation VIII

Time: Thursday 16:15–18:00 Location: PHIL A 301

HK 44.1 Thu 16:15 PHIL A 301

Integrated Control Systems for the Silicon Tracking System of the CBM experiment — •David Gutierrez Menendez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Goethe-Universität Frankfurt, Frankfurt, Germany

The Silicon Tracking System (STS) is the central detector for charged-particle tracking in the Compressed Baryonic Matter (CBM) experiment at FAIR. Its performance relies not only on the precise operation of 1.8 million readout channels but also on robust Detector Control Systems (DCS) and Experiment Control Systems (ECS) to ensure safe, stable, and automated detector operation. The team previously carried out initial validation of control functionality in the mini-CBM setup. It exercised key components of the STS slow controls, readout supervision, and interlock logic under realistic beam conditions.

Building on these results, dedicated developments and extensive testing have been conducted in a large-scale lab setup to deploy a complete control infrastructure for the assembly and integration of the STS half-units, including monitoring, configuration, and finite-state-machine control for front-end electronics, power systems, and environmental sensors. This lab campaign also serves as a testbed for integrating DCS and ECS workflows ahead of installation at FAIR.

The current status of the STS control systems, together with recent progress and upcoming integration steps, will be presented.

HK 44.2 Thu 16:30 PHIL A 301

Systematic studies of the CBM MVD cooling system with CFD simulations — •Christopher Braun for the CBM-MVD-Collaboration — Goethe-Universität

The Micro Vertex Detector (MVD) is the first downstream detector of the Compressed Baryonic Matter Experiment (CBM) at the future Facility for Antiproton and Ion Research (FAIR). It consists of four planar stations, placed equidistantly at distances between 8 and 20 cm downstream of the target, and is equipped with dedicated CMOS Monolithic Active Pixel Sensors (MAPS). Its stations operate in a harsh radiation environment and within the moderate vacuum of the target chamber. Each detector plane will feature a material budget x/X_0 ranging between 0.3 and 0.5 %. These strict material budget constraints and vacuum operation call for a two-stage cooling system, based on passive, conductive inside, and an active, convective cooling outside of the acceptance.

This contribution will present the cooling concept of the CBM MVD, with focus on CFD simulations of the full system, which are compared with experimental results obtained with a prototype setup operating in vacuum, and a performance comparison of different coolants (Water, Glycol-Water, and Novec-649) for the detector's coolant temperature range between $-10\,°C$ and $+15\,°C$.

HK 44.3 Thu 16:45 PHIL A 301

Precision Assembly for the P2 Inner Tracker — •Emre Eli-

Bollar for the P2-Collaboration — Institut fur Kernphysik, Johannes Gutenberg-Universitat, Johann-Joachim-Becher-Weg 45, Mainz, Germany

The P2 experiment at the new electron accelerator MESA in Mainz aims to measure the weak mixing angle in elastic electron-proton scattering at low momentum transfer Q^2 with unprecedented precision. Precise assembly of silicon tracker modules is essential for reliable track reconstruction and for controlling systematic uncertainties in the determination of the momentum transfer. The tracker system measures the scattering angle of outgoing low-energy electrons. To meet these requirements, an automated assembly workflow based on a four-axis robotic system (Gluebot) has been developed and validated.

The system was adapted to detector constraints with emphasis on alignment accuracy, repeatability, and operational stability. The detector design requires a sensor placement precision better than 50 μm. Targeted hardware modifications and software improvements were implemented in the Gluebot, enabling stable automated gluing and pick-and-place operations with μm-level positioning performance.

The feasibility of automated tracker-module assembly was demonstrated using representative components. Beyond its original scope, the system is used for additional detector projects, demonstrating its robustness. The talk will present the system design, achieved performance, and its role in ongoing tracker-module production.

HK 44.4 Thu 17:00 PHIL A 301

Investigations of gas flow through nozzles to optimise the deflection of filament target beams — •Eva-Maria Hausch, Jost Froning, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

To deflect a cryogenic hydrogen target beam, a recently developed method called cryobending is used, whereby gaseous helium is directed towards the filament target beam through deflection nozzles. Experiments have indicated that this allows the target beam to be deflected in a targeted manner to overcome a distance of more than 4 metres. Two types of deflection nozzles have been tested so far. In addition to experimental approaches such as interferometry, gas flow simulations are intended to determine the most effective type and size of nozzle, i.e. with which nozzle the least amount of helium gas can be used for the largest possible deflection to minimise the impact on the vacuum. In this talk, the first approaches to determining the optimal operating parameters regarding cryobending will be discussed.

Funding was received from GSI F&E (MSKHOU2527), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 44.5 Thu 17:15 PHIL A 301

Design of the liquid hydrogen target for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Bonnekamp[2,4], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,3], •Jayanta Naik[1], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], Siddharth Thakker[1], 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 — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment aims to precisely measure the weak mixing angle $\sin^2\theta_W$ through parity-violating electron-proton scattering at low momentum transfer. This is projected to achieve a relative precision of 0.16% for $\sin^2\theta_W$. To achieve this precision, there is a need for a target design that will have small false asymmetry due to aluminum windows and the conical diverter. The liquid hydrogen target is 60 cm long, along with a potential helium cell positioned upstream of the primary hydrogen cell.

In this talk, the design of the target cell is explained, which includes the simulation results for the aluminum upstream and downstream windows, helium cell, and the conical flow diverter.

HK 44.6 Thu 17:30 PHIL A 301

Long-distance filament target beams — •Jost Froning, Eva-Maria Hausch, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

When using cryogenic filament target beams in accelerator experiments in nuclear and particle physics, it may be necessary to overcome greater distances between the beam production nozzle and the interaction point. To demonstrate the suitability of such a filament target beam, a new setup with a distance of more than 4 m between the nozzle and the beam dump was recently commissioned in Münster. This talk shows how a continuous frozen hydrogen filament target beam with a diameter of 10 μm can be deflected and guided to the interaction point using a newly developed technique called cryobending, which uses helium gas to steer the target beam.

Funding was received from GSI F&E (MSKHOU2527), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 44.7 Thu 17:45 PHIL A 301

Electromagnetic Characterization and Performance Analysis of Button Beam Position Monitors - cSTART — •Anjana Madhusoodhanan Nair PK[1,2], Arnulf Quadt[1], Christoph Quitmann[2], Dima El Khechen[3], Jakob Krämer[2], and Nigel John Smale[3] — [1]II. Physikalisches Institut Georg-August-Universität Göttingen — [2]RI Research Instruments GmbH, Bergisch Gladbach — [3]Karlsruhe Institute of Technology

Button-type Beam Position Monitors (BPMs) are a key element of the beam diagnostics system for the cSTART (compact STorage ring for Accelerator Research and Technology) project, where precise beam position measurements are essential for stable operation. This study presents the electromagnetic characterization and performance evaluation of the cSTART button BPM design through a combination of numerical simulations and experimental validation, including *CST Particle Studio* simulations of signal formation, button capacitance, frequency response, and wakefield effects, as well as Time Domain Reflectometry measurements and beam-based tests at the FLUTE facility with controlled beam offsets. The results demonstrate the accuracy, limitations, and suitability of the BPM system for cSTART operation and contribute to the optimization of beam diagnostics in compact storage ring accelerators.

HK 45: Instrumentation IX

Time: Thursday 16:15–17:45 Location: PHIL B 302

HK 45.1 Thu 16:15 PHIL B 302

Development and Characterization of the CBM Neutron Calorimeter (NCAL) — •Dachi Okropiridze[1,2], Dieter Grzonka[2,3], and James Ritman[2,1,3] for the CBM-Collaboration — [1]Ruhr-Universitat Bochum (RUB), Bochum, Germany — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Julich (FZJ), IKP-1, Julich, Germany

The Neutron Calorimeter (NCAL) is proposed as a neutral spectator detector for the Compressed Baryonic Matter (CBM) experiment at FAIR. Located downstream of the Forward Spectator Detector (FSD), the NCAL detects spectator neutrons at small polar angles, thereby improving centrality determination and reaction-plane reconstruction. Furthermore, it enables a complementary physics program for elementary reactions with final-state neutrons.

The detector design features thick plastic scintillator modules with photomultiplier readout. Two prototypes have been constructed and characterized using minimum-ionizing particles and radioactive sources. A scintillator-based veto detector was developed for charged-particle rejection. We report on response measurements performed with quasi-monoenergetic neutron beams at the UJV Rez cyclotron, evaluating neutron detection efficiency and energy resolution.

Additionally, NCAL prototypes were tested in the mCBM experiment at GSI. Integrated into a DiRICH-based data acquisition system, the detector's rate capability and stability were investigated under realistic beam conditions.

HK 45.2 Thu 16:30 PHIL B 302

Thermal Neutron Detection with Lithium-Silica Glass in Proton Therapy — •Kim Tabea Giebenhain[1], Anna Becker[2,3], Lara Dippel[1,3], Markel Fix-Martinez[2,3], Hans-Georg Zaunick[1,3], Dzmitry Kazlou[1], Kilian-Simon Baumann[2,3], Ulrich Weber[2,3], Klemens Zink[2,3], and Kai-Thomas Brinkmann[1,3]

— [1]2[nd] Physics Institute, Justus Liebig University, Giessen, Germany — [2]TH Mittelhessen University of Applied Sciences, Giessen, Germany — [3]LOEWE Research Cluster for Advanced Medical Physics in Imaging an Therapy (ADMIT)

Neutron detection is an important topic in IonBeam Therapy, specifically when irradiating patients with ultra high dose rates (also knownas FLASH). At cyclotron-based facilities, these dose rates can only be reached at the highest energies without a degrader. which necessitates range modulators and thick absorbers to ensure conformal tumor coverage in clinical ranges. These absorbers can increase the amount of produced neutrons significantly. To reliably assess the neutron amount, efficient neutron detectors are needed to benchmark Monte-Carlo simulations which are used for dosimetric assessment. This work presents the findings of a scintillation-based thermal neutron detector, consisting of Lithium-silica glass and a photomultiplier tube. The detector has been tested at an Americium-Beryllium neutron source and for different absorbers at the Marburg IonBeam Therapy center.

This project is financed with funds of LOEWE-Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 2: LOEWE-Schwerpunkte

HK 45.3 Thu 16:45 PHIL B 302

Normalization detectors for the neutron lifetime experiment tauSPECT — •Viktoria Ermuth[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg-Universität Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

The τSPECT experiment measures the free neutron lifetime by confining ultracold neutrons (UCN) with magnetic field gradients and counting the remaining neutrons after varying storage times. There are statistical and systematic changes over time in the yield and energy of the neutrons produced by the pulsed UCN source that can lead to systematic uncertainties. Therefore, the amount of UCNs filled into the trap during each filling cycle has to be monitored. A neutron detector has been built and installed in the experiment beamline to monitor the flux of UCNs during the filling process. The charged particles resulting from the neutron capture reaction ^{10}B (n,α)^{7}Li cause scintillation in a ^{10}B-coated ZnS:Ag layer. This light is detected by silicon photomultipliers coupled in coincidence to the scintillator. A second version suited for a larger beamline diameter and with some design improvements is currently under development. Since the two detectors will be at different heights on the UCN path, this will also give an insight into the UCN energy spectrum.

This talk will show the detector*s design, results of measurements, as well as the progress for the improved version.

HK 45.4 Thu 17:00 PHIL B 302

Development of a BaF - Plastic Phoswich Detector for Particle Identification in Mixed Fields — •Lara Dippel[1,2], Anna Becker[2,3], Kilian Simon Baumann[2,3], Kai-Thomas Brinkmann[1,2], Kim Tabea Giebenhain[1], Dzmitry Kazlou[1], Markel Fix Martinez[2,3], Uli Weber[2,3], Hans-Georg Zaunick[1,2], and Klemens Zink[2,3] — [1]2nd Physics Institute, Justus Liebig University Giessen, Germany — [2]LOEWE Research Cluster for Advanced Medical Physics in Imaging and Therapy (ADMIT) — [3]TH Mittelhessen University of Applied Sciences, Giessen, Germany

This work presents the development of a Phoswich detector for fast neutron detection and particle discrimination in mixed radiation fields. The detector consists of a Barium Fluoride (BaF) crystal optically coupled to a thin plastic scintillator. Measurements were performed at the Marburg Ion Beam Therapy Center, where a water phantom was irradiated with 300 MeV/u carbon ions. Particle discrimination and identification were achieved using pulse shape discrimination (PSD) techniques, allowing the relative abundances of particles produced in the irradiation to be extracted. The measurement setup was replicated in a Geant4 simulation to validate the particle identification and to compare the relative particle yields. This work is part of the ADMIT consortium under Project Part A, which focuses on estimating spectral neutron fluxes for flash therapy in tumor treatment applications.

This project is financed with funds of LOEWE - Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz, Förderlinie 2: LOEWE-Schwerpunkte.

HK 45.5 Thu 17:15 PHIL B 302

Portable standalone n/γ detector based on RedPitaya board — •Dzmitry Kazlou, Roman Bergert, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — 2[nd] Institute of Experimental Physics, Justus-Liebig-University, Giessen, Germany

A portable neutron/γ detector was developed leveraging the open-source RedPitaya platform (Xilinx Zynq-7010/7020 SoC) as a compact data acquisition system based on a 125 MS/s 14-bit ADC, combining low-cost and easily accessible components. A custom open source SiPM bias board was used to eliminates the need for an external high-voltage supply. Dedicated fast broad-band preamplifiers have been developed for the Hamamatsu S14160-6050 and S14160-3010 silicon photomultipliers, providing a dual-channel readout with an extended dynamic range. The commercially available EJ-276D plastic scintillator was chosen as the detector material due to its well-performing pulse shape discrimination (PSD) capability, enabling efficient separation of fast neutrons from γ-rays.

The detector was calibrated with standard γ-sources (^{137}Cs, ^{22}Na, ^{207}Bi) and characterized in mixed neutron/γ fields from known AmBe, ^{252}Cf, and RaBe sources, after which it was tested in a high-energy neutron field with γ background. The proton beam measurements were performed to obtain the proton light-yield quenching factor, which is necessary for the subsequent unfolding of the neutron spectrum. The resulting portable device is highly suited for radiation monitoring, dosimetry, and applications requiring simultaneous identification of neutrons and γ-quanta.

HK 45.6 Thu 17:30 PHIL B 302

A spatially resolving detector for ultracold neutrons — •Konrad Franz[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

Ultracold neutrons (UCNs) are neutrons with a kinetic energy of around 100 neV. Their defining property is that they can be confined by material vessels and magnetic field gradients. This allows for long observation times and thereby precision measurements of fundamental neutron properties. Spatial resolution is often desirable in UCN experiments, as it provides information about the energy and phase space distribution of the probed ensemble. The presented detector design consists of a sandwich structure. In a ^{10}B conversion layer neutrons generate energetic ions through the ^{10}B (n, α) reaction. In the subsequent scintillation layer light is released which is then guided onto an array of silicon photomultipliers by a 3D printed light guide. This setup is well suited for in-situ detection of UCNs in strong magnetic fields and compatible with vacuum environments. In a first test beam time, a detector prototype was compared to a commercial UCN detector and its spatial resolution was evaluated. This talk will present the detector setup as well as the test beam time results. Furthermore, its use case for tackling systematic effects in the latest generation of precision neutron lifetime experiments will be highlighted at the example of the τSPECT experiment.

HK 46: Members' Assembly

Agenda

- Approval of the minutes and the agenda
- Report from HK division chair
- Report from KHuK
- Aob

Time: Thursday 18:00–19:30 Location: AM 00.017

All members of the Hadronic and Nuclear Physics Division are invited to participate.

HK 47: Invited Talks

Time: Friday 9:00–10:30 Location: MED 00.915

Invited Talk HK 47.1 Fri 9:00 MED 00.915
Supernova signatures on Earth and beyond — •Jenny Feige — Museum für Naturkunde, Berlin, Germany

The detection of cosmic signatures in deep-sea, ice, and lunar samples has made an important contribution to nuclear astrophysics in recent years. In particular, ^{60}Fe from near-Earth supernovae has been imprinted during the time periods 2-3 and 7-8 Myr ago, together with ^{244}Pu, which is produced exclusively by the rapid neutron capture process. These data, which establish a link between supernovae and the r-process, add another piece to the puzzle of the possible r-process sites.

This data also corroborates theoretical studies that suggest that more than 10 SNe exploded at a distance of 50-150 pc over the last 10-15 Myr. Their overriding shock fronts created a volume of hot gas that is seen in observational data and referred to as the Local Bubble, which currently engulfs our Solar System.

Here, I review the advancements made during the recent years in (1) the detection of different interstellar radioisotopes in deep-ocean and terrestrial records, and (2) what these detections reveal on the nature of the interstellar matter our Solar System encountered in the past.

Invited Talk HK 47.2 Fri 9:30 MED 00.915
ALICE 3 - The next-generation heavy-ion experiment at the LHC — •Lars Döpper for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

ALICE 3 is a completely new heavy-ion setup at the LHC, proposed as the successor and next generation of the current ALICE detector. To utilize the LHC to its full potential as a heavy-ion collider during Run 5, a completely new detector is required and envisioned to start operation after the Long Shutdown 4 in 2036.

Building on the physics achievements of Runs 3 and 4, ALICE 3 is designed to address key open questions in heavy-ion physics, with a particular focus on the heavy-flavour sector at low transverse momentum. These measurements will provide unique sensitivity to the time evolution of the quark-gluon plasma and its approach to thermal equilibrium. To facilitate these precision measurements, ALICE 3 will consist of a full silicon-pixel tracking system, covering the pseudorapidity range of at least $|\eta| < 2.5$. This tracking system at the heart of ALICE 3 is further complemented by systems for particle identification. All of this will be encased within a new superconducting solenoid magnet with a field strength of 2 T.

In this talk I will give an overview about the motivation behind this new detector, the different detector subsystems and some of the challenges we have yet to overcome on our journey towards ALICE 3.

This work is supported by BMFTR.

Invited Talk HK 47.3 Fri 10:00 MED 00.915
Towards Physics Operation of the CBM Experiment at FAIR — •Adrian Rodríguez Rodríguez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter (CBM) experiment at FAIR is designed to explore strongly interacting matter at high net-baryon densities, created in nucleus–nucleus collisions at $\sqrt{S_{NN}} = 2.5$–4.9 GeV. Addressing this physics program requires a novel experimental approach capable of sustaining interaction rates of up to 10 MHz. CBM therefore implements a triggerless, free-streaming readout scheme, combined with a fully integrated detector, data transport, and online computing architecture. The experiment is now transitioning from prototyping to large-scale realization. A central detector subsystem is the Silicon Tracking System (STS), which provides charged-particle momentum reconstruction with a resolution better than 2%. Embedded in a 1 Tm magnetic field, the STS is a low-mass, large-acceptance, radiation-hard silicon tracker composed of 876 double-sided microstrip modules arranged in eight stations. Module production and qualification are well advanced, and integration activities have progressed to the assembly of the first functional detector sub-units. In parallel, the FAIR Phase-0 program enables performance measurements of CBM detector components and validates their operation under realistic heavy-ion conditions. This contribution reviews the CBM physics goals and experimental concept, with emphasis on the STS, summarizing the status of detector construction and recent results from integration and commissioning towards the upcoming physics phase.

HK 48: Invited Talks

Time: Friday 11:00–12:30 Location: MED 00.915

Invited Talk HK 48.1 Fri 11:00 MED 00.915
Probing confinement and string-breaking with quantum simulations — •Torsten Zache — Universität Innsbruck, Institut für Theoretische Physik — Institut für Quantenoptik und Quanteninformation (IQOQI Innsbruck) der Österreichischen Akademie der Wissenschaften

The simulation of QCD at finite baryon density or in non-equilibrium scenarios remains an outstanding challenge for traditional computing methods. Quantum simulation offers a promising alternative. In this talk, I briefly review the current status of quantum simulations of lattice gauge theories and present recent progress toward simulating QCD-like physics, including the observation of confinement and string-breaking in lower dimensional gauge theories on existing quantum devices.

Invited Talk HK 48.2 Fri 11:30 MED 00.915
Exploring stochastic aspects of nuclear gamma decays with photonuclear reactions — •Johann Isaak — TU Darmstadt, Institut für Kernphysik, Darmstadt, Germany

Understanding electromagnetic decays of atomic nuclei is essential both for advancing our knowledge of fundamental nuclear structure phenomena and for numerous applications, such as modeling nucleosynthesis processes. Photonuclear reactions provide a powerful tool to probe the photoresponse of nuclei and to explore the competition between statistical and non-statistical gamma decays. In this talk, I will present recent results obtained with quasimonochromatic photon beams, exploring the gamma decay behavior of both spherical and deformed nuclei across a wide range of excitation energies, from the dominant giant dipole resonance down to energies below the neutron separation threshold. I will highlight the interplay between statistical and non-statistical decays and discuss their consequences on our understanding of nuclear structure and broader implications. The talk will conclude with a perspective on open questions and future directions in this field.

Invited Talk HK 48.3 Fri 12:00 MED 00.915
Precision QCD with ePIC at the Electron-Ion Collider — •Tyler Kutz — Johannes Gutenberg-Universität Mainz

The majority of visible matter in the Universe is hadronic, composed of quarks and gluons whose interactions are modeled by quantum chromodynamics (QCD). Describing the properties of protons, neutrons, and nuclei in terms of their fundamental QCD constituents remains a major experimental and theoretical effort. The electron-ion collider (EIC), being developed at Brookhaven National Lab, is a next-generation facility designed for high-precision studies of QCD. By facilitating collisions of polarized electrons with polarized protons and nuclei, the EIC will enable multi-dimensional probes of nucleon and nuclear structure. These measurements are essential to understanding the origin of nucleon mass and spin, the nucleon's 3D structure, QCD in the nuclear medium, and other emergent QCD phenomena. This talk will give an overview of ePIC, the first EIC detector collaboration, including the collaboration organization, detector capabilities, physics program, and future outlook.