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

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Overview of Invited Talks and Sessions

(Lecture halls HBR 14: HS 1 and 4, HBR 19: C 1, 2, 5a, 5b, and 103, HBR 62: EG 03, 05, 18, and 19; Poster HBR 14: Foyer)

Invited Talks

HK 12.1	Tue	11:00–11:30	HBR 14: HS 1	**How to understand the hadron spectrum** — •Meike Küssner
HK 12.2	Tue	11:30–12:00	HBR 14: HS 1	**3-body problem from phenomenology and lattice QCD** — •Maxim Mai
HK 12.3	Tue	12:00–12:30	HBR 14: HS 1	**Measurement of Antiproton-Production Cross Sections at AMBER** — •Thomas Pöschl
HK 13.1	Tue	14:00–14:30	HBR 14: HS 1	**First laser spectroscopy measurements of ^{53}Ca and the prospects for measuring ^{54}Ca** — •Tim Lellinger
HK 13.2	Tue	14:30–15:00	HBR 14: HS 1	**High-precision mass measurements near Sn-100 challenge nuclear theory** — •Lukas Nies
HK 13.3	Tue	15:00–15:30	HBR 14: HS 1	**Ab initio advances for medium-heavy nuclei and electroweak properties** — •Takayuki Miyagi
HK 36.1	Wed	14:00–14:30	HBR 14: HS 1	**Hydrodynamic attractors and transport in small systems** — •Aleksas Mazeliauskas
HK 36.2	Wed	14:30–15:00	HBR 14: HS 1	**Multi-particle correlations: from hot-and-dense quark-gluon matter to an ultracold-and-dilute system with few atoms** — •Ilya Selyuzhenkov
HK 36.3	Wed	15:00–15:30	HBR 14: HS 1	**Observing the emergence of elliptic flow** — •Sandra Brandstetter, Philipp Lunt, Carl Heintze, Maciej Galka, Keerthan Subramanian, Marvin Holten, Philipp Preiss, Selim Jochim
HK 59.1	Thu	11:00–11:30	HBR 14: HS 1	**Gamma spectroscopy with AGATA: New insights in nuclear excitations along the nuclear chart** — •Peter Reiter
HK 59.2	Thu	11:30–12:00	HBR 14: HS 1	**Anisotropic flow in heavy-ion collisions at high and low beam energies** — •Hannah Elfner
HK 59.3	Thu	12:00–12:30	HBR 14: HS 1	**Status of ALICE and ALICE 3** — •Alexander Schmah
HK 60.1	Thu	14:00–14:30	HBR 14: HS 1	**Theory of multi-quark states** — •Christoph Hanhart
HK 60.2	Thu	14:30–15:00	HBR 14: HS 1	**Cross-Experiment Insights into Multiquarks and Molecular States** — •Mikhail Mikhasenko
HK 60.3	Thu	15:00–15:30	HBR 14: HS 1	**Molecular and bound states searches with femtoscopy** — •Valentina Mantovani Sarti
HK 74.1	Fri	9:45–10:15	HBR 14: HS 1	**Strange hadron spectroscopy at GlueX and beyond** — •Peter Hurck
HK 74.2	Fri	10:15–10:45	HBR 14: HS 1	**Overview of LUNA project at LNGS** — •Denise Piatti
HK 75.1	Fri	11:00–11:30	HBR 14: HS 1	**Precision theory for charge radii of light nuclei** — •Arseniy Filin, Vadim Baru, Evgeny Epelbaum, Christopher Körber, Hermann Krebs, Daniel Möller, Andreas Nogga, Patrick Reinert
HK 75.2	Fri	11:30–12:00	HBR 14: HS 1	**Investigating dense nuclear matter - recent results from HADES** — •Behruz Kardan

HK 75.3	Fri	12:00–12:30	HBR 14: HS 1	**High-precision mass measurements of light ion species** — •Sangeetha Sasidharan, Olesia Bezrodnova, Wolfgang Quint, Sven Sturm, Klaus Blaum

Invited Talks of the joint Symposium Strong-Interaction Matter under Extreme Conditions

See SYEC for the full program of the symposium.

SYEC 1.1	Wed	9:00– 9:45	HBR 14: HS 1	**Strong-interaction Matter under Extreme Conditions: a Review** — •Guy D. Moore
SYEC 1.2	Wed	9:45–10:30	HBR 14: HS 1	**Theory of Strong-Interaction Matter** — •Gergely Endrodi
SYEC 2.1	Wed	11:00–11:45	HBR 14: HS 1	**Unravelling the phase structure of strong-interaction matter with high-energy heavy-ion experiments** — •Tetyana Galatyuk
SYEC 2.2	Wed	11:45–12:30	HBR 14: HS 1	**Neutron star mergers in numerical relativity** — •Masaru Shibata

Sessions

HK 1.1–1.7	Mon	16:45–18:30	HBR 14: HS 1	**Computing I**
HK 2.1–2.6	Mon	16:45–18:30	HBR 14: HS 4	**Nuclear Astrophysics I**
HK 3.1–3.5	Mon	16:45–18:15	HBR 19: C 1	**Instrumentation I**
HK 4.1–4.5	Mon	16:45–18:15	HBR 19: C 2	**Instrumentation II**
HK 5.1–5.5	Mon	16:45–18:15	HBR 19: C 5a	**Structure and Dynamics of Nuclei I**
HK 6.1–6.5	Mon	16:45–18:15	HBR 19: C 5b	**Structure and Dynamics of Nuclei II**
HK 7.1–7.4	Mon	16:45–18:15	HBR 19: C 103	**Astroparticle Physics I**
HK 8.1–8.5	Mon	16:45–18:15	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases I**
HK 9.1–9.5	Mon	16:45–18:15	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases II**
HK 10.1–10.5	Mon	16:45–18:15	HBR 62: EG 18	**Hadron Structure and Spectroscopy I**
HK 11.1–11.6	Mon	16:45–18:15	HBR 62: EG 19	**Hadron Structure and Spectroscopy II**
HK 12.1–12.3	Tue	11:00–12:30	HBR 14: HS 1	**Invited Talks I**
HK 13.1–13.3	Tue	14:00–15:30	HBR 14: HS 1	**Focus Session I: New Results on Nuclear Structure at Shell Closures**
HK 14.1–14.6	Tue	15:45–17:15	HBR 14: HS 1	**Structure and Dynamics of Nuclei III**
HK 15.1–15.5	Tue	15:45–17:15	HBR 14: HS 4	**Structure and Dynamics of Nuclei IV**
HK 16.1–16.5	Tue	15:45–17:15	HBR 19: C 1	**Instrumentation III**
HK 17.1–17.5	Tue	15:45–17:15	HBR 19: C 2	**Instrumentation IV**
HK 18.1–18.6	Tue	15:45–17:15	HBR 19: C 5a	**Instrumentation V**
HK 19.1–19.5	Tue	15:45–17:15	HBR 19: C 5b	**Structure and Dynamics of Nuclei V**
HK 20.1–20.5	Tue	15:45–17:15	HBR 19: C 103	**Astroparticle Physics II**
HK 21.1–21.6	Tue	15:45–17:15	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases III**
HK 22.1–22.5	Tue	15:45–17:15	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases IV**
HK 23.1–23.5	Tue	15:45–17:15	HBR 62: EG 18	**Heavy-Ion Collisions and QCD Phases V**
HK 24.1–24.5	Tue	15:45–17:15	HBR 62: EG 19	**Hadron Structure and Spectroscopy III**
HK 25.1–25.5	Tue	17:30–19:00	HBR 14: HS 1	**Hadron Structure and Spectroscopy IV**
HK 26.1–26.5	Tue	17:30–19:00	HBR 14: HS 4	**Structure and Dynamics of Nuclei VI**
HK 27.1–27.5	Tue	17:30–19:00	HBR 19: C 1	**Instrumentation VI**
HK 28.1–28.5	Tue	17:30–19:00	HBR 19: C 2	**Instrumentation VII**
HK 29.1–29.4	Tue	17:30–19:00	HBR 19: C 5a	**Instrumentation VIII**
HK 30.1–30.6	Tue	17:30–19:15	HBR 19: C 5b	**Structure and Dynamics of Nuclei VII**
HK 31.1–31.5	Tue	17:30–19:00	HBR 19: C 103	**Nuclear Astrophysics II**
HK 32.1–32.5	Tue	17:30–19:00	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases VI**
HK 33.1–33.5	Tue	17:30–19:00	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases VII**
HK 34.1–34.5	Tue	17:30–19:00	HBR 62: EG 18	**Heavy-Ion Collisions and QCD Phases VIII**
HK 35.1–35.5	Tue	17:30–19:00	HBR 62: EG 19	**Hadron Structure and Spectroscopy V**
HK 36.1–36.3	Wed	14:00–15:30	HBR 14: HS 1	**Focus Session II: Emergence of Collectivity in Few-Body Hadron Systems**
HK 37.1–37.5	Wed	15:45–17:15	HBR 14: HS 1	**Nuclear Astrophysics III**
HK 38.1–38.5	Wed	15:45–17:15	HBR 14: HS 4	**Structure and Dynamics of Nuclei VIII**
HK 39.1–39.5	Wed	15:45–17:15	HBR 19: C 1	**Instrumentation IX**

HK 40.1–40.6	Wed	15:45–17:15	HBR 19: C 2	**Instrumentation X**
HK 41.1–41.4	Wed	15:45–17:15	HBR 19: C 5a	**Instrumentation XI**
HK 42.1–42.6	Wed	15:45–17:15	HBR 19: C 5b	**Structure and Dynamics of Nuclei IX**
HK 43.1–43.6	Wed	15:45–17:15	HBR 19: C 103	**Outreach I**
HK 44.1–44.6	Wed	15:45–17:15	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases IX**
HK 45.1–45.6	Wed	15:45–17:15	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases X**
HK 46.1–46.6	Wed	15:45–17:15	HBR 62: EG 18	**Heavy-Ion Collisions and QCD Phases XI**
HK 47.1–47.5	Wed	15:45–17:15	HBR 62: EG 19	**Hadron Structure and Spectroscopy VI**
HK 48.1–48.6	Wed	17:30–19:00	HBR 14: HS 1	**Heavy-Ion Collisions and QCD Phases XII**
HK 49.1–49.6	Wed	17:30–19:15	HBR 14: HS 4	**Nuclear Astrophysics IV**
HK 50.1–50.5	Wed	17:30–19:00	HBR 19: C 1	**Instrumentation XII**
HK 51.1–51.7	Wed	17:30–19:15	HBR 19: C 2	**Instrumentation XIII**
HK 52.1–52.6	Wed	17:30–19:00	HBR 19: C 5a	**Structure and Dynamics of Nuclei X**
HK 53.1–53.5	Wed	17:30–19:00	HBR 19: C 5b	**Structure and Dynamics of Nuclei XI**
HK 54.1–54.6	Wed	17:30–19:00	HBR 19: C 103	**Computing II**
HK 55.1–55.6	Wed	17:30–19:00	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases XIII**
HK 56.1–56.7	Wed	17:30–19:15	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases XIV**
HK 57.1–57.5	Wed	17:30–19:00	HBR 62: EG 18	**Hadron Structure and Spectroscopy VII**
HK 58.1–58.5	Wed	17:30–19:00	HBR 62: EG 19	**Hadron Structure and Spectroscopy VIII**
HK 59.1–59.3	Thu	11:00–12:30	HBR 14: HS 1	**Invited Talks II**
HK 60.1–60.3	Thu	14:00–15:30	HBR 14: HS 1	**Focus Session III: Multiquark and Molecular States**
HK 61.1–61.5	Thu	15:45–17:15	HBR 14: HS 1	**Instrumentation XIV**
HK 62.1–62.5	Thu	15:45–17:15	HBR 14: HS 4	**Nuclear Astrophysics V**
HK 63.1–63.6	Thu	15:45–17:15	HBR 19: C 1	**Instrumentation XV**
HK 64.1–64.5	Thu	15:45–17:15	HBR 19: C 2	**Instrumentation XVI**
HK 65.1–65.5	Thu	15:45–17:15	HBR 19: C 5a	**Structure and Dynamics of Nuclei XII**
HK 66.1–66.6	Thu	15:45–17:15	HBR 19: C 5b	**Structure and Dynamics of Nuclei XIII**
HK 67.1–67.4	Thu	15:45–17:15	HBR 19: C 103	**Fundamental Symmetries I**
HK 68.1–68.5	Thu	15:45–17:15	HBR 62: EG 03	**Heavy-Ion Collisions and QCD Phases XV**
HK 69.1–69.6	Thu	15:45–17:15	HBR 62: EG 05	**Heavy-Ion Collisions and QCD Phases XVI**
HK 70.1–70.5	Thu	15:45–17:15	HBR 62: EG 18	**Hadron Structure and Spectroscopy IX**
HK 71.1–71.6	Thu	15:45–17:15	HBR 62: EG 19	**Hadron Structure and Spectroscopy X**
HK 72.1–72.62	Thu	17:15–18:45	HBR 14: Foyer	**Poster**
HK 73	Thu	19:00–20:30	HBR 14: HS 1	**Members' Assembly**
HK 74.1–74.2	Fri	9:45–10:45	HBR 14: HS 1	**Invited Talks III**
HK 75.1–75.3	Fri	11:00–12:30	HBR 14: HS 1	**Invited Talks IV**

Members' Assembly of the Hadronic and Nuclear Physics Division

Thursday 19:00–20:30 HBR 14: HS 1

HK 1: Computing I

Time: Monday 16:45–18:30 Location: HBR 14: HS 1

HK 1.1 Mon 16:45 HBR 14: HS 1

Volunteer computing in HEP: PoUW blockchain for CBM — •Felix Hoffmann and Udo Kebschull — Goethe Universität Frankfurt

HEP experiments rely on computational power for conducting Monte Carlo simulations and analyzing real-world data collected from experiments. These calculations are traditionally done on large computing clusters like the WLCG or on locally managed servers. In the past, there have also been volunteer computing approaches, such as BOINC projects, in which anyone can participate and donate computational power to support a scientific experiment.

This talk explores the idea of a novel blockchain consensus algorithm in which miners run MC simulations for CBM with a given set of parameters instead of wasting energy spamming hashing functions like SHA256. The goal is to bring the blockchain community and the HEP community together: The blockchain community has available computational power and needs some form of blockchain consensus to secure the underlying blockchain, and the HEP community is in need of computational power. To make this possible, a libp2p application is currently being implemented in Golang and is expected to be completed before the end of 2024. This talk will give an overview of the general idea and provide implementation details.

HK 1.2 Mon 17:00 HBR 14: HS 1

Brute-force Minimization Approach for Alignment in CBM — •Nora Bluhme for the CBM-Collaboration — FIAS, Goethe University Frankfurt am Main, Germany

The CBM experiment (Compressed Baryonic Matter), which is planned at the future FAIR facility (Facility for Antiproton and Ion Research), will be used to investigate heavy-ion collisions at high interaction rates. In such high-energy physics experiments, the track-based software alignment of the detectors is a generic and crucial task. By determining the exact detector geometry, the alignment provides the required accuracy to utilise the high intrinsic resolution of the measurements. This is typically achieved by minimising a χ^2 cost function for a set of reconstructed tracks with respect to the alignment parameters in question.

To complement the available alignment tools, an alignment approach based on brute-force minimisation is developed. Potential advantages of this method are tighter parameter handling and the use of more constraint types for more accurate alignment results.

In this contribution, recent progress in applying the brute-force minimisation approach for alignment in the CBM setup is presented.

This work is supported by BMBF (05P21RFFC1).

HK 1.3 Mon 17:15 HBR 14: HS 1

Exploring the Effects of Longitudinally Polarized Electrons on the Degree of Linear Polarization of Crystalline Bremsstrahlung — •Leoniedas Reschke for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, 53115 Bonn

The baryon excitation spectrum is probed with a real photon beam at several experimental facilities. In the case of single pseudoscalar meson photoproduction, a complete analysis of the process requires the measurement of not only the unpolarized cross section but also various single and double-polarization observables. Certain polarization observables require the use of linearly or circularly polarized photons. Typically, non-polarized electrons in combination with a diamond radiator, are employed to generate linearly polarized bremsstrahlung, while longitudinally polarized electrons in combination with an amorphous radiator, are employed to generate circularly polarized bremsstrahlung. The combination of longitudinally polarized electrons with a crystalline radiator, such as a diamond, results in elliptically polarized photons. The software package Diracxx offers a tool for computing the partial differential cross-section corresponding to a specific recoil momentum transferred from the incoming electron to the atomic nucleus of a radiator material. This package enables the swift and sufficiently precise computation of polarization spectra arising from the combination of a diamond crystal with longitudinally polarized electrons. This presentation shows results derived from these computational studies.

HK 1.4 Mon 17:30 HBR 14: HS 1

Simulating ultra cold neutron storage and lifetime measurement in a fully magnetic trap — •Sylvain Vanneste for the tauSPECT-Collaboration — Johannes Gutenberg University, Mainz, Germany

The accurate determination of the free neutron lifetime is of special interest in today's precision physics era. Its value is tightly connected to quarks mixing, and to the ratio of hydrogen to helium produced during the early Universe. As of today, the two existing distinct measurement techniques provide non-compatible results, giving rise to the so-called neutron lifetime puzzle.

With the aim of reducing experimental systematic uncertainties due to neutron absorption by material walls, the τSPECT experiment is a fully magnetic trap for Ultra Cold Neutrons (UCNs). In order to precisely understand and characterise the behaviour of UCN after production, guidance, storage, and finally detection inside τSPECT, a tailored simulation is being developed using the PENTrack software. The framework includes UCN dynamics via gravity; transmission trough, and reflection from, material surfaces; moving geometries; and interactions with magnetic fields. This work presents the results of such end-to-end simulations, comparisons with actual data measurements, and possible improvements for UCN magnetic storage experiments.

HK 1.5 Mon 17:45 HBR 14: HS 1

Applying TGeoArbN based tessellation in CBM geometry description* — •Simon Neuhaus — Bergische Universität Wuppertal, Wuppertal, Deutschland

Tessellation is a method to describe any volume using a triangle-based surface mesh. Tessellation of detector geometries offers promising new possibilities to efficiently create ROOT/GEANT detector geometries for simulation directly from CAD output (e.g. step files). This enables more rapid iteration cycles in detector design and lowers the risk of potential discrepancies in the generated simulation geometry. The sole disadvantage might be a significant increase in computing time using this new method of geometry creation.

TGeoArbN is a software tool for tessellation, developed at the University of Bonn for the Panda experiment. This tool is independent from tessellation implemented in GEANT. This has the benefit that TGeoArbN runs with both, GEANT3 and GEANT4 based simulations. This talk discusses first studies using TGeoArbN to generate parts of the RICH detector of the CBM experiment.

The application of PANDA TGeoArbN in CBM is a good example of the synergy effects generated by the exchange between different detector groups and universities within the NRW FAIR Network.

*Work supported by BMBF 05P21PXFC1, "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia, and GSI.

HK 1.6 Mon 18:00 HBR 14: HS 1

Multi-particle Reconstruction in Detector Data using object-centric Machine Learning — •Sara Aumiller[1], Nicole Hartman[1], Lukas Heinrich[1], Florian Kaspar[1], Karina-Sânziana Stelea[1], Stefan Wallner[1], Dominik Ecker[1], Luise Meyer-Hetling[1], Andrii Maltsev[1], and Thomas Pöschl[2] — [1]Technical University of Munich, Germany — [2]CERN, Geneve, Switzerland

High-energy physics experiments require high performance on separation and reconstruction of multi-particle signals in detector data. This task gets especially challenging if signals of multiple, quasi-simultaneous particles overlap. Such events occur in various forms like calorimetric clusters, Cherenkov light rings or track patterns. Traditional reconstruction methods of particle-detector data are regularly pushed to their limits when confronted with this challenge as they require specific development for each task and get computationally expensive.

In this talk, I will explore a universal approach of multi-particle reconstruction using object-centric machine learning. This includes state-of-the-art artificial-neural-network methods like Invariant Slot Attention and Variational Autoencoding which are applied on simulated, particle-detector data. The research holds potential for future application in experiments like COMPASS or AMBER at CERN.

HK 1.7 Mon 18:15 HBR 14: HS 1

Machine Learning Algorithms for Pattern Recognition with the PANDA Barrel DIRC — •Yannic Wolf[1,2], Roman Dzhygadlo[1], Klaus Peters[1,2], Georg Schepers[1], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

Precise and fast hadronic particle identification (PID) is crucial to reach the physics goal of the PANDA detector at FAIR. The Barrel DIRC (Detection of Internally Reflected Cherenkov light) is a key detector for the identification of charged hadrons in PANDA. Several reconstruction algorithms have been developed to extract the PID information from the measured location and arrival time of the Cherenkov photons. In comparison to other Ring Imaging Cherenkov detectors, the hit patterns observed with DIRC counters do not appear as rings on the photosensor plane but as complex, disjoint 3D-patterns.

Using the recent advances in machine learning (ML) algorithms, especially in the area of image recognition, we plan to develop new ML PID algorithms for the PANDA Barrel DIRC and compare the results to conventional reconstruction methods. First network implementations show a performance comparable to conventional methods on a limited phase space. As a next step, we are investigating ways to extend the phase space, while also experimenting with different data input structures to optimize the training process and increase PID performance.

HK 2: Nuclear Astrophysics I

Time: Monday 16:45–18:30 Location: HBR 14: HS 4

Group Report HK 2.1 Mon 16:45 HBR 14: HS 4

The Super-FRS Ion Catcher: towards the Early- and First-Science experiments at FAIR — •Daler Amanbayev, the FRS Ion Catcher Collaboration, and the Super-FRS Experiment Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany

The Super-FRS Ion Catcher (Super-FRS-IC) at the Super-FRS at FAIR will play a crucial role in shaping experiments envisaged for the Early- and First-Science programs. The first experiments aim to measure β-delayed neutron emission probabilities P_{xn} – important input for r-process calculations, but reliable data are scarce, especially for x>1. In addition, they aim to study multi nucleon transfer (MNT) reactions driven by secondary beams as a promising avenue for accessing heavy neutron-rich nuclei. At a later stage, the Super-FRS-IC will enable experiments of MATS and LaSpec collaborations at the Low-Energy Branch.

At the Super-FRS-IC, beams of exotic nuclei produced at relativistic energies will be thermalized by a newly developed Cryogenic Stopping Cell (CSC) and analyzed via the Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS). A unique combination of characteristics, e.g., high areal density and rate capability of the CSC (up to 40 mg/cm^2 and at least 10^7 ions/s, correspondingly), and broad mass range and high sensitivity of the MR-TOF-MS enable conducting experiments in new and effective ways.

This contribution presents the Super-FRS-IC setup and provides an overview of the aforementioned experiments and methods.

HK 2.2 Mon 17:15 HBR 14: HS 4

Determining proto neutron stars' minimal mass with a chirally constrained nuclear equation of state — •Selina Kunkel and Jürgen Schaffner-Bielich — Institut für Theoretische Physik, Goethe-Universität, Frankfurt am Main, Germany

We study the minimal masses and radii of proto-neutron stars during different stages of their evolution. The main focus lies on the stages directly after the supernova explosion, where neutrinos are captured in the core and the lepton per baryon ratio is approximately $Y_L = 0.4$ and a few seconds after the supernova, when all neutrinos have left the star. All equations of state used for this purpose fulfill *Chiral Effective Field Theory* constraints at $T = 0$. We find for the neutrino-trapped cases higher minimal masses than for the neutrino-free cases. Thermal effects, in this work a higher constant entropy per baryon, also rise the minimal mass. The masses for the cases studied all lie between $M_{min} = 0.11M_\odot - 0.73M_\odot$. The minimal mass depends linearly on the lepton fraction for values of $Y_L = 0.1 - 0.4$. Hence, proto-neutron stars can exhibit higher minimal masses than their cold, catalyzed form during all stages of their evolution.

HK 2.3 Mon 17:30 HBR 14: HS 4

Neutron matter properties from Fermi liquid theory — •Faruk Alp[1,2,3], 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 — [3]Max-Planck-Institut für Kernphysik, Heidelberg

Fermi liquid theory is a powerful framework to describe interacting Fermi systems at low temperatures. Employing this formalism we calculate Landau parameters from chiral effective field theory interactions and determine properties of neutron matter such as the speed of sound and effective mass. Calculations are performed using many-body perturbation theory based on two- and three-body interactions. The goal is to obtain a comprehensive understanding of the systematic uncertainties of the Landau parameters and investigate possible ways to extrapolate the equation of state to higher densities.

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HK 2.4 Mon 17:45 HBR 14: HS 4

Correlations between nuclear matter parameters and the gravitational wave frequency emitted by a neutron star merger remnant — •Mario Jakobs[1,2], Andreas Bauswein[1], and Gabriel Martínez-Pinedo[1,2] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [2]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany

With upcoming detectors, we will be able to observe gravitational waves (GW) emitted even after the merging of two neutron stars. The merger remnant has a dominant oscillation frequency that depends strongly on the nuclear equation of state (EOS). Here we quantify this dependency using simulations. Once post-merger GW observation data are available, this will enable us to derive properties of the nuclear EOS that are not well constrained today. To achieve this, we develop an EOS meta model allowing us to vary a single EOS parameter without altering others simultaneously. By using a meta model, we can reproduce a range of different available EOS models in a single framework. We then explore its parameter space by conducting general relativistic hydrodynamics simulations of the merger event. In our analysis we find, for instance, a clear correlation between the dominant frequency and the slope of the nuclear symmetry energy at saturation. This work was funded by Deutsche Forschungsgemeinschaft - Project-ID 279384907 - SFB 1245 and - Project-ID 138713538 - SFB 881. Support by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under grant agreements No. 759253 and No. 885281 is acknowledged.

HK 2.5 Mon 18:00 HBR 14: HS 4

Geant4 Monte Carlo Simulation of the $^{12}C(\alpha,\alpha')$ reaction — •Timo Biesenbach[1], David Werner[1], Peter Reiter[1], Konrad Arnswald[1], Maximilian Droste[1], Pavel Golubev[2], Rouven Hirsch[1], Hannah Kleis[1], Nikolas Königstein[1], Dirk Rudolph[2], Alessandro Salice[1], Joe Roob[1], Madalina Ravar[1,3], 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 the three-particle decay of the Hoyle state in ^{12}C provide a crucial probe for the inner structure of ^{12}C and they are very relevant for the topic of stellar nucleosynthesis. To study the decay modes, a ^{12}C(α,α') reaction at 27 MeV beam energy was performed at the 10 MV FN-tandem accelerator at the Institute for Nuclear Physics of the University of Cologne using the Lund-York-Cologne-Calorimeter. The reaction and experimental setup were rebuilt using the Geant4 simulation-framework. Detailed Monte-Carlo simulations of the experiment were performed to determine the setup's sensitivity and detection efficiency for the scattered α and the three decay α's. The impact of the data analysis on the identification of the sequential and direct decay modes of the Hoyle state but also states at higher excitation energy is scrutinized in detail by comparing simulated with experimentally obtained data. The preliminary results include Dalitz plots and sensitivity limits for the identification of the individual α decay branches.

HK 2.6 Mon 18:15 HBR 14: HS 4

Gaussian processes for the nuclear equation of state — •Hannah Göttling[1,2], Jonas Keller[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-energy regime, chiral effective field theory (EFT) provides a systematically improvable description of nuclear systems. With Gaussian processes (GPs) we introduce a tool to realize non-parametric evaluations of the EOS, considering correlations along independent variables. Besides constructing an emulator we use GPs for a statistical description of chiral expansion coefficients and apply Bayesian statistics to assess the EFT truncation errors. The evaluation of observables with GPs enables us to further calculate derivatives. With that we are able to provide the pressure and other thermodynamic quantities of pure neutron matter and symmetric nuclear matter with propagated chiral truncation uncertainties.

Funded by the research cluster ELEMENTS (Project ID 500/10.006) and by the DFG - Project-ID 279384907 - SFB 1245.

HK 3: Instrumentation I

Time: Monday 16:45–18:15 Location: HBR 19: C 1

Group Report HK 3.1 Mon 16:45 HBR 19: C 1

The Surrounding Background Tagger for the SHiP Experiment at CERN — •Horst Fischer for the SHiP-SBT-Collaboration — Albert-Ludwigs-Universität Freiburg

The Search for Hidden Particles (SHiP) experiment is an ambitious initiative designed as a dedicated proton beam dump facility located in the ECN3 cavern at CERN. The overall goal of this experiment is to explore the realm of long-lived, neutral, feebly interacting particles outside the Standard Model, produced by the collision of 400 GeV/c protons with a robust heavy metal target. Over a 15-year time span, the SHiP experiment aims to accumulate an impressive 6x10^20 protons on target, employing a sophisticated detector setup strategically designed to suppress potential background to virtually negligible levels. The Surrounding Background Tagger (SBT) will be a cornerstone of background suppression. It is designed to reject background by detecting charged particles that either enter the Hidden Sector vacuum decay vessel from external sources or arise from deep inelastic interactions within the vacuum vessel walls. To this end the SBT detector encloses ae expansive 50-meter-long decay vessel utilizing liquid scintillator (LAB-PPO) filled cells. Light capture is facilitated by Wavelength shifting Optical Modules (WOMs) made of PMMA and that are coated with a wavelength shifting dye and equipped with silicon photomultipliers. In 2023, a four-cell prototype detector was developed for a test beam campaign at CERN. We will report on the results of the test beam exposure and, as well as the ongoing R&D work.

HK 3.2 Mon 17:15 HBR 19: C 1

Testbeam Readout and Slow Control of 4-cell Prototype for the SHiP SBT — •Tim Molzberger for the SHiP-SBT-Collaboration — Physikalisches Institut, Albert-Ludiwgs-Universität Freiburg, 79104 Freiburg, Germany

The Search for Hidden Particles (SHiP) is a proposed next-generation beam dump experiment at CERN to scan for previously undiscovered long-lived and feebly interacting neutral particles beyond the Standard Model. This task requires unprecedented efficiency in background rejection by multiple veto detectors like the surrounding background tagger (SBT). We present the developments for the readout and the slow control of the latest SBT prototype testbeam at CERN in October 2023. The readout features silicon photomultipliers for photodetection and ASICs for signal amplification and shaping. A group of controller boards powers and controls the configuration of this readout, which is one element of the low cost slow control developed for this testbeam. The slow control further features sensors to monitor the orientation and position of the prototype and dedicated software to organize all activities and store data.

HK 3.3 Mon 17:30 HBR 19: C 1

Improved Design of a Compact Scintillating-Fiber Detector for Space Applications — •Liesa Eckert[1], Peter Hinderberger[1], Martin J. Losekamm[1], Luise Meyer-Hetling[1], Stephan Paul[1], Thomas Pöschl[2], and Sebastian Rückerl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN, Geneva, Switzerland — [3]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany

We aim to measure the charged nuclear component of the space radiation environment with compact detectors composed of scintillating-plastic fibers read out by silicon photomultipliers. With different detector versions, we study the radiation spectrum's composition for the determination of astronaut radiation exposures with the RadMap Telescope and aim to measure the antiproton flux in Earth's radiation belts with the upcoming AFIS mission. For the latter, we are currently updating the detector design of the RadMap Telescope to achieve better performance and higher mechanical stability, and to reduce the production effort. We plan to test the improved design as part of the In-Orbit Verification Experiment 1 (IOV-1), a technology demonstration experiment on the International Space Station. In this talk, I will present the improvements we made in the past year with respect to the design of the RadMap Telescope, as well as the difficulties we dealt with during development and production. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 3.4 Mon 17:45 HBR 19: C 1

Advancements in Compact Scintillation Detector "RUBIK " for Tracking of Space Radiation — Roman Bergert, •Hartmut Schotte, Niclas Friedler, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physics Institute, Justus-Liebig-University Giessen

A segmented scintillation detector designed for use in radiation tracking within the space environment is discussed. The detector utilizes single unity polyvinyl toluene (PVT) based cubes as the sensitive detector volume, ensuring a compact and efficient tracking system. Addressing the challenges posed by power consumption, volume, and weight constraints specific to the mission requirements is a pivotal aspect of the detector design. We present the results of our first prototype, emphasizing its performance in the context of the specified mission parameters. Notably, discussions center around the detector's capabilities under diverse stress factors, such as temperature cycles and vacuum conditions, criticalconsiderations for its application in space. The implications of the detector's performance in meeting the specified requirements, offering insights gained from the initial prototype. Lessons learned from its behavior under different environmental stresses contribute to the refinement of the detector concept, guiding the development of subsequent prototypes. The progress made in tailoring the detector for optimal performance in the challenging conditions of space environments, setting the stage for further advancements for the final design choice is summarized.

HK 3.5 Mon 18:00 HBR 19: C 1

Development of a cost effective PET-like system utilizing organic scintillators and SIPMs to be used for particle tracking — •Esther Constanze Wais, Nadia Böhle, Mario Fink, Thomas Held, Fritz-Herbert Heinsius, Matthias Steinke, and Ulrich Wiedner — Experimentalphysik 1, Ruhr-Universität Bochum, Bochum, Deutschland

Although PET has established itself as a reliable tool in medical applications over the last 20 years, industrial applications have so far been limited. The reason for this are the high costs of constructing a detector on the scale required for industrial purposes. A cost-effective detector has been built. The detector uses long (1000 mm × 20 mm × 20 mm) organic scintillator rods instead of small inorganic scintillator

crystals, significantly reducing material and readout costs compared to a conventional detector.
The scintillation light gets detected by SiPMs. Since no SiPMs with the required dimensions were available, four SiPMs are connected in a 'hybrid circuit' to form a SiPM array of the required size. The goal of the measurements is to investigate the behavior of granular matter in rotary kilns or grate systems in order to test simulations calculations. These calculations will be used in order to make rotary kilns and grate systems more efficient.

Acknowledgment: This work has been funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) 422037413-CRC/TRR 287 'BULK-REACTION'

HK 4: Instrumentation II

Time: Monday 16:45–18:15 Location: HBR 19: C 2

Group Report HK 4.1 Mon 16:45 HBR 19: C 2
Current status in the concept design, assembly, and performance evaluation of the Silicon Tracking System for the CBM experiment — •Dario Alberto Ramirez Zaldivar for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter (CBM) is one of the experimental pillars at the FAIR facility. The Silicon Tracking System (STS) is the central detector for tracking and momentum measurement. It consists of 876 double-sided silicon sensors arranged in 8 stations.

Significant strides have been made over the past year in developing the STS. The finalized concept design and geometry implementations mark a crucial milestone in the detector's evolution. The consolidation of the procedures for module assembly and testing materializes at the onset of the series production.

Prototype components of the STS have been operated in mini-CBM (mCBM), a small-scale setup at SIS18 consisting of sub-units of all major CBM systems, which aims to verify the concepts of free-streaming readout electronics, data transport, and online reconstruction as well as in the E16 experiments at J-PARC.

This report provides an overview of the recent progress and highlights the comprehensive performance studies conducted on the STS modules. In-beam operation at the mCBM and E16 facilities has provided invaluable insights into the detector's capabilities and response under realistic experimental conditions. These findings support extrapolating the detector's final performance.

HK 4.2 Mon 17:15 HBR 19: C 2
Studies of detector data rates and hit multiplicity for the Silicon Tracking Systems of the CBM experiment — •Mehulkumar Shiroya for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Silicon Tracking System (STS) is the main tracking device of the Compressed Baryonic Matter (CBM) Experiment, a fixed target experiment at the SIS100 accelerator, under construction at the FAIR Facility Darmstadt. The STS is designed to measure up to 700 charged particles produced in nucleus-nucleus collisions up to an interaction rate of 10 MHz.It consists of 876 double-sided micro-strips silicon sensors, read out by two Front-End Boards (FEBs) with 8 ASICs each, arranged in 8 tracking stations. To meet the high interaction rate demand, the CBM experiments operate with free streaming electronics. A realistic estimate of the data rate expected in the detector is therefore of crucial importance to drive the decisions on the read-out system design and network data transfer components procurement. Simulation studies have been performed including different experimental scenarios, a realistic detector geometrical setup, which includes all the known passive materials, as well as realistic modelling of the detector response and front-end electronics. The impact of the detector noise and additional signals of delta electrons originating from the target has been evaluated. Detector data rate and hit multiplicity are studied in real data and compared to simulations, to benchmark and validate the estimates for the highest rates expected at SIS100.

HK 4.3 Mon 17:30 HBR 19: C 2
HI-TREX: Compact, high resolution particle detection system for ISOLDE — Roman Gernhäuser, •Sergei Golenev, Robert Neagu, and Lutz Ziegele for the MINIBALL-Collaboration — Technische Universität München, Germany

HI-TREX is a particle detection setup, developed for the HIE-ISOLDE facility at CERN, designed for transfer reactions using radioactive ion beams.
HI-TREX is based on a thin double-sided silicon strip detector (DSSSD), high-resolution front-end electronics with SKIROC ASICs, and a custom FPGA-based readout board for the fiber-based TRB data acquisition system.
In order to characterize the performance of the detectors, a full system test was conducted in Delft, Netherlands. Even for very low-energy particles from the ^{6}Li(n,α)^{3}H reaction, we achieved an energy resolution FWHM $\approx$ 13 keV. We will present the experimental setup, simulations and a 3-dimensional vertex reconstruction, demonstrating the capability of this new instrument.
(supported by BMBF 05P21WOCI1)

HK 4.4 Mon 17:45 HBR 19: C 2
Module and ladder characterization and burn-in tests of the Silicon Tracking System for the CBM experiment — •Lady Maryann Collazo Sánchez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The Silicon Tracking System (STS) in the upcoming heavy-ion CBM experiment is tailored for an unprecedented 10 MHz beam-target interaction rate. A unique integration strategy was employed to maintain a material budget within 2 - 8% X_0 while ensuring ample granularity, spatial precision, and timing accuracy. The read-out electronics sit external to the sensitive volume, connected to double-sided double-metal silicon sensors through ultra-thin micro cables. Each double-sided silicon strip sensor is connected to two Front-End Boards (FEBs), featuring eight custom-designed STS-XYTER ASICs (SMX) per FEB. Post-assembly, rigorous quality control tests, including time and amplitude calibration of all module ASICs, ensure reliable performance, operational refinement, and accurate data interpretation. Operating at room temperature to -20 °C (coolant) and -10 °C (effective), FEBs undergo mechanical stress due to temperature fluctuations. The burn-in test exposes modules to varying temperatures and power cycles, identifying weaknesses and evaluating electronics robustness and module functionality. Post-testing, modules are affixed to a carbon fiber ladder, undergoing further assessments to verify sustained functionality and performance. This study outlines the status and outcomes of tests on the first modules of the STS detector's series production, providing valuable insights into its development and performance capabilities.

HK 4.5 Mon 18:00 HBR 19: C 2
Functional and in-beam performance tests of a PANDA MVD detector prototype — •Nils Tröll[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Marvin Peter[1], Fabio Cossio[3], Michele Caselle[4], Tobias Stockmanns[2], Lukas Tomasek[5], Pavel Stanek[5], and Francesca Lenta[3] for the PANDA-Collaboration — [1]JLU Gießen, IIPI, Heinrich-Buff-Ring 16, 35392 Gießen, Germany — [2]FZ Jülich, Wilhelm-Johnen-Straße, 52428 Jülich, Germany — [3]INFN Physics Turin, Via Pietro Giuria, 1 10125 Torino-TO, Italy — [4]KIT, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany — [5]CVUT Prague, 22 Břehová 7, Praha 1, Czech Republic

The Micro-Vertex-Detector (MVD) of a PANDA experiment is the closest part with respect to the primary interaction point. Double-sided silicon strip sensors of the MVD enable tracking of charged particles, which is essential for a very precise determination of secondary decay vertices of short-lived particles.

For the first time, two double-sided MVD silicon strip detectors were successfully tested in conjunction with the Torino Amplifier for Strip detectors (ToASt) ASIC and the Data Acquisition System for the PANDA MVD during a beamtime. The detector system underwent testing in the high-energy proton beam at the COSY acceleration facility. In the analysis, various properties, such as clustering and strip multiplicity, were examined to validate the functionality of the system.
The work is supported by BMBF.

HK 5: Structure and Dynamics of Nuclei I

Time: Monday 16:45–18:15 Location: HBR 19: C 5a

Group Report HK 5.1 Mon 16:45 HBR 19: C 5a

Investigating the Pygmy Dipole Resonance: A multi-messenger approach — •Markus Müllenmeister, Michael Weinert, Florian Kluwig, Miriam Müscher, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The enhanced dipole (*E1*) response below and around the neutron separation energy of heavy and medium mass nuclei is known as the Pygmy Dipole Resonance (PDR). The historical perspective of a neutron skin oscillation being the sole cause of these excitations has been challenged in recent decades [1]. Despite continued research efforts, the structure, emergence, and evolution of the PDR remain largely unknown [2]. To access this information, systematic studies encompassing different probes on a variety of target nuclei, as well as comparable results in similar mass regions, are needed [3]. Recently, efforts have been undertaken to single out specific phenomena using complementary experiments with hadronic and electromagnetic probes [4], as well as neutron transfer reactions [5]. This contribution will outline the experimental methods used and highlight results from the complementary approaches. Supported by the DFG (ZI 510/10-1).

[1] J. Endres *et al.*, Phys. Rev. C **80** (2009) 034302.
[2] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360.
[3] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16.
[4] M. Müscher *et al.*, Phys. Rev. C **102** (2020) 014317.
[5] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021) 242501.

HK 5.2 Mon 17:15 HBR 19: C 5a

Investigation of the dipole strength distribution in ^{70}Zn up to the neutron threshold[a] — •J. Hauf[1], V. Werner[1], M. Beuschlein[1], R. Beyer[2], A. Gupta[1], T. Hensel[2], J. Isaak[1], A. Junghans[2], J. Kleemann[1], P. Koseoglou[1], E. Masha[2], C. Nickel[1], O. Papst[1], M. Pichotta[2], N. Pietralla[1], K. Prifti[1], K. Römer[2], K. Schmidt[2], R. Schwengner[2], S. Turkat[2], J. Vogel[1], A. Wagner[2], and A. Yadev[2] — [1]IKP, TU Darmstadt — [2]Helmholtz-Zentrum Dresden-Rossendorf

We perform a series of experiments to study the dipole strength distribution of the neutron-rich isotope ^{70}Zn, up to its neutron threshold of about 9.2 MeV. ^{70}Zn is of particular interest due to its location on the N=40 harmonic oscillator shell and in view of shape coexistence in this region. The main goal of the present study is in particular to obtain information on the E1 strength distribution, typically attributed to the pygmy dipole resonance, and possible M1 strength embedded in the dipole response. Following our initial nuclear resonance fluorescence bremsstrahlung experiment at γELBE with a maximum energy of 11.5 MeV, we now measured at a lower maximum energy of 7.5 MeV, in order to resolve ambiguities in the assignments of observed transitions and excited states. The present status of the analysis and an outlook on further planned experiments will be given.

[a]This work was supported by the DFG under grant numbers SFB 1245, project-ID 279384907, and GRK 2891, project-ID 499256822

HK 5.3 Mon 17:30 HBR 19: C 5a

Dipole strength distribution of ^{96}Mo: Electric and magnetic contributions* — •V. Skibina[1], O. Papst[1], J. Isaak[1], A. D. Ayangeakaa[2,3], T. Beck[1,4], R. Beyer[5], A. Boeltzig[5], M. L. Cortés[1,6], S. W. Finch[3,7], U. Friman-Gayer[3,7,8], D. Gribble[2,3], M. Heumüller[1], X. James[2,3], R. V. F. Janssens[2,3], S. Johnson[2,3], A. Junghans[5], J. Kleemann[1], F. Kluwig[9], P. Koseoglou[1], T. Lossin[5], B. Löher[10], M. Müscher[9], M. Pichotta[5], N. Pietralla[1], K. Prifti[1], G. Rusev[11], K. Römer[5], D. Savran[10], K. Schmidt[5], R. Schwengner[5], A. Thees[5], A. Wagner[5], V. Werner[1], A. Yadav[5], and A. Zilges[9] — [1]IKP, TU Darmstadt — [2]UNC, NC, USA — [3]TUNL, NC, USA — [4]MSU, MI, USA — [5]HZDR, Dresden — [6]RIKEN, JP — [7]Duke U., NC, USA — [8]ESS, SE — [9]University of Cologne — [10]GSI, Darmstadt — [11]LANL, USA

We performed a Nuclear Resonance Fluorescence experiment on ^{96}Mo at the γELBE facility with a 7.8 MeV endpoint energy bremsstrahlung beam. The experiment follows studies with 13 MeV endpoint energy [1], which were sensitive mainly up to the neutron-separation threshold. The present analysis focuses on intermediate energies, yields cross sections, branching ratios and, in combination with HIγS data, parities of dipole-excited states.

Supported by the DFG under grant Nos. GRK 2891 * Project-ID 499256822, and SFB 1245 - project ID 279384907, and by U.S. DOE under grant Nos. DE-FG02-97ER41041 and DE-FG02-97ER41033.

[1] G. Rusev *et al.*, Phys. Rev. **C 79**, 061302(R) (2009).

HK 5.4 Mon 17:45 HBR 19: C 5a

Nuclear structure studies in ^{96}Ru using electron-gamma coincidence reactions at the S-DALINAC — •Bastian Hesbacher, Jonny Birkhan, Isabelle Brandherm, Johann Isaak, Igor Jurosevic, Norbert Pietralla, Maxim Singer, Maximilian Spall, and Gerhart Steinhilber — Institut für Kernphysik, Technische Universität Darmstadt

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. One of the challenges of this measurement technique lies in the coincident bremsstrahlung, which - apart from the angular distribution - cannot be distinguished from the γ-radiation of decaying nuclei after excitation by inelastic electron scattering. In 2021 a successful $^{96}\mathrm{Ru}(e,e'\gamma)$ measurement was performed at the S-DALINAC with coincidence-resolution improved by two orders of magnitude [2]. The scattered electrons were registered with the QCLAM spectrometer. The γ-radiation was detected by 6 $LaBr_3$:Ce detectors. Two methods for the subtraction of the bremsstrahlung background will be applied to the $^{96}\mathrm{Ru}(e,e'\gamma)$ data allowing for the extraction of ground-state γ-decays of excited states. Preliminary results on γ-decays of ^{96}Ru will be presented.

This work is supported by the Collaborative Research Center 1245.

[1] C. N. Papanicolas et al., Phys. Rev. Lett. **54**, 26 (1985).
[2] G. Steinhilber, Doctoral thesis, TU Darmstadt (2023).

HK 5.5 Mon 18:00 HBR 19: C 5a

Investigation of angular distributions in nuclear reactions using a new particle-γ coincidence setup — •Gloria Huppelsberg, Michael Weinert, Markus Müllenmeister, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

To gain a better understanding of nuclear reactions populating states in the region of the Pygmy Dipole Resonance (PDR), angular correlation data is needed.[1] For this purpose, a new particle-γ coincidence setup was developed at the 10 MeV FN-Tandem accelerator laboratory at University of Cologne. This setup allows the investigation of particle angular distributions using, eg., (p,p'γ), (α,α'γ) and (d,pγ) reactions. Up to twelve ΔE-E Silicon detectors can be mounted next to each other on a rotatable plate inside a scattering chamber which makes it possible to effortlessly adjust the detection angle. For the precise identification of the excited states through particle-γ coincidences, a high purity germanium detector is mounted on top of the chamber. The commissioning experiment of the chamber is intended to investigate the single particle character of the Pygmy Dipole Resonance [2,3] in lighter nuclei employing the particle angular distributions of excited states. This contribution presents the new setup, reports on first experiments and outlines a road map for future measurements. Supported by DFG (ZI 510/10-1).

[1] M. Spieker *et al.*, Phys. Rev. C **108**, 014311 (2023)
[2] M. Spieker *et al.*, Phys. Rev. Lett. **125**, 102503 (2020)
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127**, 242501 (2021)

HK 6: Structure and Dynamics of Nuclei II

Time: Monday 16:45–18:15 Location: HBR 19: C 5b

Group Report HK 6.1 Mon 16:45 HBR 19: C 5b

Nuclear charge radius measurements in ^{32}Si at FRIB — •Kristian König for the BECOLA-Collaboration — TU Darmstadt, Germany — Michigan State University, USA

The nuclear charge radius of ^{32}Si was determined from isotope shift measurements performed at the collinear laser spectroscopy setup BECOLA at the Facility for Rare Isotope Beams (FRIB, Michigan State University). The extracted charge radius was compared to ab initio nuclear lattice effective field theory, valence-space in-medium similarity renormalization group and mean field calculations. Furthermore, the charge radius of ^{32}Si completes the radii of the mirror pair ^{32}Ar - ^{32}Si, whose difference was correlated to the slope L of the symmetry energy in the nuclear equation of state [1]. In this talk the BECOLA facility will be presented, the ^{32}Si results will be discussed and an outlook for future experiments at FRIB will be given.

This work was supported in part by the National Science Foundation, Grants No. PHY-21-11185 and the DFG, Project-Id 279384907-SFB 1245.

[1] arXiv:2309.02037 [nucl-ex]

HK 6.2 Mon 17:15 HBR 19: C 5b

Two-Neutron Halo Nuclei With Weak Neutron-Core Interaction — •Daniel Kromm[1], Matthias Göbel[2], and Hans-Werner Hammer[1] — [1]Technische Universität Darmstadt, Institut für Kernphysik — [2]Istituto Nazionale di Fisica Nucleare, Sezione di Pisa

We investigate the renormalization properties of an EFT for two-neutron halo nuclei with weak neutron-core interaction proposed by Hongo and Son. In this theory, there is a universal prediction for the ratio of the mean-square matter radius and charge radius. We investigate the possibility to predict the radii separately without using additional input. We argue that one further renormalization input is required to predict both radii separately. Using one of the radii as this input, we quantify the restriction on the UV cutoff from the Landau pole. We apply our results to the case of ^{22}C and discuss the hierarchy of scales implicit in the power counting.

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

HK 6.3 Mon 17:30 HBR 19: C 5b

Nuclear Moments and Charge Radii of Neutron-Rich Palladium Isotopes — •Laura Renth for the ATLANTIS-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

We present the first experimental results taken at the new collinear laser spectrosocpy setup ATLANTIS (**A**rgonne **T**andem hall **LA**ser beamli**N**e for a**T**om and **I**on **S**pectroscopy) at the Argonne National Laboratory. Short-lived exotic isotopes are generated from the CARIBU source, which collects ^{252}Cf fission fragments in a gas catcher. After mass speparation, the isotopes of interest are transported at a beam energy of 27keV to the laser spectroscopy setup.

The hyperfine spectra of neutron rich palladium iostopes $^{112-116,118}$Pd will be presented as well as the differential mean-square nuclear charge radii, nuclear moments and nuclear spins. These properties add insights in the physics of nuclear shell strucuture evolution, which are discussed in this talk.

This work was supported by DFG - Project-Id 279384907-SFB 1245, BMBF 05P196RDFN1 and by the NSF PHY-21-11185, is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics, under contract number DE-AC02-06CH11357 and used resources of ANL's ATLAS facility, which is a DOE Office of Science User Facility.

HK 6.4 Mon 17:45 HBR 19: C 5b

Uncertainty quantification for nuclear structure calculations using low-resolution potentials — •Tom Plies[1,2], Matthias Heinz[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

Uncertainty quantification is a key aspect in modern nuclear theory. Nuclear Hamiltonians are uncertain, with the uncertainty residing in the low-energy constants (LECs) parametrizing the interactions. As these parameter-dependent interactions are used as input for nuclear structure calculations, distributions of many-body observables can be inferred from distributions of LECs. We deploy the singular value decomposition (SVD) to recover a linear operator basis for our interactions. We use Bayesian methods to infer distributions for the LECs from the theoretical uncertainties in nucleon-nucleon phase shifts. We then sample from the LEC posteriors to obtain distributions for the ground-state energies of ^{3}H and ^{16}O.

* Funded by the ERC Grant Agreement No. 101020842 and by the DFG – Project ID 279384907 – SFB 1245.

HK 6.5 Mon 18:00 HBR 19: C 5b

Investigation of the proton radius of the neutron-rich Borromean halo nucleus ^{19}B — •Divyang Prajapati for the RIBF132-Collaboration — Saint Mary's University, Halifax, Canada

The structural properties of neutron-rich nuclei are an ideal presentation for understanding the underlying nuclear forces. The evolution of the nuclear charge or matter-density distribution along the isotopic chain reflects the complex nature of strong force. For instance, the drip line nucleus ^{19}B has garnered the attention of theory and experiments due to its Borromean structure. However, the proton distribution of this nucleus is still unknown, and theoretical predictions vary widely.

The measurement of the charge-changing cross-section (σ_{cc}) has emerged as a new method for probing the point proton radius of exotic nuclei. Therefore, the σ_{cc} of the ^{19}B nucleus was measured at RIBF, RIKEN using the BigRIPS and ZDS. The secondary beam of ^{19}B was produced via projectile fragmentation of a ^{48}Ca primary beam at ∼345A MeV on a ^{9}Be production target. The σ_{cc} was measured with a carbon target, placed at the achromatic focus F11. The measurement of Time Of Flight (TOF) using plastic scintillators, magnetic rigidity (Bρ) using PPAC, and energy loss (ΔE) information from MUSIC detectors identifies the A, Q, and Z of the particle.

The presentation will describe the experimental details. Preliminary observations from the data analysis will be discussed. The radius that will be extracted from the measured cross-sections via Glauber model analysis will aid in understanding the evolution of neutron skin in ^{19}B and its Borromean structure.

HK 7: Astroparticle Physics I

Time: Monday 16:45–18:15 Location: HBR 19: C 103

Group Report HK 7.1 Mon 16:45 HBR 19: C 103

Compact Particle Detectors for the Study of Cosmic Rays and of Earth's Radiation Belts — •Martin J. Losekamm[1], Liesa Eckert[1], Peter Hinderberger[1], Luise Meyer-Hetling[1], Stephan Paul[1], Thomas Pöschl[2], and Sebastian Rückerl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN, Geneva, Switzerland — [3]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany

We develop compact charged-particle detectors for space applications based on scintillating-plastic fibers and silicon photomultipliers. In this contribution, I will present recent advances in several projects of our group that currently are in various stages of development. I will particularly focus on the RadMap Telescope, a radiation-monitoring experiment that was deployed to the International Space Station in April 2023 and has successfully been collecting data since. The instrument comprises several sensors that are optimized for the detailed characterization of the radiation environment astronauts are exposed during their stay in space. I will also summarize our work towards a small-satellite mission that shall measure the flux of antiprotons trapped in Earth's Van Allen radiation belts to augment the data previously

collected by the PAMELA instrument.

Group Report HK 7.2 Mon 17:15 HBR 19: C 103
BDF/SHiP @CERN: Search for Hidden Particles at a Future Beam Dump Facility — •Annika Hollnagel for the SHiP-Collaboration — JGU Mainz (DE)

In conjunction with the CERN North Area Consolidation, an upgrade of the existing ECN3 experimental hall will enable a diverse physics program at the CERN SPS, complementing research at the energy frontier. At a dedicated Beam Dump Facility (BDF), the Search for Hidden Particles (SHiP) experiment has been proposed to exploit the full potential of the 400 GeV proton beam, covering a wide range of the Hidden Sector while also offering a rich neutrino physics program.

In line with the European Strategy for Particle Physics, BDF/SHiP has been identified as a frontrunner proposal by the CERN Physics Beyond Colliders (PBC) initiative. With the final CERN Research Board decision being imminent, this is the ideal time for new groups to join the project.

This talk will give an overview of the detector technologies and physics capabilities of the proposed experiment.

HK 7.3 Mon 17:45 HBR 19: C 103
Active Transverse Energy Filter Development for KATRIN — •Sonja Schneidewind, Kevin Gauda, Kyrill Blümer, Christian Gönner, Volker Hannen, Hans-Werner Ortjohann, Sebastian Wein, and Christian Weinheimer for the KATRIN-Collaboration — Institute for Nuclear Physics, University of Münster

The KATRIN experiment aims to measure the neutrino mass via tritium β-decay spectroscopy. Despite implementation of efficient countermeasures, we still observe an elevated experimental background (150 mcps instead of 10 mcps), which needs to be reduced to reach the targeted sensitivity of 0.2 eV/c^2. Radioactive decays in the stainless steel vessel of the main spectrometer produce highly-excited Rydberg or autoionizing atomic states in the volume. These release low-energetic electrons, which are energetically indistinguishable from β-electrons at the detector. Their angular distribution, however, is significantly sharper. The "active Transverse Energy Filter" (aTEF) concept was invented to reduce this background by discrimination of electrons in a large magnetic field based on their pitch angle (EPJ-C 82, 922 (2022)). This talk will introduce the "Si-aTEF" as a concept based on Si-PIN diodes. The fabrication process and prototype performance will be presented. The implementation of the Si-aTEF in KATRIN - success supposed - and the expected sensitivity improvement will be shown. This work is supported by the Helmholtz Association, by BMBF (grant numbers 05A23PMA, 05A23PX2, 05A23VK2 and 05A23WO6) and DFG (Research Training Group GRK 2149) in Germany.

HK 7.4 Mon 18:00 HBR 19: C 103
Progress of the Neutron Decay Facility PERC and its Silicon Detector — •Manuel Lebert for the PERC-Collaboration — Physik-Department, Technische Universität München, Germany — Forschungs-Neutronenquelle Heinz Maier-Leibnitz, Garching, Germany

The PERC facility is currently under construction at the FRM II in Garching, Germany. It will serve as an intense and clean source of electrons and protons from neutron beta decay for precision studies. It aims to improve the measurements of the properties of weak interaction by one order of magnitude and to search for new physics via new effective couplings.

PERC's central component is a 12 m long superconducting magnet system. It hosts an 8 m long decay region with a uniform field. To minimize systematic uncertainties, an additional high-field region selects the phase space of electrons and protons that can reach the main detector.

The main detector and two backscattering detectors will initially be scintillation detectors with a (silicon) photomultiplier readout. In a later upgrade, the downstream detector will be replaced by a pixelated silicon PIN-detector with a thickness of 2mm. In this talk, I present the status of the ongoing installation of PERC and its infrastructure, which is expected to be ready for neutrons by the end of 2024, as well as first results of the characterization of the silicon detector.

HK 8: Heavy-Ion Collisions and QCD Phases I

Time: Monday 16:45–18:15 Location: HBR 62: EG 03

Group Report HK 8.1 Mon 16:45 HBR 62: EG 03
Probing hadronisation effects with heavy-flavour particles with ALICE at the LHC — •Jeremy Wilkinson for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

The study of heavy-quark (charm and beauty) hadronisation has recently become a major topic of interest at the CERN LHC. Typically, the fragmentation functions that describe the evolution from a bare heavy quark to a bound hadronic state were assumed to apply universally. However, measurements of the relative production rates of charm baryons and mesons at the LHC have challenged this assumption, indicating that the hadronisation of heavy-flavour quarks in collider experiments is dependent on the collision system.

In this contribution, the most recent results from the ALICE Collaboration on the hadronisation of heavy-flavour particles at the LHC will be presented. Measurements of prompt and non-prompt Λ_c^+-baryon production in pp and p–Pb collisions are used to investigate the hadronisation of charm and beauty baryons. The production of the Ξ_c^0 baryon was measured in p–Pb collisions at midrapidity for the first time. The available measurements of prompt ground-state charm hadrons in p–Pb collisions were combined to compute the charm fragmentation fractions and total charm cross section at midrapidity. Recent measurements of Ω_c^0 production in semileptonic decays are presented along with the determination of its relative branching fractions. Finally, a brief overview of the current status of heavy-flavour measurements using data from Run 3 of the LHC is presented.

HK 8.2 Mon 17:15 HBR 62: EG 03
Charmed baryon measurements in proton-proton collisions at $\sqrt{s} = 13.6$ TeV with the ALICE experiment in Run 3 — •Federica Zanone for the ALICE Germany-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Germany

At LHC energies, charmed-baryons are copiously produced. Moreover, the recent upgrade of the ALICE experiment allows to operate at an increased interaction rate and in continuous readout mode, thus allowing for collecting a significantly larger data set compared to Run 2. This opens a new dimension of precise charmed-baryon measurements in several decay channels, helping to shed light on the mechanisms responsible for the production and decay of these particles. This topic became of crucial interest after recent studies by ALICE challenged the assumptions of the universality of charm hadronization processes across different collision systems. Moreover, the decay of charmed baryons is still poorly understood. Measurements of corresponding branching ratios pose a challenge to all models.

In this picture, the measurements of $\Xi_c^0 \to \Xi^+\pi^-$ and of the Cabibbo-suppressed decays $\Omega_c^0 \to \Xi^+\pi^-$ (SCS) and $\Omega_c^0 \to \Xi^+K^-$ (DCS) play a key role. To address these challenging analyses, ALICE relies on the implementation of dedicated triggers, thus allowing for the exploration of a data sample that is about 300 times larger than the previous data set but at the same time applying an efficient data storage procedure. We present recent results from Run 3.

HK 8.3 Mon 17:30 HBR 62: EG 03
Reconstruction of heavy-flavor hadrons with ALICE in Run 3 — •Phil Lennart Stahlhut for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

Heavy-flavor hadrons are sensitive probes for the quark-gluon plasma, a hot nuclear matter state produced at extremely high temperatures and/or densities, like the ones reached in heavy-ion collisions at the CERN LHC. Therefore, measurements of heavy-flavor hadron production in proton-proton collisions are a crucial reference for production measurements in heavy-ion collisions, while also providing an important test of perturbative quantum chromodynamics.

The reconstruction of short-lived particles and their corresponding decay vertices can be performed with the Kalman Filter Particle package. It provides a full description of the decay particle both at its production and decay vertex and includes the complete treatment of tracking and vertexing uncertainties. Moreover, the KF Particle package supports the use of geometrical, mass and topological constraints in the reconstruction process and is suitable even for high-density track environments.

This contribution will outline recent developments of the reconstruction and selection workflow of heavy-flavor hadrons in O^{2}Physics, the new analysis software framework for ALICE in Run 3, and selected results from proton-proton collisions.

HK 8.4 Mon 17:45 HBR 62: EG 03

Charmonium production measurement at midrapidity using TRD-triggered data in ALICE — •Jinjoo Seo — Physikalisches Institut Universität Heidelberg

Quarkonium production is considered one of the golden probes of the quark-gluon plasma (QGP) formation in heavy-ion collisions. Due to their large mass, the production of heavy-quarks is governed by hard scales of QCD, while the formation of the bound quarkonium state involves soft QCD scales. Quarkonium productions in pp collision is essential to provide a baseline for Pb–Pb results, and also useful for investigating the production mechanisms. The ψ(2S) production relative to J/ψ is observable with discriminating power between the two quarkonium production models. Thanks to the ALICE online single-electron triggers from the Transition Radiation Detector (TRD), the ψ(2S) signal can be extracted at midrapidity in the dielectron channel.

In this contribution, the J/ψ and ψ(2S) productions and the excited-to-ground state yield ratio (ψ(2S)-to-J/ψ) at midrapidity with the TRD-triggered data measured in ALICE in pp collisions at $\sqrt{s} = 13$ TeV will be shown.

HK 8.5 Mon 18:00 HBR 62: EG 03

Charmonia production and dissociation within microscopic Langevin simulations — •Naomi Oei[1], Juan Torres-Rincon[2], Hendrik van Hees[1], and Carsten Greiner[1] — [1]Goethe University, Frankfurt, Germany — [2]Universitat de Barcelona, Barcelona, Spain

The investigation of heavy quarkonia can give insight into processes that occur during the evolution of the quark-gluon plasma and therefore allows conclusions about the properties of the medium. One advantage of theoretical approaches is that heavy quarks can be treated non-relativistically due to their large masses. We choose a classical model to describe charm and anticharm quarks as Brownian particles in the background medium of light quarks and gluons. Their motion and the interaction with the medium are based on a Fokker-Planck equation, which can be realized with Langevin simulations, quantifying how position and momentum of the quarks change due to random kicks from the medium. The heavy quarks interact over a Coulomb-like potential to form bound states, which can later dissociate again due to interactions with the medium. Therefore dissociation and regeneration of charmonium states can be described. The medium evolution is parametrized by a transversally expanding, boost invariant fireball. Box simulations at fixed temperature and volume are used to verify that the system reaches the expected thermal distribution in the equilibrium limit and to test bound state properties. Within the fireball model, the initial momentum distribution of the pairs results from the PYTHIA event-generator and the elliptic flow of charm and anticharm quarks as well as of charmonia is studied at RHIC and at LHC energy.

HK 9: Heavy-Ion Collisions and QCD Phases II

Time: Monday 16:45–18:15 Location: HBR 62: EG 05

Group Report HK 9.1 Mon 16:45 HBR 62: EG 05

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, measures heavy-ion and elementary collisions at a few GeV beam energies, enabling the investigation of nuclear matter at high densities and moderate temperatures. One pillar of HADES is the study of these collisions not only through hadrons, which are heavily affected by freeze-out stages, but also via rare electromagnetic probes, as they allow unique insights into the evolution of the collision throughout. In particular, virtual photons, decaying into e^+e^- pairs, encode numerous characteristics of the fireball and deliver additional information in their invariant mass.

In this contribution, we present measurements of such dileptons collected in heavy-ion Ag+Ag and Au+Au as well as elementary p+p collisions at $\sqrt{s_{NN}} = 2.55$ GeV and $\sqrt{s_{NN}} = 2.42$ GeV. Combination of these HADES data sets brings a unique opportunity to gain new insights into the dilepton excess and its dependence on system size and centrality. Hence, we provide an overview of recent works and progress in the dilepton analysis at HADES. This includes advances in the particle identification, multidifferential dilepton spectra as well as studies on collectivity via the investigation of anisotropic flow and polarisation.

This work has been supported by BMBF (05P18RDFC1), GSI F&E, HGS-HIRe, HFHF and ELEMENTS (500/10.006).

HK 9.2 Mon 17:15 HBR 62: EG 05

Simulating final-state electromagnetic interaction in heavy-ion collisions at energy of few GeV — •Szymon Harabasz[1], Wojciech Florkowski[3], Tetyana Galatyuk[1,4], Malgorzata Gumberidze[4], Radoslaw Ryblewski[2], Piotr Salabura[3], and Joachim Stroth[4,5] — [1]TU Darmstadt — [2]Institute of Nuclear Physics PAS — [3]Jagiellonian University in Krakow — [4]GSI, Darmstadt — [5]Institut für Kernphysik, GU Frankfurt

It has been shown that transverse-mass and rapidity spectra of p and $\pi^{\pm}$ produced in Au-Au collisions at $\sqrt{s_{\rm NN}} = 2.4$ GeV are well reproduced by thermal emission from a spheroid single freeze-out hypersurface [1]. To better understand the particle spectra, it is necessary to account for the effect of electromagnetic interactions. In central collisions at relatively low energies, i.e., of few GeV, incoming nucleons are largely stopped in the interaction region, and high positive electric charge density is generated. The electromagnetic field accelerates positively charged particles, and decelerates negatively charged ones.

In order to simulate this effect in THERMINATOR 2, a direct solution to relativistic Newton equation has been implemented, including electromagnetic forces between particles.

This work was supported in part by TU Darmstadt, Darmstadt (Germany): HFHF, ELEMENTS:500/10.006, GSI F&E, DAAD PPP Polen 2018/57393092; Goethe-University, Frankfurt(Germany): HFHF, ELEMENTS:500/10.006, GET_INvolved Programme of FAIR/GSI.

[1] S. Harabasz *et al.*, Phys.Rev.C **107** (2023) no.3, 034917

HK 9.3 Mon 17:30 HBR 62: EG 05

Soft ω meson production in pp collisions at $\sqrt{s} = 5.02$ TeV with ALICE — •Merle Luisa Wälde for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt

Measurements of hadron production cross sections in proton-proton (pp) collisions at high energies are important to test our understanding of QCD and as a reference for heavy-ion studies. While the production of particles in hard scatterings can be calculated in a perturbative approach, the production via soft processes relies on phenomenological model approaches that require experimental input and suffer from sizeable uncertainties in their predictions. Therefore, the production cross section of the ω meson needs to be measured down to the lowest transverse momentum ($p_{\rm T}$) where the reach to low momenta is scarce at LHC energies and midrapidity.

In this talk, the first measurement of the ω meson down to $p_{\rm T} = 0$ in pp collisions at $\sqrt{s} = 5.02$ TeV at midrapidity will be presented. This measurement is performed in the decay channel $\omega \to \rm e^+e^-$ with ALICE. We will discuss the estimation of the different background sources as well as uncertainties related to the signal extraction, and track and PID requirements. The final results will be compared to model calculations focusing on particle production in the soft-$p_{\rm T}$ regime.

HK 9.4 Mon 17:45 HBR 62: EG 05

Macroscopic description of HADES Au+Au and Ag+Ag particle yields using the HRG model — •Marvin Kohls for the HADES-Collaboration — Goethe-Universität Frankfurt

A comparison of strange hadron production yields in Au(1.23 AGeV)+Au and Ag(1.58 A GeV)+Ag collisions, measured with HADES, reveals a universal scaling behavior as a function of the system size. Together with the apparent observation of a melting ρ-meson, these findings hint towards the possibility of describing matter properties with thermal/statistical parameters extracted from a hadron resonance gas (HRG).

In this contribution, we will systematically compare measured particle yields to HRG fits. Particular emphasis will be placed on elucidating the characteristics of light nuclei and their excited states. Furthermore, the canonical description of strangeness, in particular the production rates of K^-, $\phi(1020)$, and Ξ^-, will be discussed.

This work has been supported by BMBF (05P21RFFC2), GSI and HFHF.

HK 9.5 Mon 18:00 HBR 62: EG 05

towards the extraction of the baryon chemical potential for the fixed-target program at STAR — •Yannick Söhngen for the CBM-Collaboration — Physikalisches Institut Heidelberg

The fixed-target program at STAR aims to extend the range in which the phase diagram of strongly interacting matter can be investigated towards lower collision energies or higher values of the baryon chemical potential. The ratio of proton and antiproton yields has been shown to provide a good estimator for the value of the baryon chemical potential. The status of current efforts to extract the baryon chemical potential at energies close to proton pair-production in gold-gold collisions will be presented and discussed.

HK 10: Hadron Structure and Spectroscopy I

Time: Monday 16:45–18:15 Location: HBR 62: EG 18

Group Report HK 10.1 Mon 16:45 HBR 62: EG 18

Spectroscopy highlights from COMPASS and prospects for the new AMBER experiment — •Henri Pekeler for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The COMPASS experiment, located at the M2 beam line at CERN, had a very rich hadron-physics program for the last two decades. Within this talk, we will focus on the data, for diffractive dissociation, i.e. events of the type $\pi^- p \to X^- p$ or $K^- p \to X^- p$, providing the world's largest data sets in various final states.

The data sets are decomposed into individual J^{PC} contributions by partial-wave analyses employing many novel tools developed by COMPASS. The results provide a full picture of light π_J and a_J mesons up to masses of about 2.5 GeV, including candidates for exotic mesons. Highlights include the solution of the long-standing puzzle of the light spin-exotic state with $J^{PC} = 1^{-+}$, the precise determination of resonance parameters of many states, as well as several signals for new states, some not fitting model expectations. We will also present first results for the strange meson sector, including a significant signal for a supernumerous state with $J^P = 0^-$.

The successor experiment of COMPASS, AMBER, started data taking for its phase 1 in 2023. In phase 2, several new measurements are planned with a high-intensity kaon beam, including precision spectroscopy of K_J and K_J^* states, where no new data has been available for more than 20 years. We will present first studies about improvements of the experimental setup. Supported by BMBF.

HK 10.2 Mon 17:15 HBR 62: EG 18

Investigation of the decays $\chi_{cJ} \to \eta'\pi^+\pi^-$ and search for the spin exotic meson $\pi_1(1600)$ at BESIII — •Frederik Weidner, Salleh Ahmed, Anja Brüggemann, Nikolai in der Wiesche, and Alfons Khoukaz — Universität Münster, Münster, Germany

In recent years the search for exotic hadrons has uncovered more and more states which seem to be incompatible with the conventional classification as two or three quark states. Some of these have quantum numbers, which cannot be produced by the conventional quark model, such as $J^{PC} = 1^{-+}$ in case of the $\pi_1(1600)$, which is discussed to be in a hybrid multiplet together with the $\eta_1(1855)$.

With the BESIII experiment decays of the χ_{cJ} mesons can be investigated through their production in radiative decays of the $\psi(2S)$ meson. When considering the decay of these charmonia into three pseudoscalar mesons, spin exotic quantum numbers like $J^{PC} = 1^{-+}$ can be accessed. Additionally, precision measurements of branching ratios of the χ_{cJ} states can help solidify our understanding of charmonia and, therefore, of the transition region between perturbative and non-perturbative QCD. In this talk the search for the $\pi_1(1600)$ in the decay $\chi_{c2} \to \eta'\pi^+\pi^-$ using a partial wave analysis, and the determination of branching ratios of $\chi_{cJ} \to \eta'\pi^+\pi^-$, will be presented.

This work is supported by the German Research Foundation under project number 443159800 and GRK 2149/2 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

HK 10.3 Mon 17:30 HBR 62: EG 18

Search for the Lightest Scalar Glueball via the Reactions $\psi(2S) \to \phi$ + Light Mesons at BESIII — •Nikolai in der Wiesche, Frederik Weidner, Salleh Ahmed, Anja Brüggemann, Tessa Bertelsmeier, Johannes Bloms, Peter Sandmann, and Alfons Khoukaz — Universität Münster, Münster, Germany

The self-interaction of gluons is one of the most fundamental feature of QCD. It implies that there should be bound states of gluons, so-called glueballs, which would provide an excellent probe of the strong interaction since they do not couple to any other standard model interaction. Theoretical calculations predict that the lightest glueball with quantum number $J^{PC} = 0^{++}$ has a mass between 1.6 GeV and 1.7 GeV. The three experimentally observed isoscalar 0^{++} states $f_0(1370)$, $f_0(1500)$ and $f_0(1710)$ are strong contenders for containing admixtures of the scalar glueball. However, they could also fit into a scalar meson nonet, making their classification very controversial.

In this talk, the current state of the coupled channel analysis of the reactions $\psi(2S) \to \phi + \pi\pi, 4\pi, K\bar{K}$ and $\eta\eta$ will be presented, using the world's largest $\psi(2S)$ data set obtained at BESIII. In this analysis, the properties of the f_0 states, which are produced as intermediate resonances in the recoil systems of the ϕ meson, will be extracted using partial wave analyses.

This work is funded by the German Research Foundation under the project GRK 2149/2 and by the Ministry for Culture and Science of the State North Rhine-Westphalia under funding code NW21-024-E.

HK 10.4 Mon 17:45 HBR 62: EG 18

Partial-Wave Analysis of the $\omega\pi\pi$ Final State at COMPASS — •Philipp Haas for the COMPASS-Collaboration — Technische Universität München

The Constituent Quark model describes mesons as $q\bar{q}'$ states. However, QCD allows configurations beyond $q\bar{q}'$ states, so-called exotic mesons. One example of an exotic configuration are hybrid mesons, where in addition to $q\bar{q}'$ the gluonic field contributes to the total quantum numbers of the state. Lattice QCD predicts the lightest hybrid meson with quantum numbers $J^{PC} = 1^{-+}$ around 1.6 GeV/c^2. This state was found and established at the COMPASS experiment at CERN as $\pi_1(1600)$ in its decay to the $\eta^{(\prime)}\pi$ and 3π final states. However, lattice QCD predicts $b_1(1235)\pi$ as dominant decay channel of $\pi_1(1600)$.

COMPASS acquired the so-far world's largest sample of this decay in the diffractive scattering reaction $\pi^- + p \to \omega(782)\pi^-\pi^0 + p$. We perform a partial-wave analysis of this process, including modeling the $\omega(782) \to 3\pi$ decay to allow better signal separations from possible backgrounds in our sample. In this talk we present the current status of the analysis. Among other resonance-like signals, we find a signal with quantum numbers $J^{PC} = 1^{-+}$ decaying to $b_1(1235)\pi$ around 1.7 GeV/c^2.

* funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and BMBF Verbundforschung 05P21WOCC1 COMPASS.

HK 10.5 Mon 18:00 HBR 62: EG 18

Analysis of the radiative decay $J/\psi \to \gamma\phi\omega$ at BESIII — •Orestis Afedulidis — Ruhr-Universität Bochum, Bochum, Deutschland

Exotic mesons like glueballs and hybrids are predicted to be copiously produced in radiative J/ψ decays. A good reaction to discover such states is the doubly OZI suppressed decay $J/\psi \to \gamma\omega\phi$.

This talk covers the analysis of this process, using the worlds largest data sample of $\approx 10^{10}$ J/ψ events collected with the BESIII detector.

Preliminary results of the data selection, background studies and a partial wave analysis will be shown.

Supported by DFG (CRC 110 / NSFC-DFG)

HK 11: Hadron Structure and Spectroscopy II

Time: Monday 16:45–18:15 Location: HBR 62: EG 19

HK 11.1 Mon 16:45 HBR 62: EG 19

Photoproduction of $K^+(\Sigma(1385) \to \Lambda\pi^0)$ at very forward K^+ angles at the BGOOD experiment — •Mrunmoy Jena for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The differential cross section for photoproduction of $K^+\Sigma^0$ previously carried out at the BGOOD showed a peak like structure followed by a significant decrease in strength around $W = 1900$ MeV (at very forward angles) potentially indicating the formation of a bound $K^+\Sigma(1385)$ molecular state. If this is the case, there appears to be an equivalence between this proposed state in the strange quark sector and the $P_c(4380)$ state in the charm sector identified at the LHCb. In light of these results, a precision measurement near threshold at forward K^+ angles for $\gamma p \to K^+\Sigma(1385)$ is essential to shed light on the reaction mechanism.

This work reports for the first time, the differential cross section for the $\gamma p \to K^+\Sigma(1385)$ for the dominant decay channel $\Sigma(1385) \to \Lambda\pi^0$ at very forward angles ($\cos\theta^K_{CM} > 0.9$). The missing mass (from the $K^+\pi^0\pi^0$ and the $K^+\pi^0$ system) technique was used for event reconstruction and to remove $K^+\Lambda(1405)$ background events.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 11.2 Mon 17:00 HBR 62: EG 19

Analysis of the reaction $pp{\to}ppKK$ with HADES — •Valentin Kladov[1,2], Johan Messchendorp[2], and James Ritman[1,2,3] — [1]Ruhr-Universität Bochum — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH — [3]Forschungszentrum Jülich

In this study we present an exclusive analysis of the $pp{\to}ppKK$ reaction with data collected by the HADES detector during February 2022. In the course of this analysis, we developed a neural network-based particle identification procedure (PID), which compensates for the differences between simulation and experiment via domain adversarial technique, mixing experimental and simulation datasets during training. With this PID we detect and identify all final state particles, which allows an efficient suppression of background by means of kinematic refit with a 4C constraint, corresponding to the conservation of 4 Momentum in the process. We observed clear signals from $\phi(1020){\to}KK$ and $\Lambda(1520){\to}pK$ with their parameters consistent with PDG data within one standard deviation. This talk will present the event selection procedures which will be the basis for a subsequent partial wave analysis, with the goal to determine the contribution of various baryonic resonances in the initial step of the reaction. Additionally, the analysis will be extended to the $ppKK\pi^0$ final state.

HK 11.3 Mon 17:15 HBR 62: EG 19

Investigation of $K^+(\Lambda(1405) \to \Sigma^+\pi^-)$ photoproduction at the BGOOD experiment — •Linus Plagens for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

Since its discovery in the 1960's, the $\Lambda(1405)$ resonance has been intensively studied and today is considered as the archetype of a dynamically generated resonance. It is imperative to conduct precise measurements on its invariant mass distribution, commonly referred to as the *line shape*, as well as its differential cross section. The BGOOD experiment at the Electron Stretcher Accelerator (ELSA) at the University of Bonn is well-suited for this task. The unique combination of a central detector with a forward spectrometer allows the investigation of very forward-going kaons through meson photoproduction. In this talk, results obtained for the differential cross section for $\Lambda(1405) \to \Sigma^+\pi^-$ in the reaction $\gamma p \to K^+\Lambda(1405)$ will be presented.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 11.4 Mon 17:30 HBR 62: EG 19

New data for the photoproduction of $\Lambda(1520)$ at the BGOOD experiment — •Emil Rosanowski for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The BGOOD experiment at the ELSA facility at the University of Bonn is used to study photoproduction in the *uds* sector. The unique design of a central electromagnetic calorimeter complemented by a forward spectrometer for charged particles enable the study of K^+Y systems, where the recoiling hyperon (Y) is at low momentum transfer.

Studies of the reaction $\gamma p \to K^+\Lambda(1520)$ where the K^+ is at forward angles were made. Preliminary differential cross section measurements will be presented.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 11.5 Mon 17:45 HBR 62: EG 19

Dilepton production in proton-proton reaction at 4.5 GeV with the HADES spectrometer — •Rayane Abou Yassine for the HADES-Collaboration — TU Darmstadt — GSI Helmholtzzentrum für Schwerionenforschung GmbH — Laboratoire de Physique des 2 infinis Irène Joliot- Curie, Université Paris-Saclay, France

The investigation of dilepton production in hadron collisions is an important tool to study the electromagnetic decays of resonances. It provides a reference spectra for the hot and dense matter effects (heavy-ion collisions A+A). In February 2022, the HADES collaboration measured p+p collisions at 4.5 GeV beam kinetic energy. In this contribution we present results for the multi-differential analysis of signal spectra as well as the vector meson production cross section.

HK 11.6 Mon 18:00 HBR 62: EG 19

A simulation of the reaction $\bar{\text{p}}\text{p} \to \pi^0\pi^0\eta \to 6\gamma$ with the $\bar{\text{P}}$ANDA detector — •Jean Franç Noël for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, 53115 Bonn

An important frontier in high energy physics is the study of the formation of hadrons, which is described by quantum chromodynamics. The $\bar{\text{P}}$ANDA-experiment is an upcoming experiment, which will be located at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt. $\bar{\text{P}}$ANDA aims to shed new light on this topic by investigating deep inelastic scattering in antiproton-proton collisions, up to a center-of-mass energy of 5.5 GeV.

This talk will be focused on a simulation of the reconstruction of the decay $\bar{\text{p}}\text{p} \to \pi^0\pi^0\eta$, $\pi^0 \to \gamma\gamma$, $\eta \to \gamma\gamma$ with the $\bar{\text{P}}$ANDA detector. Predictions for the underlying resonance structure are included into the simulation by usage of a so-called Partial Wave Analysis (PWA)-filter. These predictions are based on the Bonn-Gatchina PWA model.

In this presentation, I will show preliminary results for background simulations and the reconstruction of the corresponding Dalitz plot.

Supported within the programme "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia (project "NRW-FAIR", ID: NW21-024-C)

HK 12: Invited Talks I

Time: Tuesday 11:00–12:30 Location: HBR 14: HS 1

Invited Talk HK 12.1 Tue 11:00 HBR 14: HS 1

How to understand the hadron spectrum — •Meike Küssner — Ruhr-Universität Bochum

The spectroscopic observation of hadrons played a key role in the development of the quark model and the strong interaction. QCD predicts a zoo of "exotic" hadrons with more complex internal structures than the quark-antiquark mesons and three-quark baryons of the original quark model. Nowadays, there are experimentally observed states that are often assigned to the light meson or charmonium sector, indicating an exotic nature. Such exotic particles include glueballs, hybrids, and tetraquarks. Not only do these states pose a theoretical challenge, but experimentally it is often difficult to distinguish and characterize exotic and non-exotic matter. Here it helps to compare different production mechanisms and decay patterns. This provides additional constraints and allows a coupled channel partial wave analyses. Therefore, gluon-poor two-photon fusion events and gluon-rich hadronic reactions are used to disentangle the highly populated light meson spectrum. Sophisticated dynamical models and analysis tools need to be applied, respecting unitarity and analyticity. The talk will discuss recent experimental results and techniques and analyses methods in order to identify and characterize exotic and non-exotic QCD states.

Invited Talk HK 12.2 Tue 11:30 HBR 14: HS 1

3-body problem from phenomenology and lattice QCD — •Maxim Mai — HISKP, Uni Bonn

The quest of unraveling the nature of excited hadrons necessarily involves determination of universal (reaction independent) parameters of these states. Such determinations require input, either from experiment or theory. The challenge in answering these questions from theory arises from the very structure of the theory of strong interaction, the QCD.

Lattice gauge theory is the only tool available to us to tackle the non-perturbative dynamics of QCD encoded in the determined finite-volume interaction spectra. Many insights have been gained on resonant two-body systems in the past by studying such spectra. Now – with the advent of the three-body finite-volume methods – advances are being made towards more complex systems. This progress will be discussed in the talk, including theoretical developments and applications to phenomenologically interesting systems.

Invited Talk HK 12.3 Tue 12:00 HBR 14: HS 1

Measurement of Antiproton-Production Cross Sections at AMBER — •Thomas Pöschl for the AMBER-Collaboration — European Organization for Nuclear Research (CERN), Geneva, Switzerland

To the best of our knowledge, cosmic-ray antiprotons are exclusively produced by interactions of cosmic rays with interstellar material. By comparing their measured flux with our expectations, we can test for the presence of exotic sources of antimatter, such as dark matter annihilations. This method requires a precise knowledge of antiproton production over a wide range of collision energies and for different collision systems as they occur in the Galaxy. For collisions of protons with light ions such as helium, experimental data are sparse, limiting the interpretation of the measured cosmic antiproton flux.

The AMBER collaboration aims to measure antiproton production in collisions of protons with hydrogen, deuterium, and helium at different collisions energies using the M2 beam line at CERN's SPS. First measurements of proton-helium collisions were recorded in 2023, and measurements with hydrogen and deuterium targets are planned for 2024. These data sets will be of particular interest for the investigation of a possible isospin-asymmetric production.

I will review our current knowledge of collisional antiproton production, the uncertainty of the production cross sections on the modeling of the cosmic antiproton flux, and the impact of the upcoming experimental data from AMBER.

HK 13: Focus Session I: New Results on Nuclear Structure at Shell Closures

Time: Tuesday 14:00–15:30 Location: HBR 14: HS 1

Invited Talk HK 13.1 Tue 14:00 HBR 14: HS 1

First laser spectroscopy measurements of ^{53}Ca and the prospects for measuring ^{54}Ca — •Tim Lellinger for the COLLAPS-Collaboration — EP-SME-IS, CERN — TU-Darmstadt

Over a decade ago, the first experimental evidence for the N=32 sub shell closure in the calcium isotopic chain emerged [1,2]. Subsequent experimental and theoretical investigations have confirmed this finding. However, in laser spectroscopy measurements extending up to ^{52}Ca (N=32), no indications of this shell gap were apparent [3]. Crossing the shell gap with laser spectroscopy setups has proved difficult due to the simultaneous requirement of a sensitivity of approximately 10 ions/s and a measurement uncertainty on the order of MHz.

This contribution presents the first laser spectroscopy measurements of ^{53}Ca, facilitated by an extension of the collinear laser spectroscopy technique employed at the COLLAPS setup at ISOLDE/CERN. This technique, termed as *radioactive detection after optical pumping and state selective charge exchange* (ROC), combines the high sensitivity of a particle detection scheme with the high resolution of low-power, continuous wave lasers utilized in a collinear geometry. The methodology of this technique will be explained, followed by the presentation and discussion of preliminary values for the charge radius and magnetic dipole moment of ^{53}Ca in the context of the robustness of the N=32 sub shell closure, as well as the prospects to measure ^{54}Ca.

[1] Wienholtz, F. et al. Nature vol. 498, 346-349 (2013)
[2] Steppenbeck, D. et al. Nature vol. 502, 207-210 (2013)
[3] R.F. Garcia Ruiz et al, Nature Physics vol. 12, 594-598 (2016)

Invited Talk HK 13.2 Tue 14:30 HBR 14: HS 1

High-precision mass measurements near Sn-100 challenge nuclear theory — •Lukas Nies for the ISOLTRAP-Collaboration — CERN, 1211 Geneva, Switzerland — Universität Greifswald, Germany

Nuclear binding energies arise from various effects that govern nuclear properties. Different nucleon configurations within nuclear isomers lead to modified binding energies, often resulting in mass differences of tens to hundreds of kilo-electronvolts. These isomeric excitation energies can be directly accessed by measuring the difference in atomic masses of ground and isomeric states. In this contribution, high-precision mass measurements of ground and isomeric states in tin, indium, and cadmium isotopes near tin-100 using the multi-reflection time-of-flight technique will be presented and compared to nuclear theory.

Invited Talk HK 13.3 Tue 15:00 HBR 14: HS 1

Ab initio advances for medium-heavy nuclei and electroweak properties — •Takayuki Miyagi — Technische Universität Darmstadt, Department of Physics, 64289 Darmstadt, Germany — ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany

A reliable prediction of electroweak processes involving a nucleus is required to further understand nuclear structure and other related topics, such as nucleosynthesis and particle physics. In the past two decades, the range of applicability of nuclear ab initio calculations has been rapidly extending and reaching mass number of 200 systems. With controlled uncertainty estimations, an ab initio calculation can provide a meaningful prediction where performing experiments is difficult or impossible. Nuclear radii and moments are complementary information to the energies and can be useful tools to test the quality of the calculations. In this presentation, I will discuss our recent results for charge radii, magnetic and quadrupole moments of medium-heavy nuclei computed with the combination of chiral effective-field theory and valence-space in-medium similarity renormalization group approach.

* Funded by ERC Grant Agreement No. 101020842

HK 14: Structure and Dynamics of Nuclei III

Time: Tuesday 15:45–17:15 Location: HBR 14: HS 1

HK 14.1 Tue 15:45 HBR 14: HS 1

Isoscalar Properties of the Pygmy Dipole Resonance in ^{120}Sn
— •Michael Weinert, Florian Kluwig, Markus Müllenmeister, Miriam Müscher, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

A concentration of electric dipole strength below the neutron separation threshold is known to be common in medium to heavy mass nuclei. The established picture of a neutron-skin oscillation being the single cause for this strength was questioned about 15 years ago, when comparing the excitation in bremsstrahlung experiments to results from a hadronic probe, i.e., $(\alpha, \alpha'\gamma)$ [1]. The evolution of the so-called *isospin splitting* previously found in ^{124}Sn was recently investigated via a ^{120}Sn$(\alpha, \alpha'\gamma)$ experiment at $E_\alpha = 130$ MeV. The experiment was performed at the CAGRA+GR setup at RCNP, Osaka, and is sensitive to both isoscalar properties and the surface character of excitations in the Pygmy Dipole Resonance (PDR) region. This contribution presents the analyzed data set as well as recent theoretical efforts from two state-of-the-art EDF+QPM and RQTBA models coupled to reaction theory. Since the PDR in ^{120}Sn is also known to have significant single-particle character [2], the new theoretical results allow to study the connection between microscopic nuclear structure effects and the macroscopic surface mode probed in the $(\alpha, \alpha'\gamma)$ experiment. Supported by the DFG (ZI 510/10-1).

[1] J. Endres *et al.*, Phys. Rev. C **80**, 034302 (2009)
[2] M. Weinert *et al.*, Phys. Rev. Lett. **127**, 242501 (2021)

HK 14.2 Tue 16:00 HBR 14: HS 1

Level densities and γ strength function of ^{90}Zr from the Oslo Method
— •Isabelle Brandherm[1], Johann Isaak[1], Ann-Cecilie Larsen[2], Maria Markova[1], and Peter von Neumann-Cosel[2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Department of Physics, University of Oslo, Norway

The Oslo method was developed to determine level densities and γ strength functions (GSF) of nuclei up to the particle separation threshold. Particle-γ coincidence data are used to generate a primary γ-ray matrix, which allows a simultaneous extraction of both observables in an iterative procedure.

In this talk preliminary results on ^{90}Zr are presented. This nucleus is of particular interest, since it allows comprehensive tests of the Brink-Axel hypothesis (similar to [1]) and of the shape method for a model-independent extraction of the GSF [2]. Two experiments were performed at the Oslo Cyclotron laboratory using (p,p'γ) and $(\alpha, \alpha'\gamma)$ reactions. Particle-γ coincidence data were taken with the Silicon Ring (SiRi) consisting of $\Delta E - E$ telescopes and the Oslo Scintillation Array (OSCAR) of large-volume (3"x8") $LaBr_3$:Ce detectors.

[1] M. Markova et al., Phys. Rev. Lett. 127, 182501 (2021).
[2] M. Wiedeking et al., Phys. Rev. C 104, 014311 (2021).

Supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245

HK 14.3 Tue 16:15 HBR 14: HS 1

The dipole response of ^{64}Ni below the neutron-separation threshold
— •Miriam Müscher[1], Johann Isaak[2], Florian Kluwig[1], Deniz Savran[3], Tanja Schüttler[1], Ronald Schwengner[4], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]TU Darmstadt, Institute for Nuclear Physics, Germany — [3]GSI, Darmstadt, Germany — [4]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Real-photon scattering is an ideal method to study the dipole response of atomic nuclei due to the low angular-momentum transfer of photons [1]. Systematic investigations of dipole-excitation modes along isotopic and isotonic chains aim for a better understanding of their underlying structures. The $Z = 28$ isotopic chain is well suited for this purpose due to its four stable, even-even isotopes. Therefore, real-photon scattering experiments have already been conducted on ^{58,60,62}Ni [2-5].

To complete these studies, two complementary (γ, γ') experiments were performed on ^{64}Ni to extract absolute cross sections and to distinguish electric and magnetic dipole transitions up to the neutron-separation threshold $S_n = 9.7$ MeV. In this contribution, experimental details and results will be presented.

This work is supported by the BMBF (05P21PKEN9).

[1] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903.
[2] F. Bauwens *et al.*, Phys. Rev. C **62** (2000) 024302.
[3] M. Scheck *et al.*, Phys. Rev. C **88** (2013) 044304.
[4] M. Scheck *et al.*, Phys. Rev. C **87** (2013) 051304(R).
[5] T. Schüttler, Bachelor's Thesis, University of Cologne (2023).

HK 14.4 Tue 16:30 HBR 14: HS 1

Model-independent test of the Brink-Axel hypothesis
— •O. Papst[1], J. Isaak[1], A. D. Ayangeakaa[2,3], T. Beck[1,4], S. W. Finch[3,5], U. Friman-Gayer[3,5,6], D. Gribble[2,3], X. James[2,3], R. V. F. Janssens[2,3], S. R. Johnson[2,3], J. Kleemann[1], F. Kluwig[7], P. Koseoglou[1], B. Löher[8], M. Müscher[7], N. Pietralla[1], D. Savran[8], V. Werner[1], and A. Zilges[7] — [1]TU Darmstadt — [2]UNC, Chapel Hill, NC, USA — [3]TUNL, Durham, NC, USA — [4]FRIB, MSU, East Lansing, MI, USA — [5]Duke University, Durham, NC, USA — [6]ESS, Lund, SE — [7]University of Cologne — [8]GSI, Darmstadt

According to the Brink-Axel hypothesis, the photon strength function (PSF) is independent of the detailed structure of initial and final states, and thus independent of level energies, spins, and parities involved. Upward (excitation) and downward (deexcitation) PSF are thus expected to be the same. However, for ^{96}Mo, significant discrepancies were observed [1] in several experiments. To study the observed discrepancies, we performed an experiment on ^{96}Mo at HIγS using a new method [2] that allows for the simultaneous measurement of upward and downward PSF in a single nuclear resonance fluorescence experiment with $\gamma\gamma$ coincidences. First results will be discussed.

Supported by the BMBF, grant No. 05P21RDEN9, the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 499256822 – GRK 2891, and the U. S. DOE, grant No. DE-FG02-97ER41041, No. DE-FG02-97ER41033, and No. DE-SC0023010.

[1] D. Martin *et al.*, Phys. Rev. Lett. **119**, 182503 (2017)
[2] J. Isaak *et al.*, Phys. Lett. B **788**, 225 (2019)

HK 14.5 Tue 16:45 HBR 14: HS 1

The isovector spin-$M1$ response of ^{90}Zr and ^{92}Mo
— •A. Gupta[1], V. Werner[1], K. E. Ide[1], A. D. Ayangeakaa[2,3], M. Beuschlein[1], S. W. Finch[3,4], U. Friman-Gayer[3,4,5], D. Gribble[2,3], J. Hauf[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 University, Durham, NC, USA — [5]ESS, Lund, SE — [6]GSI, Darmstadt

Nuclei near N=50, above Z=28 [1], play a significant role in core-collapse supernovae scenarios through their electron capture rates, which depend on the corresponding Gamow-Teller (GT) transitions. GT transitions are the weak analogue of isovector spin-flip M1 (IVSM1) transitions. The nuclide ^{92}Mo features two extra protons in the proton $g_{9/2}$ orbital beyond the closed pf shell which may cause additional IVSM1 strength as compared to ^{90}Zr. The dipole response in both isotones in a nuclear resonance fluorescence experiment using the hybrid array of HPGe Clover and $LaBr_3$ detectors at the HIγS facility have been studied and will be presented. Measuring asymmetries of ground-state transitions in an integral approach will be used to obtain the overall M1/E1 ground-state transition strength up to 10 MeV. Supported by DFG Project No.279384907-SFB 1245 and the U.S. DOE Grant Nos. DE-FG02-97ER41041 and DE-FG02-97ER41033.

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

HK 14.6 Tue 17:00 HBR 14: HS 1

^{232}Th($\vec{\gamma}$,f) reaction measured by quasi-monochromatic photon beams*
— •Annabel Ibel[1], Dimiter Balabanski[2], Joachim Enders[1], Sean W. Finch[3], Alf Göök[4], Calvin R. Howell[3], Ronald C. Malone[5], Maximilian Meier[1], Andreas Oberstedt[2], Stephan Oberstedt[6], Marius Peck[1], Norbert Pietralla[1], Jack A. Silano[5], Gerhart Steinhilber[1], Forrest Q. L. Friesen[3], Anthony P. D. Ramirez[5], Anton P. Tonchev[5], Werner Tornow[3], and Vincent Wende[1] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]ELI-NP, IFIN-HH, Magurele, Romania — [3]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [4]Uppsala Universitet, Uppsala, Sweden — [5]Lawrence Livermore National Laboratory, Livermore, CA,

USA — [6]EC-JRC Geel, Belgium

High-precision photon-induced ^{232}Th($\vec{\gamma}$,f) experiments give access to information about the fission process from measuring the kinetic energy, the mass and the angular distribution of the fission fragments using a Frisch-Grid Ionization Chamber. This contribution will show data from an experimental campaign conducted at the High Intensity Gamma-ray Source facility using quasi-monochromatic photon beams between 6.2 MeV and 13 MeV. A comparison of the measured mass distributions to previous experiments using bremsstrahlung will be presented.

*Supported by DFG (GRK 2891, project ID 499256822)

HK 15: Structure and Dynamics of Nuclei IV

Time: Tuesday 15:45–17:15 Location: HBR 14: HS 4

Group Report HK 15.1 Tue 15:45 HBR 14: HS 4

Experiments with exotic nuclei at the FRS Ion Catcher — •Jianwei Zhao for the FRS Ion Catcher-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

At the FRS Ion Catcher, projectile and fission fragments are produced at relativistic energies, separated in-flight, energy-bunched, slowed down, and thermalized in a gas-filled cryogenic stopping cell (CSC). Subsequently, they are extracted and their masses are measured by using a Multiple-Reflection Time-Of-Flight Mass-Spectrometer (MR-TOF-MS). The MR-TOF-MS features mass resolving powers of up to one million and relative mass measurement accuracies of down to 2x10^{-8} with measurement times of merely a few tens of milliseconds.

Recently, direct mass measurements of neutron-deficient nuclides around the $N = 50$ shell closure below ^{100}Sn, including the first direct mass measurements of ^{98}Cd and ^{97}Rh, shed light on the nuclear structure in this region and on the "^{100}Sn mass riddle". Additionally, broadband mass measurements of fission fragments from a ^{252}Cf spontaneous fission source reveal evidence for shape transitions in the $N \sim 90$, Z = 56-63 region, and provide direct determination of independent isotopic fission yields.

An overview of the setup, recent experimental highlights, technical advances including the higher rate capability of CSC, upcoming experiments in FAIR Phase-0, including studies of multi-nucleon transfer reactions inside the CSC and direct mass measurements of neutron-rich nuclides along the $N = 126$ line below ^{208}Pb, will be reported.

HK 15.2 Tue 16:15 HBR 14: HS 4

Search for near-threshold multi-neutron resonances in $(p, 2p)$ reactions with neutron-rich nuclei at R^{3}B — •Nikhil Mozumdar[1,2], Antoine Barriere[4], Martina Feijoo-Fontán[5], Thomas Aumann[1,2,3], and Olivier Sorlin[4] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]Helmholtz Forschungsakademie Hessen für FAIR — [3]GSI Helmholtz-Zentrum für Schwerionenforschung — [4]Grand Accélérateur National d'Ions Lourds — [5]University of Santiago de Compostela

In order to constrain the largely unknown multi-neutron interactions, it is necessary to measure the relevant observables sensitive to them. One such property is the possible existence of narrow resonances related to multi-neutron cluster structures and correlations. This can be investigated by studying multi-neutron resonances close to the corresponding neutron removal thresholds in neutron-rich light nuclei. Towards this end an experiment was performed at the state-of-the-art R^{3}B Setup in GSI, within the FAIR Phase-0 program. Quasi-free scattering $(p, 2p)$ reactions are studied in inverse kinematics where a radioactive ion "cocktail" beam is impinged on a 5cm LH_2 target. Complete kinematic information of resulting reactions is provided by the large combination of detectors in the setup. In this communication, the first 2-neutron reconstruction procedure in the neutron detector NeuLAND will be discussed along with preliminary results.

Supported by HFHF, the GSI-TU Darmstadt cooperation and the BMBF project 05P21RDFN2.

HK 15.3 Tue 16:30 HBR 14: HS 4

Mass measurements of neutron-deficient nuclides below ^{100}Sn at the FRS Ion Catcher, GSI — •Gabriella Kripkó-Koncz for the FRS Ion Catcher-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany

The heavy $N = Z$ nuclei and the nuclei in their vicinity are highly interesting to study; they can provide important insights about nuclear structure, symmetries and interactions and have a high impact in modelling nuclear astrophysics processes (rp-process, νp-process). A few examples of the striking phenomena are the formation of high-spin isomeric states, the direct and/or β-delayed proton emission from ground or excited states and the strong resonances in Gamow-Teller transitions close to the proton dripline. The FRS Ion Catcher (FRS-IC) experiment at the in-flight fragment separator FRS at GSI enables highly accurate direct mass measurements ($\delta m/m \sim 10^{-8}$) with thermalized projectile and fission fragments by combining a cryogenic stopping cell and a multiple-reflection time-of-flight mass spectrometer. Supported by mass measurements at the FRS-IC within FAIR Phase-0, the evolution of Gamow-Teller transition strengths for even-even $N = 50$ isotones was studied [1]. Besides this, the riddle surrounding the exotic decay modes of the (21^+) high-spin isomer of ^{94}Ag was further unraveled. These results will be presented together with intricacies of the data analysis when analyzing data obtained synchronously by FRS and FRS-IC.

[1] A. Mollaebrahimi et al., Phys. Lett. B 839, 137833 (2023).

HK 15.4 Tue 16:45 HBR 14: HS 4

Measurements of the reaction cross sections of neutron-rich Sn isotopes at the R^{3}B setup. — •Eleonora Kudaibergenova[1], Ivana Lihtar[2], Martina Feijoo-Fontán[3], Thomas Aumann[1,4,5], Igor Gašparić[2], Andrea Horvat[1,2], Valerii Panin[4], José Luis Rodríguez-Sánchez[6], and Dominic Rossi[1,4] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]RBI, Zagreb, Croatia — [3]IGFAE, Universidad de Santiago de Compostela, Spain — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [5]Helmholtz Forschungsakademie HFHF — [6]CITENI, Universidade da Coruña, Spain

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 has not yet been constrained well 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 a more precise constraint 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 charge-changing and charge-exchange analysis of ^{124}Sn+^{12}C at 900 MeV/u is presented.

The project was supported by the BMBF via Project No. 05P21RDFN2, the Helmholtz Research Academy Hessen for FAIR and the GSI-TU Darmstadt cooperation agreement.

HK 15.5 Tue 17:00 HBR 14: HS 4

^{12,16}C(p,2p) Quasi-free scattering in inverse kinematics at R^{3}B/GSI — •Enis Lorenz[1], Thomas Aumann[1,2,3], and Meytal Duer[1] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz Zentrum für Schwerionenforschung — [3]Helmholtz Forschungsakademie Hessen für FAIR

Quasi-free scattering (QFS) has proven a potent tool to study the single-particle structures of nuclei, clustering, as well as probing short-range correlated nucleon pairs in nuclei. Recently, a fully exclusive QFS measurement has been performed at the R^{3}B setup at GSI as part of the FAIR Phase-0 experimental program with radioactive-ion beam. At relativistic energy of 1.25 GeV/nucleon both ^{16}C and ^{12}C nuclei are studied by employing complete and inverse kinematics on a liquid-hydrogen target. The exclusive measurement of the two outgoing protons in coincidence with fragments and neutrons provides background-free identification of the reaction channel. In particular, both bound and unbound states, populated by knockout of deeply bound protons can be probed via the invariant mass. In this talk I will present the status of the data analysis, including preliminary results for ^{12}C. This work is supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006), the German Federal Ministry of Education and Research - BMBF project number 05P21RDFN2, and the GSI-TU Darmstadt cooperation agreement.

HK 16: Instrumentation III

Time: Tuesday 15:45–17:15 Location: HBR 19: C 1

Group Report HK 16.1 Tue 15:45 HBR 19: C 1

Status of the CBM Micro Vertex Detector — •Benedikt Gutsche for the CBM-MVD-Collaboration — Goethe-University Frankfurt, Max-von-Laue-Str. 1, 60438 Frankfurt am Main

The Compressed Baryonic Matter (CBM) Experiment will be a core experiment of the future FAIR facility. Its Micro Vertex Detector (MVD) will be composed of four planes, operating in the experiment*s target vacuum. The 0.3 * 0.5% *0 thin stations will be equipped with 50 μm thin Monolithic Active Pixel Sensors called MIMOSIS. This sensor is being developed by IPHC Strasbourg and will provide a spatial and temporal precision of 5 μm and 5 μs, respectively, with a peak rate capability of 80 MHz/cm2. This contribution will report on the progress made during the last phase of R&D. A TrbNet-based readout system for the MIMOSIS sen- sor was deployed, that aims to be an affordable and portable DAQ solution for probe testing and quality assessment. The second gen- eration and next-to-final full-size sensor prototype MIMOSIS-2, was released and is being characterized. The 3D-model of the MVD was updated to a more detailed version and an improved integration and re-working technique of the sensors onto the carrier made of highly heat-conductive TPG was introduced. Simulations have been done, like for the reconstruction efficiencies while comparing tracking and vertexing geometries.

HK 16.2 Tue 16:15 HBR 19: C 1

Status of irradiation studies with MIMOSIS-1 Sensors* — •Benedict Arnoldi-Meadows for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

Due to the fixed target geometry of the cbm experiment, its Micro Vertex Detector will be exposed to a strong gradient in terms of total ionizing dose (tid). It is foreseen to equip this detector with cmos Monolithic Active Pixel Sensors called mimosis. This sensor is currently being developed in a R & D project between Goethe-University Frankfurt, iphc Strasbourg and gsi and is supposed to withstand such a radiation dose gradient. This gradient calls for operating pixels on the same sensor being irradiated to tids between 0 and 5 MRad with the same detection threshold and steering parameters.

While the tolerance of the sensor to a uniform radiation dose of 5 MRad was established in earlier studies with the first full-sized protoype called mimosis-1, its tolerance to such strong dose gradients remains to be demonstrated. This contribution will present the results of dedicated laboratory studies with mimosis-1 addressing this issue.

*This work has been supported by bmbf (05P21RFFC2), gsi, Eurizon, hgs-hire, and hfhf.

HK 16.3 Tue 16:30 HBR 19: C 1

Material budget studies for the ALICE ITS3 — •Simon Groß-Bölting for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg, Germany

During the LHC Long Shutdown 3 (LS3), ALICE plans to replace the innermost three layers of the current Inner Tracking System (ITS2) to a new version. The ITS3 will consist of ultra-thin cylindrically bent silicon sensors, which are held in place by lightweight carbon foam spacers. The carbon foam will be attached to the silicon sensors using glue and carbon fleeces, a material similar to Velcro. Due to the porosity of the fleece, the distribution of the glue layer may vary, especially as capillary effects become significant, and this variability can have an impact on the material budget. Knowing the material budget as precise as possible is crucial for simulating collisions and reconstructing the trajectories of the produced charged particles. To investigate the properties of materials and determine their associated radiation length, test beam experiments are conducted which yield information about the multiple scattering angle of charged particles as they traverse the material under study.

This talk will highlight the preparatory steps taken for an upcoming DESY test beam. The objective is to perform a material budget tomography using electrons on various material samples intended for use in the final ITS3, in order to evaluate the different material budget contributions. To prepare for the analysis a test beam with an Aluminium target as a well-known scatterer has been done with a proton beam in Marburg in fall 2023 and a short overview will be presented.

HK 16.4 Tue 16:45 HBR 19: C 1

Characterizing the analog signal behavior of APTS chips for ALICE ITS3 Upgrade at the LHC — •Alexander Musta for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

This presentation will discuss the Analog Pixel Testing Structure (APTS) used to test different pixel designs for the upcoming new Inner Tracking System (ITS3) for the ALICE experiment. The underlying motivation for testing these pixel technologies is to find the most suitable silicon detector that minimizes charge sharing, power consumption, and data output. For the ITS3, Monolithic Active Pixel Sensor (MAPS) detectors are envisioned. Different doping structures and pixel sizes are currently under investigation. In this presentation, the most promising doping layout for different pixel sizes called the modified process with a gap, has been investigated. Properties such as capacitance, charge collection efficiency (CCE), mean cluster sizes, and the behavior under different bias voltages for these chips have been studied.

HK 16.5 Tue 17:00 HBR 19: C 1

The new Cologne CATHEDRAL spectrometer for nuclear lifetime measurements — •Christoph Fransen, Andrey Blazhev, Felix Dunkel, Arwin Esmaylzadeh, Jan Jolie, Lukas Knafla, Casper-David Lakenbrink, Mario Ley, Richard Novak, Stefan Thiel, Franziskus von Spee, Nigel Warr, and Michael Weinert — Institute for Nuclear Physics, University of Cologne, Germany

A new spectrometer for simultaneous lifetime measurements with Doppler-shift techniques, especially with the recoil-distance Doppler-shift (RDDS) technique, and the fast-timing method was developed for the Cologne FN Tandem accelerator facility. The high γ-ray efficiency and very compact geometry of the new setup in combination with different charged-particle detector arrays allows to investigate weak reaction channels using particle-γ-γ coincidences. This is crucial both for precise fast-timing measurements and RDDS experiments. Especially for the latter, an advantage can be drawn from the gain in efficiency as with the use of γ-γ coincidence analysis methods [1] any need for assumptions on feeding conditions can be avoided. In particular, the new spectrometer is designed for transfer reactions, but can be also used with other experimental probes, e.g., fusion-evaporation and Coulomb excitation. We will present the results of a commissioning experiment demonstrating the high capabilities of the new setup and show an overview of first experiments.

[1] A. Dewald et al., Prog. Part. Nucl. Phys. 67, (2012) 786

HK 17: Instrumentation IV

Time: Tuesday 15:45–17:15 Location: HBR 19: C 2

Group Report HK 17.1 Tue 15:45 HBR 19: C 2

The $\overline{\text{P}}$ANDA Forward-Endcap EMC Test-Beamtime @COSY — •Celina Frenkel for the PANDA-Collaboration — Institut für Strahlen- und Kernphysik, Universität Bonn

The forward endcap (FWEC) of the electromagnetic calorimeter of the $\overline{\text{P}}$ANDA-experiment equipped with ≈ 20% of its crystals was tested for the first time under final conditions at the COSY accelerator at FZ-Jülich. The assembly of the FWEC started in March 2023, where all detector components were put together including the mechanical structures, the built, tested and precalibrated detector modules, the cooling system and the readout electronics.

Two weeks of proton-beamtime in August and September were conducted using a beam momentum of 2.74 GeV/c and a plastic target. For a comprehensive data analysis, full waveforms from the FWEC-

SADCs were recorded. During the second week of beamtime, a stable operation of the detector as a common system at the intended temperature of -25°C and therefore one of the main aims of the test-beamtime was achieved. The other aim was to measure photons as the decay products of the π^0 which will in future be the basis to perform a pion calibration for each individual readout channel.

This talk will give an overview on the assembly of the FWEC at COSY and present first data analysis results including the different steps of raw data pre-processing as well as results from data reconstruction using PandaRoot leading to the observation of a π^0-signal.

Supported by BMBF and supported within the MKW programme "Netzwerke 2021" (project "NRW-FAIR", ID: NW21-024-C).

HK 17.2 Tue 16:15 HBR 19: C 2

Using the Crystal Barrel-DAQ for the Test-Beamtimes of the $\overline{\text{P}}$ANDA Forward Endcap @COSY — •Benedikt Otto for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

In August and September 2023 two test-beamtimes for the partly equipped $\overline{\text{P}}$ANDA forward endcap EMC took place at COSY. For these a data acquisition originally developed for the Crystal Barrel/TAPS experiment at ELSA was deployed.

The $\overline{\text{P}}$ANDA Sampling Analog to Digital Converters (SADCs) were used in self-triggered mode. This comes with the challenge to avoid incomplete events which can be caused by the significant deadtime due to the full waveform readout. To assure a synchronous readout of the SADCs, a custom LVDS-based synchronization bus was implemented.

An adapted version of the CB-SADC firmware with support for the synchronization bus was developed. To handle the data, commercial computing and network infrastructure was used. A total of over 200TB of waveforms were collected and are now being analyzed.

Supported by BMBF and within the programme "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia (project "NRW-FAIR", ID: NW21-024-C).

HK 17.3 Tue 16:30 HBR 19: C 2

The Gain Monitoring System for CALIFA — •Carl Georg Boos, Christian Sürder, Thorsten Kröll, Anna-Lena Hartig, Han-Bum Rhee, Leyla Atar, and Fabian Raddatz for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt

The CALIFA array is part of the R3B setup used for kinematically complete measurements of nuclear reactions. Those measurements are conducted at GSI and later at FAIR, Darmstadt. CALIFA is one of the core elements, which can be used both as a calorimetre and a spectrometre for the measurement of light charged particles and γ-rays. It consists of CsI(Tl) crystals connected to avalanche photodiodes (APDs). As the gain is not constant for those detector systems, e. g. due to temperature dependencies of the APDs, a pulsed LED gain monitoring system (GMS) was developed. There, light of LEDs is coupled by optical fibres into the detector units mimicking scintillation light. This will provide a stable reference in the energy spectrum of the detector. As the reliability of such a GMS depends strongly on the stability of the light source, the prototypes were investigated in detail.

Different types of shifts of the LED peaks were determined and characterised. Here it was shown that the LEDs themselves are stable, but several factors are responsible for the observed instability. Currently it is worked on the improvement of stability and to investigate the correlation of shifts in different energy ranges.

This work was supported by BMBF 05P19RDFN1 and 05P21RDFN2.

HK 17.4 Tue 16:45 HBR 19: C 2

A neutron leakage detector for the free neutron lifetime experiment τSPECT — •Julian Auler[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

The neutron storage experiment τSPECT aims to measure the free neutron lifetime by confining ultracold neutrons (UCNs) in a three-dimensional magnetic trap. In contrast to material bottles, magnetic storage eliminates interactions with the trap wall, allowing for the neglect of systematic effects on the measured lifetime related to wall interactions, such as capture or inelastic scattering of UCNs. The presented neutron leakage detector is intended to investigate systematic effects related to the magnetic storage by detecting UCNs possibly escaping from the magnetic trap. Potential escape channels are, e.g., depolarization of UCNs in the radial confinement field produced by a cylindrical Halbach octupole array of permanent magnets or microphonic heating of UCNs due to vibrations of the trap. Because of the fast spatial drop-off of the radial octupole field, the detector covering the inner surface of the octupole must be very thin in order not to cut into the storage depth of the trap. For this purpose, a multilayer structure with a conversion and scintillator layer is used. Wavelength-shifting fibers are guiding the scintillation light from inside the experiment to the actual photosensor. In this talk, the design of the detector and first characterization measurements of suitable fibers will be presented and an outlook on future implementations will be given.

HK 17.5 Tue 17:00 HBR 19: C 2

An energy resolving ultracold neutron detector for the neutron lifetime experiment τSPECT — •Konrad Franz[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [3]Paul Scherrer Institute, Villigen PSI, Switzerland

The defining feature of ultracold neutrons (UCNs) is, that they can be stored in material vessels and magnetic field gradients. This property allows for long observation times and thereby precision measurements of neutron properties like the free neutron lifetime. In the presented detector design, UCNs are converted into an electrical signal by employing a conversion layer stacked with a scintillation layer, in which the neutron induced α-particle generates a light pulse. The scintillation light is then guided onto an array of silicon photomultipliers via a 3D printed light guide. This setup is well suited for in-situ detection of UCNs in high magnetic field regions. Combining spatial resolution with a magnetic field gradient allows for UCN energy determination. The talk will explain, how this feature can be used to study systematic effects in the neutron lifetime experiment τSPECT and will present the first results of test measurements with a prototype.

HK 18: Instrumentation V

Time: Tuesday 15:45–17:15 Location: HBR 19: C 5a

HK 18.1 Tue 15:45 HBR 19: C 5a

Improving the Quality Assurance of MPGDs with a Spark Detection System — •Tim Schüttler[1,2], Philip Hauer[1,2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]Forschungs- und Technologie-Zentrum Detektorphysik, Universität Bonn

Gas Electron Multipliers (GEMs) play a crucial role as amplification stages in modern gaseous detectors. GEM foils consist of a polyimide substrate coated with copper on both sides. Microscopic holes are etched into the structure using a photolithographic process.

The precision of the etching process is sensitive to various factors such as chemical concentration/temperature or treatment duration, leading to potential irregularities in the resulting GEM which can have undesirable effects during detector operation. Since we are about to establish a GEM production in Bonn for small-sized GEMs, a rigorous and reliable quality assurance of the produced foils is indispensible.

To ensure the quality of the 10×10 cm^2 GEMs commonly used for testing purposes, a small-scale versatile Spark Detection System (SDS) was developed. It allows one to apply high voltage to the GEM foil while a built-in camera monitors electric discharges within the holes. Simultaneously, the leakage current flowing through the polyimide is measured, providing valuable insights into the GEM's overall quality.

In this talk, I will explain the SDS design and address challenges encountered with leakage currents inside the system. Sample measurements will be presented to illustrate the system's effectiveness, and the efficiency as well as possible optimization options are discussed.

HK 18.2 Tue 16:00 HBR 19: C 5a

Optimizations of the specific energy loss measurement and

data to Monte Carlo matching for the ALICE TPC in Run 3 — •Tuba Gündem — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) is the primary detector for tracking and Particle Identification (PID) in the ALICE experiment. PID is achieved through the reconstruction of particle momentum and specific energy loss (dE/dx). The dE/dx for a given track is calculated using the clusters associated with the track. However, challenges arise in the form of potential loss of TPC clusters, caused by different factors such as falling below the zero suppression threshold applied in the front-end electronics.

In this talk, various strategies for dealing with subthreshold clusters and cluster acceptance effects, offering new possibilities for optimizing the dE/dx calculation will be presented. Furthermore, the impact of space-charge distortion on dE/dx will be discussed. In addition, a method for improving the matching of simulated dE/dx with reconstructed dE/dx in data will be shown.

HK 18.3 Tue 16:15 HBR 19: C 5a

TPC cluster shape analysis — •Janis Noah Jäger for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

An important aspect of the latest ALICE upgrade is the upgrade of the Time Projection Chamber (TPC). The TPC is the main tracking and particle identification device in ALICE. By replacing the Multi-Wire Proportional Chambers (MWPC) with stacks of four Gas Electron Multiplier (GEM) foils, a continuous readout of the TPC is achieved. The modification also required a major upgrade of the entire readout chain, from the front-end cards, via data acquisition and distribution, up to online reconstruction and data compression. Furthermore, the complete reconstruction and calibration software was rewritten, including the TPC cluster finding algorithm.

This talk discusses the analysis of cluster shapes as a function of different track properties and compares it with Monte Carlo simulations. Properties such as track angles can lead to a broadening of the cluster. Effects such as diffusion also play an important role in the shape of the cluster.

HK 18.4 Tue 16:30 HBR 19: C 5a

Current Status of the GEM Production at the FTD in Bonn — •Philip Hauer[1,2], Markus Ball[2], Dmitri Schaab[2], Yevgen Bilevych[2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]Forschungs- und Technologie-Zentrum Detektorphysik, Universität Bonn

Gas Electron Multipliers (GEMs) are widely used as an amplification stage in gaseous detectors. They consist of a 50 μm thick polyimide foil which is cladded on both sides by 5 μm copper. In a photolithographic process, microscopic holes (for standard GEM foils: diameter: 70 μm, pitch: 140 μm) are etched into this structure. Up to now, GEM foils are only produced at the PCB workshop at CERN.

The new Research and Technology Center for Detector Physics (FTD) in Bonn has recently commissioned commissioned new infrastructure facilitating the production of micropatterned structures like GEMs. This infrastructure includes several wet benches, a dry film laminator, an exposition machine and a mask-less aligner. With these machines, we have successfully produced an initial functional standard GEM. In the future, our research agenda includes the exploration of GEMs with different geometries as well as the production of other micropattern structures, e.g. InGrids.

In this talk, I will go through the individual steps for the GEM production and how they are performed in Bonn. First measurement results will be presented, as well as our plans for the future.

HK 18.5 Tue 16:45 HBR 19: C 5a

Investigating Diamond-like carbon (DLC) photocathodes for THGEM-based multi-channel photodetectors — •Anil Berkay Adigüzel, Leonardo Bugia, Berkin Ulukutlu, and Thomas Klemenz — Technische Universität München, Munich, Germany

In physics research, photon detection is vital, but current methods like Photomultiplier tubes and Silicon Photomultipliers are costly. Micro-Pattern-Gas-Detector (MPGD) photon detectors offer a cheaper alternative but struggle with visible spectrum photons due to limited stable photocathode materials. This study introduces a specialized multi-pad THGEM detector for assessing various photocathodes using diverse light sources. With 64 readout channels, it enables accurate background estimation and uniformity assessment of photocathodes. Initial validation involved measuring CsI in the VUV range, confirming expected efficiency. Diamond-Like Carbon (DLC) photocathodes, though less efficient than CsI, show higher resilience to gas-related aging, making them a potential choice when paired with a high-gain amplification structure. This research is funded by the DFG Sachmittel FA 898/5-1

HK 18.6 Tue 17:00 HBR 19: C 5a

A versatile trigger-less readout for MPGD tracking systems — •Karl Jonathan Flöthner[1,2], Florian Brunbauer[1], Francisco García[3], Djunes Janssens[1], Bernhard Ketzer[2], Marta Lisowska[1], Michael Lupberger[2], Hans Muller[1,2], Eraldo Oliveri[1], Giorgio Orlandini[1], Dorothea Pfeiffer[4], Leszek Ropelewski[1], Jerome Samarati[4], Fabio Sauli[1], Lucian Scharenberg[1], Miranda van Stenis[1], Rob Veenhof[1], August Brask[5], and Michael Heiss[6] — [1]CERN, Geneva, Switzerland — [2]University of Bonn, Germany — [3]HIP, Helsinki, Finland — [4]ESS, Lund, Sweden — [5]Aarhus University, Denmark — [6]PSI, Villingen, Switzerland

The beam telescope of the RD51 collaboration at CERN consists of several triple-GEM detectors, each with an active area of 10x10 cm^2, and additional scintillators to generate a trigger signal for the timing of events. The detectors are equipped with the new VMM3a ASIC coupled to the Scalable Readout System (SRS). In this configuration, the system can provide a rate capability of the order of a few MHz, spatial resolutions in the order of 50 μm and time resolutions in the nanosecond regime. During the RD51 test-beam campaigns in 2023 the system has been improved in terms of powering and noise. The telescope provided data to different groups with different detector technologies (e.g. GEM-TPC, 30×30 cm^2 AMBER prototype, MPGD DHCAL). The talk will discuss the improvements of the system and present results of different detectors under test. This work has been sponsored by the Wolfgang Gentner Programme of the BMBF (grant no. 13E18CHA).

HK 19: Structure and Dynamics of Nuclei V

Time: Tuesday 15:45–17:15 Location: HBR 19: C 5b

Group Report HK 19.1 Tue 15:45 HBR 19: C 5b

Lifetime measurements in the A≈100 mass region via the coincidence Doppler-shift attenuation method — •Anna Bohn, Elias Binger, 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 technique to determine nuclear level lifetimes in the sub-picosecond regime [1,2]. Several CDSAM experiments have been performed at the SONIC@HORUS setup [3] at the University of Cologne, including (p,p'γ) and (α,α'γ) experiments along the Zr, Ru, Sn and Te isotopic chains [4,5,6]. The combined SONIC@HORUS spectrometer enables coincident detection of γ rays and backscattered beam particles, thus, allowing for background reduction, precise transition selection and feeding exclusion, while several dozens of lifetimes can be determined from each data set.

Recent results on lifetime determination and spectroscopy benefitting from coincidence measurements will be presented within this contribution.

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

[1] A. Hennig *et al.* Nucl. Instr. Meth. A **794**, (2015) 171
[2] M. Spieker *et al.* Phys. Rev. C **97** (2018) 054319
[3] S. G. Pickstone *et al.* Nucl. Instr. Meth. A **875**, (2017) 104
[4] S. Prill *et al.* Phys. Rev. C **105** (2022) 034319
[5] A. Hennig *et al.* Phys. Rev. C **92** (2015) 064317
[6] S. Prill *et al.* Phys. Conf. Ser. **1643** (2020) 012157

HK 19.2 Tue 16:15 HBR 19: C 5b

Lifetime determination of yrast states of ^{170}W — •K.E.

Ide[1], V. Werner[1], A. Goasduff[2,3], J. Wiederhold[1], P.R. John[1], D. Bazzacco[3], M. Beckers[4], J. Benito[5], M. Berger[1], D. Brugnara[2,3], M.L. Cortés[3], L.M. Fraile[5], C. Fransen[4], A. Gozzelino[3], E.T. Gregor[3], A. Illana[3], J. Jolie[4], L. Knafla[4], H. Mayr[1], R. Menegazzo[3], D. Mengoni[2,3], C. Müller-Gatermann[4,6], C.M. Nickel[1], O. Papst[1], G. Pasqualato[7], C.M. Petrache[8], N. Pietralla[1], F. Recchia[2,3], T. Stetz[1], D. Testov[2,7], J.J. Valiente-Dobón[3], and I. Zanon[2,3,9] — [1]IKP, TU Darmstadt — [2]U Padova, Italy — [3]INFN, LNL, Italy — [4]IKP, U Köln — [5]U Madrid, Spain — [6]ANL, USA — [7]INFN, Padova, Italy — [8]U Paris-Saclay, France — [9]U Ferrara, Italy

Nuclear quadrupole collectivity is identified from enhanced $E2$ decay rates. The $B(E2; 2_1^+ \to 0_1^+)$ value is obtained from the 2_1^+ state's lifetime, $\tau(2_1^+)$. Recent measurements of $\tau(2_1^+)$ of Hf and W isotopes revealed discrepancies to literature. We measured ^{170}W at LNL with the GALILEO array and plunger. Our $\tau(2_1^+)$ result of $^{170}W_{96}$ confirms the $B(E2)$ literature value. The strongly different $B(E2)$ value for ^{172}W would imply a sudden $E2$ strength increase between $N=96$ and $N=98$ for W isotopes, in contrast to the gradual evolution in the Hf isotopes. After the initial $\tau(2_1^+)$ analysis, systematic effects have been investigated and the analysis of higher yrast band members was finalized. The results are compared to CBS model predictions.

*Supported by the BMBF under Grant Nos. 05P21RDFN9, 05P21RDFN1 and 05P21PKFN1.

HK 19.3 Tue 16:30 HBR 19: C 5b

Shape Coexistence Near Doubly-Magic ^{78}Ni — •Lukas Nies for the ISOLTRAP and JYFLTRAP-Collaboration — CERN, 1211 Geneva, Switzerland — Universität Greifswald, Germany

Nuclear magic numbers are associated with sudden changes in nuclear observables between neighboring isotopes, such as binding energies, charge radii, transition strengths, etc. Furthermore, shape coexistence is often found in nuclei where intruder states across shell gaps lead to a large amount of deformation [1], indicating nearby magicity. Indication for shape coexistence in ^{79}Zn with $N = 49$ and $Z = 30$ has previously been found through laser spectroscopy experiments [2] and in ^{80}Ga with $N = 49$ and $Z = 31$ through electron-conversion spectroscopy [3]. The latter, however, was disproven in a follow-up experiment [4]. In this contribution, we present further evidence for shape coexistence in ^{79}Zn through the first direct excitation energy measurements of the $1/2^+$ isomeric state, firmly establishing the $1/2^+$ and $5/2^+$ state ordering [5]. Using discrete nonorthogonal shell model calculations, we find low-lying deformed intruder states, similar to other $N = 49$ isotones, and investigate similarities in shapes between excited states in ^{79,80}Zn and ^{78}Ni. [1] Garrett, Zielińska, and Clement, Prog. Part. Nucl. Phys. 124, 103931 (2022) [2] Yang et al., PRL 116, 182502 (2016) [3] Gottardo et al., PRL 116, 182501 (2016) [4] Garcia et al., PRL 125, 172501 (2020) [5] Nies et al., PRL 131, 222503 (2023)

HK 19.4 Tue 16:45 HBR 19: C 5b

Coulomb excitation and lifetime measurements in $^{84-86}$Ge with relativistic radioactive ion beams — •U. Ahmed[1,2], V. Werner[1,2], F. Browne[3], M. L. Cortés[4], N. Pietralla[1], P. Doornenbal[4], and K. Wimmer[5] for the HiCARI-Collaboration — [1]IKP, TU Darmstadt, Germany — [2]HFHF, GSI Darmstadt, Germany — [3]CERN, Geneva, Switzerland — [4]RIKEN, Wako, Japan — [5]GSI, Darmstadt, Germany

Coulomb excitation cross sections of $^{84-86}$Ge nuclei and level lifetimes were investigated through reactions of Ge and As beams on heavy and light targets. The cross sections of these reactions will be determined from the ratio of incoming and outgoing particles and de-excitation γ-ray peak areas as measured by the High-resolution Cluster Array (HiCARI) at RIKEN-RIBF in Japan. The ongoing gamma-ray analysis aims at the measurement of the $E2$ transition probabilities of the lowest excited 2^+ states to chart the evolution of collectivity in the Ge chain above the $N = 50$ neutron shell closure. The particle identification for the incoming particles from the BigRIPS fragment separator and the outgoing particles in the ZeroDegree spectrometer will be presented. The lineshape analysis of Doppler-corrected gamma-ray spectra based on the reconstructed velocity of incoming ions with simulated response functions will be shown and first lifetimes will be discussed.

Supported by BMBF under Grant No. 05P21RDFN1 and by HFHF

HK 19.5 Tue 17:00 HBR 19: C 5b

First measurement of the lifetime of the 2_1^+ state of ^{200}Pt — •C.M. Nickel[1], V. Werner[1], P.R. John[1], U. Ahmed[1], C. Costache[2], K.E. Ide[1], N.M. Mărginean[2], H. Mayr[1], C. Mihai[2], R.E. Mihai[2,3], N. Pietralla[1], T. Stetz[1], A. Weber[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt — [2]IFIN-HH, Bucharest-Măgurele — [3]IEAP, CTU Prague

Shape transitions between oblate, prolate, γ-soft and spherical shapes occur in the region of the W, Os, Pt and Hg isotopes [1]. For the neutron-rich Pt isotopes, the $R_{4/2}$ ratio indicates a γ-soft shape transitioning towards sphericity when approaching the neutron shell closure at $N = 126$. In the vicinity of shell closures, a decrease of quadrupole collectivity is expected. Quadrupole collectivity is quantified by the $B(E2; 2_1^+ \to 0_{gs}^+)$ transition strength, which is inversely proportional to the lifetime of the 2_1^+ state. ^{200}Pt is the lightest neutron-rich Pt isotope without a known $B(E2; 2_1^+ \to 0_{gs}^+)$ value but could mark the transition between a γ-soft and a spherical shape in the Pt isotopic chain. Therefore, the ^{198}Pt(^{18}O,^{16}O)^{200}Pt* two-neutron transfer reaction was studied at the IFIN-HH at Bucharest-Măgurele using the ROSPHERE array equipped with a plunger device and the SORCERER particle detector. After correcting for contaminants and by applying the Recoil-Distance Doppler-Shift method, the lifetime of the 2_1^+ state of ^{200}Pt was determined for the first time.

[1] Z. Podolyák et al., Phys. Rev. C 79 031305 (2009).

*Supported by the BMBF under Grant No. 05P21RDCI2.

HK 20: Astroparticle Physics II

Time: Tuesday 15:45–17:15 Location: HBR 19: C 103

Group Report HK 20.1 Tue 15:45 HBR 19: C 103

LEGEND: Background-free hunt for the neutrinoless double-beta decay — •Luigi Pertoldi for the LEGEND-Collaboration — Department of Physics, TUM School of Natural Sciences, Technische Universität München, 85748 Garching b. München, Germany

The discovery that neutrinos are Majorana fermions would have profound implications for particle physics and cosmology. The Majorana character of neutrinos would make neutrinoless double-beta ($0\nu\beta\beta$) decay, a matter-creating process without the balancing emission of antimatter, possible. The LEGEND Collaboration pursues a phased, ^{76}Ge-based double-beta decay experimental program. The first phase, LEGEND-200, deploys up to 200 kg of germanium detectors enriched in ^{76}Ge. A background index of $2 \cdot 10^{-4}$ counts/(keV kg yr) will be achieved. With that background index, when integrated over the exposure, less than one background event in the region around the expected peak position of the $0\nu\beta\beta$ decay will be accumulated. It constitutes a quasi-background-free operation of LEGEND-200, enabling a potential discovery of the $0\nu\beta\beta$ decay at a half-life of at least 10^{27} years. The second phase, LEGEND-1000, will deploy 1000 kg of enriched germanium and reach a discovery potential above 10^{28} years. This talk will portray the LEGEND project and its goals. Furthermore, first results from the currently ongoing data-taking period of LEGEND-200 are presented. This research is supported by the DFG through the Excellence Cluster ORIGINS EXC 2094-390783311, the SFB1258, and by the BMBF Verbundprojekt 05A2023.

HK 20.2 Tue 16:15 HBR 19: C 103

Low-depolarizing Neutron Supermirrors — •Karina Bernert for the PERC-Collaboration — Physik-Department, Technische Universität München, Germany

Measurements of free neutron decay enable a variety of tests of the Standard Model of particle physics. Among the observables is the parity-violating beta asymmetry A, i.e. the angular distribution of the beta particles with respect to the neutron spin, with which one can test the unitarity of the quark-mixing Cabibbo-Kobayashi-Maskawa matrix.

The new PERC (Proton Electron Radiation Channel) facility is currently being set up at the research reactor FRM II of the Heinz Maier-Leibnitz Zentrum in Garching, with the aim to measure correlation coefficients one order of magnitude more precisely than previous experiments.

PERC crucially requires low-depolarizing neutron mirrors at the level of 10^{-4}, such that the polarized neutron beam stays sufficiently polarized inside the decay volume. I show preliminary results of a measurement campaign at the ILL PF1b beam line last summer, in which we used the Opaque Test Bench setup to determine the depolarizing effect of different supermirrors. With these measurements we prove that the supermirrors are suitable for the use in PERC and in other experiments that require low depolarization.

HK 20.3 Tue 16:30 HBR 19: C 103

Measurement of the nuclear transition energies of ^{83m}Kr using the gaseous krypton source of KATRIN — •Matthias Böttcher and Benedikt Bieringer for the KATRIN-Collaboration — Institut für Kernphysik, Universität Münster

The KATRIN experiment aims to measure the electron neutrino mass m_ν with 0.3 eV/c^2 (90% C.L.) sensitivity after 1000 measurement days in 2025, by measuring the Tr beta spectrum near its endpoint E_0, and performing a fit including parameters E_0 and m_ν^2. Since these are highly correlated, systematic effects influencing the obtained m_ν will also manifest in E_0 and the derived Tr Q value. The latter is therefore valuable for cross checks of our experimental procedure. The KATRIN Q value can be determined by absolute calibration with ^{83m}Kr conversion electron lines. This is limited by knowledge of ^{83m}Kr nuclear transition energies, being known to 0.3 eV precision in literature. The excited nucleus of ^{83m}Kr decays via two-step cascade of 32.2 keV and 9.4 keV highly converted gamma transitions, and a suppressed direct transition. Using a gaseous Kr source at KATRIN, a new measurement of conversion electron lines from all three transitions was performed in 2023. Following the method described in ref. EPJ C 82 (2022) 700, the nuclear transition energies can be determined, which can allow for a reduction of the Tr Q value uncertainty to below 0.1 eV. In this talk the result of the new measurement is presented. This work is supported by Helmholtz Association and Ministry for Education and Research BMBF (grant numbers 05A23PMA, 05A23PX2, 05A23VK2, and 05A23WO6).

HK 20.4 Tue 16:45 HBR 19: C 103

Tracking of the spatial magnetic field distribution and equipment motion effects for the Fermilab Muon g-2 experiment — •Mohammad Ubaidullah Hassan Qureshi, René Reimann, and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Cluster of Excellence PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The Fermilab Muon g-2 experiment, targets a precision of 140 ppb in measuring the muon's anomalous magnetic moment. Muons undergo cyclotron motion and spin precession in a ring-shaped quasi-Penning trap within a 1.45 T uniform magnetic field. The measurement determines a ratio of two frequencies: the anomalous spin precession frequency of muons (ω_a) and the muon-weighted spin precession frequency of protons ($\tilde{\omega}_p$), representing the magnetic field experienced by these muons. Magnetic field measurements are mainly based on nuclear magnetic resonance (NMR) systems.

This presentation will focus on two crucial sub-systems in the magnetic field measurement chain, the trolley probe and fixed probe systems, providing periodic and continuous magnetic field measurements, respectively. We will go through the procedure for synchronizing measurements from these sub-systems in time and discuss the removal of the trolley system's magnetic signature, due to its motion, in the fixed probes system.

HK 20.5 Tue 17:00 HBR 19: C 103

Development of a Neural-Network-Based Event Reconstruction for the RadMap Telescope — •Luise Meyer-Hetling[1], Liesa Eckert[1], Peter Hinderberger[1], Martin J. Losekamm[1], Stephan Paul[1], Thomas Pöschl[3], and Sebastian Rückerl[2] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany — [3]CERN, Geneva, Switzerland

The RadMap Telescope is a compact multi-purpose radiation detector developed to provide near real-time monitoring of the radiation aboard crewed un uncrewed spacecrafts. A first prototype is currently deployed on the International Space Station for an in-orbit demonstration of the instrument's capabilities. Its main sensor consists of a stack of scintillating-plastic fibers whose perpendicular configuration allows the three-dimensional tracking and identification of cosmic-ray ions by reconstruction of their energy-loss profiles. We trained a set of neural networks on simulated detector data and assembled them into an analysis framework to perform an event-by-event reconstruction of track parameters, ion type and energy. In addition to our current offline analysis, we plan to implement the framework on the instrument's flight computer to analyze measurements without requiring the transmission of raw data to Earth. In this contribution, we will describe our neural-network-based reconstruction methods and present first results. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 21: Heavy-Ion Collisions and QCD Phases III

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 03

HK 21.1 Tue 15:45 HBR 62: EG 03

Anomalous transport phenomena on the lattice — Bastian Brandt, Gergely Endrodi, •Eduardo Garnacho-Velasco, and Gergely Markó — Bielefeld University, Bielefeld, Germany

We study the Chiral Separation Effect (CSE) and Chiral Magnetic Effect (CME) using lattice QCD simulations with improved staggered fermions. We present the first continuum extrapolated result of the CSE conductivity in QCD with physical quark masses as a function of temperature, revealing a severe suppression of this effect at low temperatures. In addition, we discuss several subtleties that arise on the study of CSE on the lattice. We also shed light on the equilibrium interpretation of the CME, clarifying the expected vanishing current in this setup, and how to reconcile this with former lattice QCD results by emphasizing the importance of the discretization of the currents used.

HK 21.2 Tue 16:00 HBR 62: EG 03

The Chiral Magnetic Effect in QCD with a non-uniform magnetic background — •Adeilton Dean Marques Valois, Eduardo Garnacho-Velasco, Gergely Endrodi, Bastian Brandt, and Gergely Markó — Bielefeld University, Bielefeld, Germany

We explore the impact of a non-uniform magnetic field background on the Chiral Magnetic Effect (CME) in QCD using lattice simulations with dynamical staggered quarks at the physical point. We show that, in the presence of magnetic field gradients, the system develops a localized vector current density along the direction of the field, which integrates to zero in the full volume. This demonstrates that the total CME-conductivity vanishes in QCD at equilibrium, even though steady currents can exist locally. Our primary observable is the leading-order coefficient of the vector current in a chiral chemical potential expansion. We extrapolate this observable to the continuum limit and discuss possible implications of our findings to heavy-ion physics.

HK 21.3 Tue 16:15 HBR 62: EG 03

J/ψ measurements with machine learning and Kalman filter techniques with ALICE at the LHC — •Pengzhong Lu — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — University of Science and Technology of China, Hefei, China

Quarkonium production offers an effective way to study the properties of the quark-gluon plasma (QGP) created in ultra-relativistic heavy-ion collisions. While the prompt J/ψ production provides information on suppression and (re-)generation mechanisms in the QGP, the non-prompt J/ψ component (from b-hadron decays) allows one to study heavy quark energy loss in the medium. J/ψ meson production measurements in pp collisions, besides providing a reference for the corresponding measurements in p–Pb and Pb–Pb collisions, are also crucial to better understand quantum chromodynamics.

In this talk, the performance of the combined usage of KFParticle and machine learning (ML) for the measurement of prompt and non-prompt J/ψ production will be presented. The KFParticle package, based on the Kalman Filter algorithm, shows good performances in the reconstruction of particle decays. Combining it with ML techniques will significantly improve the signal reconstruction efficiencies and signal-to-background ratios. Results from this study in ALICE Run 3 pp collisions at $\sqrt{s} = 13.6$ TeV, based on the data collected in 2022, will be shown.

HK 21.4 Tue 16:30 HBR 62: EG 03

Mid-rapidity J/ψ production as a function of multiplicity in p–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE — •Tabea Eder for the ALICE Germany-Collaboration — Institut für Kernphysik, Universität Münster

ALICE results from LHC Run 1 data on the charged-particle multiplicity dependence of the inclusive normalized J/ψ production, both at mid-rapidity, indicate a stronger than linear increase for proton-lead collisions at $\sqrt{s_{NN}} = 5.02$ TeV. The corresponding ALICE results on proton-proton collisions at $\sqrt{s} = 13$ TeV provide a clearer picture of a stronger than linear increase.

This behaviour has been associated with auto-correlation effects in PYTHIA8 studies on proton-proton collisions. Amongst others, this has been achieved by differentiating between different J/ψ production mechanisms for the multiplicity dependent J/ψ production. One of these mechanisms is the weak decay of b-flavoured hadrons, leading to production of non-prompt J/ψ. In data, these can be distinguished by their displaced vertex from prompt J/ψ, which are produced directly in the initial hard collision.

In this talk the multiplicity dependent inclusive J/ψ production is presented for p–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with improved statistics, which is needed to clarify the previous results and is achieved by using ALICE data from LHC Run 2. In addition for the first time a look into the multiplicity dependence of prompt and non-prompt J/ψ production in p–Pb collisions at ALICE is presented.

HK 21.5 Tue 16:45 HBR 62: EG 03

Multiplicity dependence of prompt and non-prompt J/ψ production in pp collisions with ALICE — •Gauthier Legras for the ALICE Germany-Collaboration — Institut für Kernphysik, Universität Münster

J/ψ production involves a hard scale for the creation of the charm-anticharm pair, and a soft scale for its hadronization. Correlating it with the multiplicity, mainly produced by soft processes, in small systems allows to investigate the interplay between hard and soft scales. A stronger-than-linear multiplicity dependence of inclusive J/ψ in pp collisions was found in previous ALICE publications, but the main reason was not yet clearly identified, justifying the need for additional studies investigating its origin. For example, there could be different contributions between prompt (produced directly in the collision) and non-prompt (coming from the decay of beauty hadrons) J/ψ. Additionally, the multiplicity can be separated in different azimuthal regions relative to the J/ψ, and, in each region, different effects for particle production, due to correlation with the presence of a prompt or non-prompt J/ψ, could be isolated.

This study aims at determining the multiplicity dependence, the multiplicity being measured either inclusively at midrapidity or in three azimuthal regions, of prompt and non-prompt J/ψ production pp collisions at $\sqrt{s} = 13$ TeV, through its decay to an electron-positron pair at midrapidity. The rejection of background and separation between both J/ψ topologies is done with Boosted Decision Trees through the study of displaced decay vertices.

HK 21.6 Tue 17:00 HBR 62: EG 03

Jet-hadron correlations in PbPb collisions at $\sqrt{s_{NN}}$ =5.02 TeV with ALICE — •Luisa Bergmann for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg

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

By analyzing the angular correlations of jets with charged hadrons, one obtains information about the energy loss of jets in the medium. The study of these correlation functions for different orientations of the jet to the event plane allows for a measurement of the energy loss which is sensitive to the in-medium path-length of the jet. In this talk, the current status of a study of event plane dependent jet-hadron correlations with data collected by the ALICE experiment in PbPb collisions at $\sqrt{s_{NN}}$ =5.02 TeV is presented.

HK 22: Heavy-Ion Collisions and QCD Phases IV

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 05

Group Report HK 22.1 Tue 15:45 HBR 62: EG 05

Recent developments in dissipative spin hydrodynamics — •Masoud Shokri[1], Annamaria Chiarini[1], Julia Sammet[1], Nils Sass[1], David Wagner[1], Ashutosh Dash[1], Enrico Speranza[2], Nora Weickgenannt[3], Hannah Elfner[1], and Dirk H. Rischke[1] — [1]Goethe University, Frankfurt am Main, Germany — [2]IPhT, Saclay, France — [3]CERN, Switzerland

Transport equations for particles with spin can be rigorously derived from quantum kinetic theory in an expansion in Planck's constant. At zeroth order, the standard Boltzmann equation is recovered. At first order, a nonlocal contribution to the collision term is found, which enables the mutual conversion of orbital angular momentum into spin and thus provides a microscopic mechanism for the time-honored Barnett effect. The method of moments is applied to derive second-order dissipative spin hydrodynamics. Investigating this theory in the linear regime confirms the need for a second-order theory. We computed the transport coefficients of this theory and found that spin diffusion happens on rather short time scales, while spin degrees of freedom approach local equilibrium on rather long time scales. This separation of time scales allows a simplification of the expression for the polarization vector and a numerical evaluation without explicitly solving the equations of motion for the spin degrees of freedom. While we find qualitative agreement with experimental data, a quantitatively reliable calculation requires the development of numerical simulations for spin hydrodynamics. Finally, an outlook for further theoretical and phenomenological developments is given.

HK 22.2 Tue 16:15 HBR 62: EG 05

Elliptic flow of non-prompt D^0 in Pb-Pb collisions at $\sqrt{s_{NN}}$= 5.02 TeV with ALICE — •Biao Zhang for the ALICE Germany-Collaboration — Physical Institute, Heidelberg, Germany

Heavy quarks (charm and beauty) are among the most interesting and powerful probes to investigate the properties of the quark-gluon plasma (QGP), because they are produced on a very short time scale in initial hard scattering processes and thus they experience the whole history of the collision. The elliptic flow (v_2) of heavy quarks can provide insight on their degree of thermalization in the medium. In this contribution we will present the first elliptic-flow measurement of non-prompt D^0 at midrapidity in semicentral Pb-Pb collisions at$\sqrt{s_{NN}}$= 5.02 TeV with ALICE. Comparisons with measurements obtained from semi-leptonic decays and with theoretical models will be presented.

HK 22.3 Tue 16:30 HBR 62: EG 05

Extending the fluid dynamic description of heavy-ions collisions to times before the collision — •Andreas Kirchner[1], Federica Capellino[2], Alaric Erschfeld[3], Stefan Floerchinger[3], and Eduardo Grossi[4] — [1]ITP Heidelberg — [2]University Heidelberg — [3]TPI Jena — [4]Dipartimento di fisica e astronomia, Universita di Firenze and INFN Sezione di Firenze

It is well established that the late states of a high energy nuclear collision can be described in terms of relativistic fluid dynamics. An open problem in this context is how the actual collision and the early time dynamics, including the thermalization process, directly after it can be described. Phenomenological models are currently employed here and they have several parameters that need to be fitted to experimental data. Using relativistic fluid dynamics of second order we develop a new approach which addresses the entire collision event, and which gets initialized in fact already before the collision. This is based on the droplet model for the incoming nuclei and a state-of-the-art equation of state including the first-order liquid-gas phase transition. The physics picture we propose assumes that the soft features of a high energy nuclear collision can be fully described through the dynamics of the energy-momentum tensor and other conserved currents.

This work is part of and supported by the DFG Collaborative Research Centre "SFB 1225 (ISOQUANT)".

HK 22.4 Tue 16:45 HBR 62: EG 05

Non-Hydrodynamic Modes from Linear Response in Kinetic Theory — •Stephan Ochsenfeld and Sören Schlichting — Universität Bielefeld, 33615 Bielefeld, Deutschland

Viscous hydrodynamics serves as a successful mesoscopic description of the QGP produced in relativistic heavy-ion collisions. In order to investigate, how such an effective description emerges from the underlying microscopic dynamics we calculate the non-hydrodynamic and hydrodynamic modes of linear response in the sound channel from a first-principle calculation in kinetic theory. We do this with a new approach wherein we linearize and discretize the collision kernel to calculate eigenvalues directly. This allows us to study the Green's functions at any point in time or frequency space. Our study focuses on scalar theory with quartic interaction and we find that the analytic structure of Green's functions in the complex plane is far more complicated than just poles or cuts which is the first step towards an equivalent study in QCD kinetic theory.

HK 22.5 Tue 17:00 HBR 62: EG 05

Differential multiharmonic flow correlations in ALICE and CBM — •Ante Bilandzic[1], ALICE Collaboration[2], and CBM Collaboration[2] — [1]Technical University of Munich — [2]N/A

Recently developed multiharmonic flow observables, Symmetric Cumulants (SC) and Asymmetric Cumulants (AC) of flow amplitudes provide independent constraints for properties of nuclear matter produced in heavy-ion collisions when compared to the traditional studies of individual flow harmonics.

This contribution will present the latest differential measurements of SC and AC observables obtained in Pb–Pb collisions in ALICE. The corresponding feasibility studies for the future CBM experiment will also be discussed. Two experiments probe different regions of the QCD phase diagram — ultrarelativistic heavy-ion collisions at the LHC at CERN explore the regime of very high temperatures (re-creating the conditions which existed in the very early Universe), while the experiments at FAIR at GSI explore the regime of very large net-baryon densities (re-creating the conditions which exist in the core of neutron stars). Multiparticle cumulant analysis is more challenging in CBM than ALICE due to the smaller center of mass collision energies and multiplicities.

HK 23: Heavy-Ion Collisions and QCD Phases V

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 18

Group Report HK 23.1 Tue 15:45 HBR 62: EG 18

Superconducting Quark Matter Core in Neutron Stars including Mesonic Fluctuations — •Ugo Mire[1] and Bernd-Jochen Schaefer[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany

A nonperturbative equation of state for two-flavor superconducting quark matter is constructed by means of a functional renormalization group (FRG) method within a quark-meson-diquark truncation. The phase structure at finite temperature, charge and quark chemical potential is investigated. The effects of mesonic fluctuations including possible truncation artifacts are discussed. By considering a smooth transition between the normal and superconducting quark matter phase we obtain an electrically and color neutral as well as β-equilibrated equation of state. This enables a detailed analysis of the tidal deformabilities and mass-radius relations of hybrid stars with superconducting quark cores and hadronic shells. We find that already the mesonic fluctuations lead to significant modifications of the corresponding astrophysical observables in the mass region of $\mathrm{M} \approx 1.5\,\mathrm{M}_{\odot}$. However, the inclusion of additional interaction channels is mandatory in the present FRG truncation since the two-solar mass limit cannot be reached.

HK 23.2 Tue 16:15 HBR 62: EG 18

Renormalization Group Consistent treatment of NJL Color Superconductivity — •Hosein Gholami — TU Darmstadt

The Nambu-Jona-Lasinio (NJL) model and specifically its extension to color superconductivity is an effective model for investigating dense quark matter. However, the reliability of its results is challenged by cut-off artifacts emerging near cut-off energy scales. In this presentation we focus on a Renormalization Group (RG) consistent treatment that successfully eliminates these artifacts. Our study reveals a substantial change in the previously established phase diagram of neutral color superconducting matter. The RG-consistent treatment not only eliminates cut-off artifacts but also aligns with an earlier Ginzburg-Landau analysis, suggesting the appearance of a so-called dSC phase in the Color-Flavor Locked (CFL) melting pattern.

HK 23.3 Tue 16:30 HBR 62: EG 18

Strange Hadron and Hypernuclei Production in Dense Baryonic Matter — •Yue Hang Leung for the CBM-Collaboration — Im Neuenheimer Feld 226 69120 Heidelberg

Strange hadrons and hypernuclei have been have been suggested to be sensitive probes to the medium properties of the nuclear matter created in heavy-ion collisions. At low collision energies, the medium formed is dense and baryon-rich due to baryon stopping. Since strange hadrons are produced near or below threshold at low collision energies, their yields may give strong constraints on the equation-of-state of high baryon density matter.

In this presentation, recent results on strange hadron and hypernuclei production from intermediate to low energy heavy-ion collisions from STAR will be discussed. Future prospects at CBM will be discussed, with a special focus on the tracking capabilities of the ongoing mCBM project.

HK 23.4 Tue 16:45 HBR 62: EG 18

Accessing the $p-\Sigma^+$ interaction via femtoscopy with ALICE — •Benedict Heybeck — Institut für Kernphysik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt, Germany

The Σ-nucleon interaction is crucial for the description of neutron stars and potential Σ-hypernuclei. Since Σ-baryons have similar masses and quark content as Λ-baryons, their interaction might be similar. However, models do not even agree if the Σ-nucleon interaction is attractive or repulsive and scattering data is scarce. Thus, two-particle intensity interferometry (femtoscopy) of Σ-baryons and nucleons can provide valuable information.

Σ^+-baryons decay into a proton and a neutral pion via the weak interaction with a branching ratio of 51.57%. The neutral pion decays electromagnetically almost exclusively into two photons which are challenging to measure with the ALICE apparatus.

In this talk, a new reconstruction method will be shown which makes use of machine learning techniques and significantly improves the reconstruction efficiency of the Σ-baryons.

The obtained correlation function will be discussed and related to latest theoretical predictions and scattering data.

HK 23.5 Tue 17:00 HBR 62: EG 18

The nuclear structure from ultracentral symmetric heavy-ion collisions — •Seyed Farid Taghavi — Technical University of Munich, Munich, Germany

Heavy-ion collision experiments are a valuable tool for studying the properties of nuclei. One potential characteristic of the evolution process at its early stages is scale-invariance. This suggests that the produced entropy at the initial stages display similar scaling as the nuclei participants. By studying ultra-central symmetric heavy-ion collisions and assuming scale-invariance, we can directly connect the characteristics of heavy-ion collisions with those of nuclei, including their two-body correlations. We propose an analytical formula for the initial state eccentricity fluctuation using this property. Specifically, we use the cluster-expansion method to determine the functionality of two-body correlations. We validate our results with TRENTo event generator.

HK 24: Hadron Structure and Spectroscopy III

Time: Tuesday 15:45–17:15 Location: HBR 62: EG 19

Group Report HK 24.1 Tue 15:45 HBR 62: EG 19
Exploring exotic hadrons with functional equations — •Markus Q. Huber[1], Gernot Eichmann[2], Christian S. Fischer[1,3], Stephan Hagel[1], Joshua Hoffer[1], and Franziska Münster[1] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Giessen, 35392 Giessen, Germany — [2]Institute of Physics, University of Graz, NAWI Graz, Universitätsplatz 5, 8010 Graz, Austria — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany

The spectrum of quantum chromodynamics consists of different types of hadrons. The group of exotic hadrons contains those which cannot be described by the conventional quark model. In this talk we describe the functional framework of Dyson-Schwinger and bound state equations and its application to such states. We give an overview of different approximations and explain when to apply them to obtain qualitative or even quantitative results. This is exemplified with recent highlights like the spectrum of charm and bottom tetraquarks or a first-principles calculation of the glueball spectrum in Yang-Mills theory. We also discuss prospects to access the hybrid sector of QCD.

HK 24.2 Tue 16:15 HBR 62: EG 19
Search for exotic states in the η_c decay to $\eta' K^+K^-$ at BESIII — •Anja Brüggemann[1], Salleh Ahmed[1], Nils Hüsken[2], Nikolai in der Wiesche[1], Frederik Weidner[1], and Alfons Khoukaz[1] for the BESIII-Collaboration — [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 reaction $\eta_c \to \eta' K^+K^-$ to determine the corresponding branching ratio as well as the mass and width of the ground-state charmonium η_c based on a signal yield much higher than achieved in former analyses. Moreover, this mesonic η_c decay provides the opportunity to investigate possible exotic content in K^+K^- intermediate states, that lie in the mass region below 2 GeV/c^2, where the lightest glueball is predicted.

Our study is based on a partial wave analysis approach that gives access to the properties of the η_c charmonium and to the partial decay widths of contributing resonances decaying into the K^+K^- subsystem. These widths are directly comparable to theoretical predictions, which assume glueball admixtures carried by certain considered resonances.

The current status of the analysis is presented.

This work is supported by the German Research Foundation (DFG) under the project number 443159800 and the DFG Research Training Group 2149/2.

HK 24.3 Tue 16:30 HBR 62: EG 19
Partial wave analysis of the radiative decay $J/\psi \to \gamma K^+K^-$ at BESIII — •Fabian Hölzken for the BESIII-Collaboration — Ruhr-Universität Bochum

Radiative J/ψ decays are an ideal source to identify exotic states with gluonic degrees of freedom such as glueballs or hybrids. The K^+K^- system of $J/\psi \to \gamma K^+K^-$ only allows for J^{PC} quantum numbers like 0^{++} or 2^{++} and as such, it provides an excellent environment for the search of the lightest scalar and tensor glueballs.

The BESIII experiment, located at the BEPCII collider in Beijing, has collected a total of $10^{10} J/\psi$ events and thereby offers sufficient statistics for this analysis.

In this talk preliminary results of a mass independent and mass dependent partial wave analysis of the K^+K^- system produced in radiative J/ψ decays will be shown.

Supported by DFG (CRC 110 / NSFC-DFG)

HK 24.4 Tue 16:45 HBR 62: EG 19
Partial-wave analysis of $\tau^- \to \pi^-\pi^-\pi^+\nu_\tau$ at Belle — •Andrei Rabusov, Daniel Greenwald, and Stephan Paul — Technical University of Munich

We present results of a partial-wave analysis of $\tau^- \to \pi^-\pi^-\pi^+\nu_\tau$ in data from the Belle experiment at the KEK $\mathrm{e^+e^-}$ collider. We demonstrate the presence of the $\mathrm{a_1}(1420)$ and $\mathrm{a_1}(1640)$ resonances. We observe the $1^-[\omega(782)\pi]_\mathrm{P}$ wave using the G-parity violating decay of $\omega(782) \to \pi^+\pi^-$. We also present validation of our findings using a model-independent approach. Our results can improve modeling in simulation studies necessary for measuring the τ electric and magnetic dipole moments and Michel parameters.

HK 24.5 Tue 17:00 HBR 62: EG 19
Partial-Wave Analysis of the $K^0_S K^-$ Final State at COMPASS* — •Julien Beckers for the COMPASS-Collaboration — Technical University of Munich

The COMPASS experiment is a multi-purpose two-stage spectrometer at the CERN SPS. One of its main goals is to probe the strong interaction at low energies by studying the excitation spectrum of light mesons. This is done by decomposing the data into partial-wave amplitudes with well-defined quantum numbers and searching for resonances in these amplitudes. One of the many final states produced at COMPASS is $K^0_S K^-$, which is complementary to COMPASS's flagship $\pi^-\pi^-\pi^+$ final state in that the same states appear as intermediate resonances. However, in $K^0_S K^-$, only selected resonances, the a_J states with even J, can appear at COMPASS' high beam energies. This allows a very selective study of these states. Additionally, the final state, consisting of two strange mesons, enables us to probe the intrinsic $s\bar{s}$ content of the isovector states. Using the so-far largest dataset of $K^0_S K^-$ events, we are able to search for new resonances and measure states with high precision. We will present the partial-wave analysis of the $K^0_S K^-$ final state, which shows several clear resonance signals.

*Funded by the DFG under Germany's Excellence Strategy - EXC2094 - 90783311 and BMBF Verbundforschung 05P21WOCC1 COMPASS.

HK 25: Hadron Structure and Spectroscopy IV

Time: Tuesday 17:30–19:00 Location: HBR 14: HS 1

Group Report HK 25.1 Tue 17:30 HBR 14: HS 1
Chiral symmetry breaking: experimental tests at COMPASS and future prospects* — •Dominik Ecker for the COMPASS-Collaboration — Technische Universität München

When we are dealing with the lightest quarks at low energies, the properties of Quantum Chromodynamics are encoded by chiral symmetry and the manifestation of its breaking. We can exploit this symmetry to build an effective field theory, which can be expanded as a perturbation theory. Chiral Perturbation Theory allows to describe a variety of phenomena observed for light mesons at low-energies, including their decays and their couplings to photons or other matter fields. Among the light hadrons, the pion plays a special role, as it is the lightest meson and emerges as a Goldstone boson from the breaking of the Chiral Symmetry. Its properties are directly related to the underlying symmetry.

In this talk, we will focus on the experimental verification of pion properties, in particular so-called anomalous couplings, which arise as a consequence of the chiral anomaly. We will review the state of the art, explain previous measurements and point out experimental challenges. We will then highlight the recent measurement of the anomalous value for $F_{3\pi}$ by the COMPASS collaboration at CERN. A proposed measurement at the AMBER experiment will allow us to extent the studies to the next heaviest quark generation in interactions with kaons.

*funded by the DFG under Germany's Excellence Strategy - EXC2094 - 90783311 and BMBF Verbundforschung 05P21WOCC1 COMPASS.

HK 25.2 Tue 18:00 HBR 14: HS 1

Measuring Dipole Moments of Charmed Baryons in a new Fixed Target Experiment at the LHC with Bent Crystals — •Jascha Grabowski and Sebastian Neubert — University of Bonn, Bonn, Germany

Values for the magnetic dipole moments of the charmed baryons have been predicted, but could never be observed experimentally, due to their short lifetimes. Their measurement would probe the internal structure of the baryons, making them a valuable anchor point for low-energy QCD models. It would also allow the search for the electric dipole moments of these states, which are suppressed in the standard model and sensitive to new physics contributions.

A sufficient spin precession for a measurement of the dipole moments of the short-lived charmed baryons can be achieved by exploiting the channeling effect of relativistic charged particles in bent crystals. A proof-of-principle setup and first simulation studies for a fixed target experiment at the LHC developed by an international group of researchers inside the CERN Physics Beyond Colliders program will be presented.

HK 25.3 Tue 18:15 HBR 14: HS 1

Spacelike electromagnetic form factors of Lambda- and Sigma-baryons — •Langtian Liu and Christian S. Fischer — Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany

An important goal of ongoing and future experiments is to explore spectra and transition form factors of baryons with non-zero strangeness. Of particular interest is the transition form factor $\gamma^{(*)}\Sigma^0 \to \Lambda$ and $\gamma^{(*)}\Sigma^0(1382) \to \Lambda$ in the time-like momentum region that can be extracted from Dalitz decays. On the road towards a theoretical description of these form factors we extend a covariant dynamical quark-diquark model for the baryon Faddeev equation to the strange-quark sector. Based on an excellent description of the mass spectrum of selected baryon octet and decuplet states and reasonable results for the nucleon form factors we determine the elastic electromagnetic form factors of Λ and $\Sigma^+, \Sigma^0, \Sigma^-, \Sigma^0(1382)$ hyperons in the space-like region as well as the ones for the octet transition $\gamma^{(*)}\Sigma^0 \to \Lambda$. We discuss qualitative and quantitative features of the diquark-quark picture and compare systematically with previous results from a three-body Faddeev approach and lattice data where available.

HK 25.4 Tue 18:30 HBR 14: HS 1

Accessing transverse momentum dependent distribution functions with semi-inclusive deep inelastic single pion production — •Stefan Diehl for the CLAS-Collaboration — Justus Liebig Universität Gießen and University of Connecticut

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. The structure-function ratio $F_{LU}^{\sin\phi}/F_{UU}$ was studied based on beam single-spin asymmetries from pion SIDIS. The talk will present a comprehensive multidimensional study for all three pions over a large range of Q^2, x_B, z and P_T, discuss the connection of the observable to TMDs and the impact of the new data on our understanding of the involved TMDs based on a comparison to TMD based reaction models. A special focus will be given to the impact of exclusive vector meson production on the SIDIS observables.

*The work is supported by Deutsche Forschungsgemeinschaft (Project No. 508107918).

HK 25.5 Tue 18:45 HBR 14: HS 1

The Chiral Anomaly in $\pi\gamma \to \pi\eta$ Scattering at COMPASS* — •Andrii Maltsev for the COMPASS-Collaboration — Technische Universität München

Quantum chromodynamics (QCD) has been extremely successful in desribing hadron interactions at high energies. However, at low energies it is no longer possible to apply the standard perturbative series in the strong coupling constant α_s. Using the chiral symmetry, a fundamental property of QCD, phenomenological models, such as the chiral perturbation theory (χPT), have been developed that are able to describe low-energy processes. Testing the predictions of such models, such as the $\pi\gamma \to \pi\pi$, $\pi\gamma \to \eta\pi$ couplings, is important for understanding the low-energy interactions of hadrons.

In this talk, the status of the measurement of the $F_{\eta\pi\pi\gamma}$ constant, which is predicted by χPT and describes the anomalous vertex $\pi\gamma \to \eta\pi$, in the COMPASS experiment will be presented, as well as the comparison with the previous measurement.

* funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and BMBF Verbundforschung 05P21WOCC1 COMPASS.

HK 26: Structure and Dynamics of Nuclei VI

Time: Tuesday 17:30–19:00 Location: HBR 14: HS 4

Group Report HK 26.1 Tue 17:30 HBR 14: HS 4

Measurement of the Neutron-Decay Lifetime of the ^{26}O Ground State — •Sonja Storck-Dutine[1], Thomas Aumann[1,2], Christoph Caesar[2,3], Julian Kahlbow[1,3], Valerii Panin[2,3], and Dominic Rossi[1,2] for the SAMURAI20-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]RIKEN Nishina Center, Tokyo, Japan

The ground state of the neutron unbound nucleus ^{26}O is speculated to have a lifetime in the pico-second regime. In order to determine the neutron-decay lifetime of the ^{26}O ground state with high sensitivity and precision, a new method has been applied. The experiment was performed at the Superconducting Analyzer for MUlti-particle from RadioIsotope Beams (SAMURAI) at the Radioactive Isotope Beam Factory (RIBF) at RIKEN. A ^{27}F beam was produced in the fragment separator BigRIPS and impinged on a W/Pt target stack where ^{26}O was produced. The ratio of the number of decays occurring inside and outside of the target will change according to the lifetime. Thus, the velocity difference between the decay neutrons and the fragment ^{24}O delivers a characteristic spectrum from which the lifetime can be extracted. With this method, a new upper limit of the ^{26}O lifetime with reduced uncertainties was measured and will be presented in the report.

Supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245, the BMBF under contract number 05P21RDFN2 and the GSI-TU Darmstadt cooperation agreement.

HK 26.2 Tue 18:00 HBR 14: HS 4

Electron scattering off ^{10}B at a scattering angle of 180° — •M. Spall, J. Birkhan, I. Brandherm, M. L. Cortés, F. Gaffron, K. E. Ide, J. Isaak, I. Jurosevic, P. von Neumann-Cosel, F. Niederschuh, N. Pietralla, M. Singer, G. Steinhilber, and T. Stetz — Institut für Kernphysik, Technische Universität Darmstadt

Electron scattering experiments at a scattering angle of 180° are an excellent tool to study transversal form factors of magnetic excitations. This is based on the suppression of longitudinal excitations by several order of magnitudes with respect to the transversal excitations and the associated radiative tail background from elastic scattering at this angle. The ^{10}B(e, e') reaction was studied with the 180° system [1] at the S-DALINAC. It was the aim to investigate the $M3$ excitation of the 3^+ ground state of ^{10}B to its excited 0^+ state at 1.74 MeV. This is the isospin-analogue to the second-forbidden beta-decay of ^{10}Be. The measurement will extend data on the form factor towards lower momentum transfer. This improves the precision of the determined transition strength. The combined information from electron scattering and beta-decay will serve as a precision test of the unified description of electroweak observables in ab-initio models. The determined form factor of the investigated M3 transition of the ^{10}B(e,e') data will be presented.

*Supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245.

[1] C. Lüttge et al., Nucl. Instrum. Meth. A 366, 325*331 (1995).

HK 26.3 Tue 18:15 HBR 14: HS 4

Reaction Measurements on ^{12}C in Inverse Kinematics at R^{3}B — •Tobias Jenegger, Roman Gernhäuser, Philipp Klenze, and Lukas Ponnath — Technische Universität München, Germany

The R^{3}B Setup at GSI allows to fully reconstruct nuclear reactions of exotic nuclei in inverse kinematics. The commissioning of the CALIFA calorimeter for the S444 experiment in 2020 opened new doors to investigate the proton-induced-quasi-free one-nucleon knockout reactions.

The CALIFA calorimeter, with its 2528 CsI scintillator crystals in its final design, is a key detector for quasi-free-scattering experiments at R^{3}B. It allows to detect both gamma rays from nuclear de-excitation processes as well as light charged particles, as protons, from knockout reactions with high angular resolution and precise Doppler correction. This dedicated detector setup allowed to study single-particle structure of ^{12}C via the ^{12}C(p,2p)^{11}B quasi-free scattering channel as well as by measuring the charge changing and total reaction cross sections of ^{12}C beam on ^{12}C and plastic targets.

We present the analysis of the S444 experiment performed in the FAIR Phase-0 campaign with relativistic ^{12}C beams at beam energies from 400, 550, 650 and 800 AMeV and discuss the different techniques used for the analysis.

Supported by BMBF 05P21WOFN1 and Excellence Cluster Origins.

HK 26.4 Tue 18:30 HBR 14: HS 4

Measurements of interaction cross-section of carbon isotopes (^{10,11,12}C) at the FRS — •Rinku Prajapat for the BARB- and Super-FRS Experiment-Collaboration — GSI, Darmstadt, Germany — Saint Mary's University, Halifax, Canada

The advancement of production techniques to access unstable nuclei far from the stability line has resulted in the discovery of many exotic nuclei characterized by short half-lives and an unusual neutron-to-proton ratio. Such nuclei are of particular interest in fundamental and applied physics. For instance, measurement of interaction cross-section (σ_I) is essential for the deduction of the interaction radii and input in treatment planning programs for radiotherapy with heavy-ions such as ^{12}C. However, the case of positron emitters (^{10,11}C) is of special interest in ion beam therapy owing to their potential application in range verification in patients directly. Thus, an experiment has been performed at GSI Darmstadt to produce and separate the fragments (^{10,11}C) of interest using the in-flight fragment separator and spectrometer FRS. The aim of the experiment was to measure the interaction and charge-changing cross-sections of ^{10,11,12}C nuclei on a carbon interaction target at therapeutically relevant energies. The measurements were done with the transmission method, which means that the unreacted part of the beams is being analyzed using the FRS magnetic spectrometer. In this contribution, the experimental overview, data analysis, together with the preliminary results will be presented. This work is supported by ERC Advanced Grant 883425 (BARB) and performed within the Super-FRS Experiment Collaboration framework of the FAIR Phase-0.

HK 26.5 Tue 18:45 HBR 14: HS 4

Halo-EFT description of one-neutron halo nuclei with core excitation — •Live-Palm Kubushishi — Johannes Gutenberg-Universität Mainz, Germany

Halo nuclei are fascinating short-lived nuclear systems found near the driplines. In standard reaction models, halo nuclei are usually described as an inert core with one or two weakly bound nucleons. However, some breakup data suggest that the dynamics of the reaction is influenced by the excitation of the core to its excited states in a significant way. Halo-EFT has been shown to give a good description of halo nuclei within reaction models. Accordingly, we extend it to include core excitation considering a rigid-rotor model of the core. As a study case, we take the ^{11}Be which is a typical one-neutron halo nucleus. Its core deformation is then treated at the first order of perturbations to include effectively the 2^+ excited state of ^{10}Be in the description of ^{11}Be. We perform a coupled-channels study of the bound states of ^{11}Be where the low energy constants are fitted to reproduce an *ab initio* calculation. For the ground state, the inclusion of core excitation allows us to better reproduce the *ab initio* predictions (wavefunction and phaseshift). In contrast, for the first excited state, core excitation does not have much influence on the calculations, confirming that this is a shell model state. This simple few-body model will enable us to study the influence of core excitation in nuclear reactions. It will also provide a better understanding of the complicated *ab initio* results.

HK 27: Instrumentation VI

Time: Tuesday 17:30–19:00 Location: HBR 19: C 1

Group Report HK 27.1 Tue 17:30 HBR 19: C 1

The $\overline{\text{P}}$ANDA Luminosity Detector — •René Hagdorn[1], Niels Boelger[1], Stephan Bökelmann[1], Achim Denig[2], Florian Feldbauer[1], Miriam Fritsch[1], Roman Klasen[1], Heinrich Leithoff[2], Jinxin Li[1], Stephan Maldaner[1], Christof Motzko[3], Jannik Petersen[2], and Gerhard Reicherz[1] for the PANDA-Collaboration — [1]Ruhr-Universität Bochum — [2]Johannes-Gutenberg-Universität Mainz — [3]Helmholtz-Institut Mainz

The $\overline{\text{P}}$ANDA experiment is primarily focused on hadron spectroscopy. It will be situated at the FAIR accelerator complex, currently under construction in Darmstadt. In order to determine the cross sections of occurring processes a precise knowledge of the luminosity is crucial. The luminosity will be measured with the Luminosity Detector. This detector is a tracking detector, which provides the angular distribution of the tracks of elastically scattered antiprotons at small scattering angles. This way, a precision of $< 5\,\%$ for the absolute time-integrated luminosity can be reached.

The detector consists of four layers of silicon pixel sensors (HV-MAPS) which combine the sensitive detection area and the readout electronics on the same chip. The sensors are glued to both sides of CVD-diamond carriers and mounted to a movable holding structure. To prevent disturbances of the primary beam the whole setup is operated in vacuum, introducing the need of an active cooling system.

The concept of the luminosity determination at $\overline{\text{P}}$ANDA is explained and the detector components including the sensor modules, cooling system, vacuum control, and data acquisition system are presented.

HK 27.2 Tue 18:00 HBR 19: C 1

Simulation and analysis of pixel cluster shapes in the ALPIDE monolithic active pixel sensor — •Fabian Königstein for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg, Germany

The ALPIDE chip, a CMOS Monolithic Active Pixel Sensor (MAPS), is the key component of the currently operating ALICE inner tracking system (ITS2). The ITS2 features good spatial resolution and detection efficiency, excelling at reconstruction of primary and secondary vertices, as well as detection of low momentum particles. ALPIDE is a digital sensor, meaning that only binary information is recorded about the passing of a particle: either a pixel records sufficient ionization charge or not. No information about the mass or energy or velocity of the particle is available. The possibility of involving the ITS2 deeper in particle identification, improving the overall performance is investigated. In this work I explore the possibility of using groups of pixels which recorded a hit, a so called pixel cluster, for rudimentary particle identification. For this, I utilize a simple theoretical model to simulate the charge diffusion and drift in ALPIDE sensors and to understand how they affect the pixel cluster properties. The model is tuned to data recorded during ALPIDE beam test campaigns. Additionally, data for different particle species is compared to the corresponding simulation result to verify the simple model.

HK 27.3 Tue 18:15 HBR 19: C 1

Simulations for the MIMOSIS-1 CMOS Monolithic Active Pixel Sensor — •Hasan Darwish for the CBM-MVD-Collaboration — Goethe University Frankfurt

MIMOSIS is a CMOS Monolithic Active Pixel Sensor designed to be used for the Micro Vertex Detector (MVD) of the future CBM experiment at FAIR in Darmstadt. The 50 um thick sensor featuring 1024 x 504 pixels with a pitch of 27 x 30 um will have to combine a spatial resolution of ~ 5 um with a time resolution of 5 us and provide a peak rate capability of 80 MHz/cm^2. Simulations have been done for the first prototype, MIMOSIS-1, using Allpix-squared simulation software. The simulations aim to reproduce the findings obtained in the sensor beam tests at DESY, COSY and CERN. The simulations as well as the reference data will be presented. *This work has been supported by BMBF (05P21RFFC2), HFHF, GSI, HGS-HIRe and Tangerine.

HK 27.4 Tue 18:30 HBR 19: C 1

Shower Shape Studies with EPICAL-2 — •Jan Schöngarth — Institut für Kernphysik, Goethe Universität Frankfurt

The EPICAL-2 detector has been designed and constructed within the endeavour to develop a novel electromagnetic calorimeter based on a SiW sampling design using silicon pixel sensors with binary readout. The R&D is performed in the context of the proposed Forward Calorimeter upgrade within the CERN-ALICE experiment and is strongly related to proton CT imaging studies as well as applicable to future collider projects.

EPICAL-2 consists of alternating W absorber and Si sensor layers employing the ALPIDE sensor developed for the ALICE-ITS upgrade. It has a total thickness of 20 radiation lengths, an area of 30 mm * 30 mm, and 25 million pixels of size $\sim 30 * 30\ \mu m^2$. EPICAL-2 has been successfully tested with cosmic muons as well as in test-beam campaigns at DESY and CERN-SPS. Monte Carlo simulations have been performed using Allpix^2, a generic simulation framework for semiconductor detectors.

In this talk, an overview of the detector response in data and simulation, using different energy proxies, namely the number of pixel hits, clusters or charged shower particles per event, is given. In addition, a study of the electromagnetic shower shape including a 2D-parametrization of lateral density profiles is presented.

Supported by BMBF and the Helmholtz Association.

HK 27.5 Tue 18:45 HBR 19: C 1

First experimental time-of-flight based proton radiography — •Felix Ulrich-Pur[1], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Vadym Kedych[3], Yevhen Kozymka[3], Wilhelm Krüger[3], Sergey Linev[1], Jan Michel[1], Jerzy Pietraszko[1], Adrian Rost[6], Christian Joachim Schmidt[1], Michael Träger[1], and Michael Traxler[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [2]Austrian Academy of Sciences, Institute of High Energy Physics — [3]Technische Universität Darmstadt — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]FAIR Facility for Antiproton and Ion Research in Europe GmbH

Low Gain Avalanche Detectors (LGADs) are silicon-based detectors especially designed for high luminosity environments. Due to their excellent 4D-tracking properties, LGADs allow single particle tracking with high spatial and time precision even at high track densities.
One application that could particularly benefit from this high rate capability is ion computed tomography (iCT), an imaging modality aiming at the improvement of treatment planning quality in ion beam therapy. Building an iCT system based on LGADs, would not only help to address the rate limitations of current iCT prototype scanners, but it would also allow to integrate time-of-flight measurements into the imaging process itself, also referred to as TOF-iCT.
In this contribution, we will present our development efforts towards a TOF-iCT system based on LGADs and show the first experimental TOF-based proton radiography recorded at MedAustron.

HK 28: Instrumentation VII

Time: Tuesday 17:30–19:00 Location: HBR 19: C 2

Group Report HK 28.1 Tue 17:30 HBR 19: C 2

τSPECT - a magnetic storage bottle for measuring the puzzling free neutron lifetime — •Noah Yazdandoost[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry - TRIGA site, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, JGU Mainz, Mainz, Germany — [3]Paul Scherrer Institut, Villigen PSI, Switzerland

The free neutron lifetime holds significance in understanding the production of light elements in the early universe and in determining the matrix element V_{ud} within the quark mixing matrix, which can be used to probe the Standard Model of Particle Physics. Previous measurements of the free neutron lifetime using two distinct methods have yielded incompatible results, emphasizing the need for a complementary approach.

In response, the τSPECT experiment offers a unique approach to measure the free neutron lifetime. The spin of neutrons, with kinetic energies in the nanoelectronvolt range, is flipped while filling those neutrons into τSPECT's storage volume. The neutrons are confined solely by the magnetic interaction, which minimizes systematic uncertainties by eliminating interactions between stored neutrons and wall atoms, providing a more reliable measurement of the neutron lifetime.

This presentation provides a overview of the τSPECT experiment. It will showcase data from the commissioning phase conducted at the TRIGA research reactor in Mainz, followed by the presentation of the latest data obtained after relocating the experiment to the Paul Scherrer Institute in Switzerland.

HK 28.2 Tue 18:00 HBR 19: C 2

Development of an improved adiabatic spin flipper unit 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

To measure the free neutron lifetime the τSPECT experiment stores ultracold neutrons (UCN) using magnetic field gradients. High-field-seeking (HFS) neutrons can overcome higher magnetic potentials whereby low-field-seeking neutrons (LFS) loose kinetic energy when moving to higher magnetic fields. Therefore, the magnetic trap of τSPECT is filled by flipping the spin of HFS neutrons transforming them to the LFS state. For the spin flip an adiabatic fast passage spin flipper unit (SFU) is used which consists of a coil producing a radiofrequency field resonant with the neutron spin precession frequency. The radiofrequency field is perpendicular to the main magnetic field and the neutron spin precession frequency is made position dependent by a small magnetic gradient. With a second SFU UCNs with higher kinetic energies, available in larger numbers, can be made storable. In the next generation of this SFU optimisations are implemented to increase the efficiency of the double spin flip. The optimised design must combine challenging constraints like little available space, cryogenic temperatures and ultra high vacuum compatibility.

This talk will show simulations and first tests on possible spin flipper designs as well as the current status of the development.

HK 28.3 Tue 18:15 HBR 19: C 2

A Multidirectional Magnetic Holding Coil for ELSA — •Victroia Lagerquist and Hartmut Dutz for the CBELSA/TAPS-Collaboration — University of Bonn

The current physics program at ELSA includes the ability to measure either transverse or longitudinal polarization observables through the use of dedicated, single purpose, internal magnetic holding coils. However, the process of changing between these coils requires significant effort and extensive downtime. We propose a single, combined, multi-directional coil which enables polarization at an arbitrary angle without the need for a physical configuration change. This combined coil has been optimized to a comparable efficiency and material budget as each of the original individual coils. I will present the current status of this ongoing project.

HK 28.4 Tue 18:30 HBR 19: C 2

Commissioning of TARLA Injector Line — Abdullah Burkan Bereketoglu[2,3], •Kutlu Kagan Sahbaz[1,3], and Veli Yildiz[3] — [1]Ankara University, Ankara, Turkey — [2]Middle East Technical University, Ankara, Turkey — [3]Turkish Accelerator & Radiation Laboratory, Ankara, Turkey

Turkish Accelerator & Radiation Laboratory (TARLA) is a Free Electron Laser (FEL) facility that is under construction in Ankara, Türkiye. The TARLA electron linac is composed of a 250 keV thermionic electron gun, an injector line with two buncher cavities and two cryomodules containing two 1.3 GHz superconducting TESLA cavities. The electron bunches generated in the electron gun are compressed in the injector line first with a subharmonic buncher (260 MHz) and then with a fundamental bunchar (1.3 GHz) down to 10 ps (σt). The first cryomodule accelerates the beam up to around 20 MeV. The bunch compressor located between the two cryomodules compresses the bunch further down to 0.3 ps (σt). After the bunch compressor, the beam is further accelerated up to 40 MeV using the second cryomodule. The 40 MeV electron beam will be used to produce infrared (IR) laser and bremsstrahlung radiation. The installation of TARLA injector was completed in October 2023 and the beam commissioning was performed in December 2023. In this contribution, the result of the injector beam commissioning will be presented together with the beam dynamics simulations performed for the preparation of the beam tests.

HK 28.5 Tue 18:45 HBR 19: C 2

Ionoacoustic detection of swift heavy ions — •Leon Kirsch[1,2,3], Walter Assmann[1], Sonja Gerlach[1], Anna-Katharina Schmidt[1], Markus Bender[2,4], Katia Parodi[1], Jörg Schreiber[1], and Christina Trautmann[2,3] — [1]Ludwig-Maximilians-Universität München — [2]GSI Helmholtzzentrum — [3]Technische Universität Darmstadt — [4]Hochschule RheinMain, Rüsselsheim

The characteristics of the ionoacoustic detectors were investigated at the SIS18 synchrotron at GSI using Xe, Pb and U ions of energies up to 1 GeV/u [1]. Microsecond-pulsed ion beams stopped in water generate an ultrasonic pressure pulse, which can be detected by a piezoelectric transducer. The analysis of the signal in time and frequency domain allows us to locate the initial position of the ion bunch in 3D space as well as to determine the range and thus the ion energy to an accuracy of 1 %. Over a wide intensity range, the signal amplitude has a linear correlation with the beam intensity. Inserting a target into the ion beam yields precise information on the energy-loss. Combined with their exceptional radiation hardness, ionoacoustic detectors hold tremendous potential as ion beam monitors for upcoming high-energy and high-intensity heavy ion facilities. In fact, they could even serve as a promising 'second generation' Faraday cup.

This work has been supported by GSI as part of the R&D project GSI-LMASS1821 with the Ludwig-Maximilians-Universität München.

[1] L. Kirsch, et al., Nucl. Instrum. Methods Phys. Res., Sect. A 1057 (2023), 168755

HK 29: Instrumentation VIII

Time: Tuesday 17:30–19:00 Location: HBR 19: C 5a

Group Report HK 29.1 Tue 17:30 HBR 19: C 5a

Further development of the planar GEM detectors for AMBER — •Jan Paschek[1], Karl Flöthner[1,3], Dimitri Schaab[1], Michael Lupberger[1,2], Igor Konorov[4], Pascal Henkel[1], Paul Clemens[1], and Bernhard Ketzer[1] — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Universität Bonn, Physikalisches Institut, Bonn, Germany — [3]GDD, CERN, Geneva, Switzerland — [4]Technische Universität München, Physik-Department, Garching, Germany

AMBER is a new experiment at CERN's SPS studying fundamental questions of hadron physics using high-energy muon, pion, kaon and proton beams. It successfully concluded its first physics beam time in 2023, yielding valuable input for dark matter searches by measuring the production cross section of antiprotons impinging on helium. This study will be extended in 2024. In 2025, a first measurement of the proton electric form factor is scheduled, using elastic muon-proton scattering. New large-size planar GEM detectors are essential for the tracking of particles with small scattering angles. While for the antiproton production measurements, the new detectors will be operated with triggered readout electronics (APV25), the measurement of the proton form factor requires the application of a self-triggering chip (VMM3a). Extensive tests were performed on the noise performance with both readout variants. A full prototype detector read out by 48 VMM3a chips was tested in a pilot run in 2023. Also other new features of the new detectors are being studied. This presentation aims to provide a comprehensive overview of AMBER's new GEM detectors.

HK 29.2 Tue 18:00 HBR 19: C 5a

Characterization of a prototype GEM detector with VMM3a readout at AMBER — •Pascal Henkel[1], Michael Lupberger[1], Martin Hoffmann[1], Karl Jonathan Flöthner[1,3], Virginia Klapper[1], Jan Glowacz[2], and Bernhard Ketzer[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik der Universität Bonn, Germany — [2]Physikalisches Institut der Universität Bonn, Germany — [3]CERN, Geneva, Switzerland

The AMBER experiment is a new fixed-target experiment at CERN's M2-beamline which started data taking in 2023 and intends to answer fundamental questions in the field of hadron physics. One important experiment in phase-1 of AMBER is the measurement of the proton charge radius by muon-proton elastic scattering. GEM detectors will be used to reconstruct scattered-muon trajectories and momenta. The experimental setup requires a continuously streaming readout of all detectors. Current plans are to use a readout system based on the VMM3a ASIC as GEM frontend chip, featuring a continuous self-triggered data aquisition.

In September 2023, data were taken under realistic AMBER beam conditions using a prototype large-size triple-GEM detector with continuous VMM3a readout. In this contribution, we will present the ongoing data analysis aiming at finding a stable working point of the detector fulfilling the requirements of the experiment. This involves characterizing the detector in terms of efficiency, signal-to-noise ratio, position and time resolution.

Group Report HK 29.3 Tue 18:15 HBR 19: C 5a

Production status of the CBM Transition Radiation Detector — •Philipp Kähler for the CBM-Collaboration — 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.

We report on the production process of the high-rate multi-wire proportional chambers for the TRD, which has been started with a first batch of 32 MWPCs with outer dimensions of 960 mm x 960 mm, each equipped with 3 456 read-out channels on the segmented cathode pad-plane. The complete TRD will feature 216 MWPCs with 329 728 channels in total. First-of-series test results will be shown and discussed.

This work is supported by BMBF grants 05P21RFFC1 and 05P21PMFC1.

HK 29.4 Tue 18:45 HBR 19: C 5a

Commissioning of the First Gas System Line for the CBM-TRD — •Fidorra Felix for the CBM-Collaboration — Institut für Kernphysik, Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment which is currently under construction at FAIR, GSI Darmstadt. It will explore the QCD phase diagram at high net-baryon densities. The Transition Radiation Detector (TRD) of the CBM experiment is based on Multi Wire Proportional Chambers (MWPCs) filled with Xe/CO2 85:15 as detector gas. This talk reports on the commissioning of the first regulated line of the gas system for the CBM-TRD. During operation, the gas flow through the chambers has to be regulated such that the relative pressure in the detector volume stays within -0/+1 mbar. To ensure the gas quality, also continuous monitoring of O_2, CO_2 and H_2O content will be included. A part of the gas system, as, e.g., the main regulation valves, the circulation pump and the PLC layer will be located in a service level above the experiment. The first gas line, including already the final tube lengths has been set up in the laboratories in Münster for characterisation of, e.g., the timing characteristics of the pressure control and for commissioning. This talk will be about the concept, the construction, the operation status of the gas system and a tightness measurement of the first final TRD MWPC. This work is supported by BMBF grant 05P21PMFC1.

HK 30: Structure and Dynamics of Nuclei VII

Time: Tuesday 17:30–19:15 Location: HBR 19: C 5b

Group Report HK 30.1 Tue 17:30 HBR 19: C 5b

Absolute electromagnetic transition rates in semi-magic N = 50 isotones as a test for $(\pi g_{9/2})^n$ single particle calculations. — Mario Ley[1], •Jan Jolie[1], Arwin Esmaylzadeh[1], Andreas Harter[1], Lukas Knafla[1], Aaron Pfeil[1], Andrey Blazhev[1], Christoph Fransen[1], Jean-Marc Regis[1], and Piet Van Isacker[2] — [1]Institut fuer Kernphysik, Universitaet zu Koeln, Zuelpicher Str. 77, D-50937 Koeln, Germany — [2]GANIL, Bvd. Henri Becquerel, F-14076 Caen, France

Single-j calculations for $(j)^n$ configurations with n = 3,..,2j+1 can be performed using a semi-empirical approach, provided that the energies and absolute electromagnetic transition rates are known for the two-particle (hole) nucleus. This approach was already successfully applied in the case of protons in the $(\pi h_{9/2})^3$ nucleus ^{211}At [1]. At the Cologne Tandem Accelerator of the Institute for Nuclear Physics we have tested these relations by measuring lifetimes of excited states in the $(\pi g_{9/2})^n$ isotones with N = 50. We started the studies in the two-proton nucleus ^{92}Mo where the previously unknown B(E2:$4^+_1 \rightarrow 2^+_1$) value, was measured with high precision using the electronic $\gamma-\gamma$ fast timing technique [2]. Subsequently we applied the same technique in ^{93}Tc and ^{94}Ru [3]. Work supported by DFG Grant JO391/18-1.

[1] V. Karayonchev, *et al.*, Phys. Rev. C 106, 044321 (2022). [2] M. Ley, L. Knafla, J. Jolie, A. Esmaylzadeh, A. Harter, A. Blazhev, C. Fransen, A. Pfeil, J.-M. Regis, P. Van Isacker, accepted for publication in Phys. Rev. C (2023). [3] M. Ley, *et al.*, to be submitted to Phys. Rev. C.

HK 30.2 Tue 18:00 HBR 19: C 5b

Coulomb excitation of ^{124}Te: persisting seniority structure in the 6^+_1 level — •Martha Reece[1,2], Ben Coombes[2], AJ Mitchell[2], Andrew Stuchbery[2], Greg Lane[2], Angela Gargano[3], Nathan Spinks[2], and Jack Woodside[2] — [1]GSI, Darmstadt, Germany — [2]ANU, Canberra, Australia — [3]INFN, Napoli, Italy

A new research program at the Australian Heavy Ion Accelerator Facility is examining the nature of near-spherical nuclei using Coulomb-excitation measurements. To facilitate these measurements, a new silicon photodiode particle detector system has been developed and integrated into the CAESAR array of Compton-suppressed γ-ray detectors. The first experiments studied ^{124}Te, a nucleus that lies in a transitional region between single-particle and collective behaviour just beyond the Z = 50 proton shell. The value $B(E2; 6^+_1 \rightarrow 4^+_1) = 25(7)$ W.u. was measured for the first time in this nucleus; this is significantly below the collective limits of the previously proposed spherical-vibrator and triaxial-rotor models. The experimental results are compared to shell-model calculations for $^{120-128}$Te, which show remarkable agreement for the known $B(E2; 6^+_1 \rightarrow 4^+_1)$ values. It appears that, despite approaching mid-shell, ^{124}Te retains single-particle structure in the 6^+_1 level. This is in contrast to other $B(E2)$ values in ^{124}Te, and neighboring ^{120,122}Te, in which collectivity becomes enhanced as more neutrons are removed.

HK 30.3 Tue 18:15 HBR 19: C 5b

Shell-Model calculations for masses and β-decay half-lives near $N = 50$ — •Zafar Iftikhar[1,2,3], Gabriel Martínez-Pinedo[1,2,4], Thomas Neff[1], Riccardo Mancino[2,1], and Frédéric Nowacki[5] — [1]GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany — [2]Institut für Kernphysik (Theoriezentrum), Department of Physics, Technische Universität Darmstadt, D-64298 Darmstadt, Germany — [3]FATA University, FR Kohat 26100, Khyber Pakhtunkhwa, Pakistan — [4]Helmholtz Forschungsakademie Hessen für FAIR, GSI Helmholtzzentrum für Schwerionenforschung, D-64291 Darmstadt, Germany — [5]Institut Pluridisciplinaire Hubert CURIEN (IPHC), Strasbourg 67200, France

The doubly magic ^{78}Ni was recently investigated at RIBF, revealing competing spherical and deformed configurations. Due to limited experimental data in this neutron-rich region, one has to rely on theoretical calculations for masses and β-decay half-lives. We perform shell-model calculations for β-decay half-lives with $pf-sdg$ model space for protons and neutrons (required by the unnatural parity states and Gamow-Teller transitions). We use an effective interaction adjusted to reproduce the experimental data around ^{78}Ni and the measured half-lives. We also report the calculated S_{2n} for the isotopic chains of Z=22−30 with $N = 40 - 52$.

ZI is supported by FATA University, Pakistan. GMP is supported by Deutsche Forschungsgemeinschaft- Project-ID 279384907 SFB1245. RM is supported by SFB1245.

HK 30.4 Tue 18:30 HBR 19: C 5b

Lifetime measurements of excited states in the doubly magic nucleus ^{40}Ca using the Doppler-Shift-Attenuation-Method — •Timon Sültenfuss, Maximilian Droste, Peter Reiter, Anna Bohn, Ramona Burggraf, Hannah Kleis, and Sarah Prill — Institute for Nuclear Physics, University of Cologne

Lifetimes of excited states in the doubly magic nucleus ^{40}Ca were measured at the FN tandem accelerator of the University of Cologne. Excited states were populated using a ^{40}Ca(p, p' γ) reaction at a beam energy of 15 MeV. The detector array SONIC@HORUS, consisting of 12 silicon and 14 HPGe detectors, was used to detect scattered protons and emitted γ-rays in coincidence. Lifetimes of yrast states in ^{40}Ca have been determined using the Doppler-Shift-Attenuation Method. To perform a lineshape analysis the APCAD code [1] was employed. The resulting new lifetimes reduce the experimental uncertainty significantly with respect to the evaluated lifetimes. Comparison of the new lifetime values with shell-model calculations will be discussed.

[1] C. Stahl et al., Comput. Phys. Commun. 214 (2017) 174-198

HK 30.5 Tue 18:45 HBR 19: C 5b

Lifetime measurement in ^{214}Rn applying the Fast-Timing method — •Martin von Tresckow for the IFIN-HH-214Rn-Collaboration — Institut für Kernphysik, TU Darmstadt

^{214}Rn is in the vicinity of the ^{208}Pb closed core and different theoretical calculations are recently published in this region, based on the independent particle model or taking into account short-range nucleon-nucleon correlations, such as α-clustering. α-clustering may have an important role in the description of the structure of ^{214}Rn due to our results in the isotope with two protons less, ^{212}Po, [Ma. von Tresckow et al., PLB 821, 136624 (2021)] and the large α-decay width of the ground state of ^{214}Rn. However the experimental transition strengths of the low lying yrast-states aren't well known and a comparison to theory predictions is not conclusive. Therefore, we performed in June 2023 a fusion-evaporation experiment to investigate excited states of ^{214}Rn and determine the lifetimes applying the Fast-Timing method. The experiment was performed at the ROSPHERE γ-ray detector array at IFIN-HH in Magurele, Romania.

I will present the current state of the lifetime analysis.

This work is financially supported by EUROLABS and by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) via grant 05P21RDFN1.

HK 30.6 Tue 19:00 HBR 19: C 5b

Gamma-ray spectroscopy of the neutron-rich ^{55,57,59}Sc isotopes — •R. Zidarova[1], M. L. Cortés[2], V. Werner[1], P. Koseoglou[1], N. Pietralla[1], P. Doornenbal[2], A. Obertelli[1], T. Otsuka[3], Y. Tsunoda[3], and Y. Utsuno[3,4] for the SEASTAR3-Collaboration — [1]IKP, TU Darmstadt, Darmstadt, Germany — [2]RIKEN Nishina Center, Wako, Saitama, Japan — [3]Center for Nuclear Study, University of Tokyo,Tokyo, Japan — [4]Advanced Science Research Center, Japan Atomic Energy Agency, Ibaraki , Japan

Experimental data have shown that far from the valley of stability new magic numbers can emerge and the traditional ones can disappear. In particular, two new magic numbers at N=32 and N=34 have been suggested in the vicinity of Z=20 based on γ-ray spectroscopy and mass measurements in Ar, Ca and Ti isotopes. In order to assess the impact of a single valence proton outside of the Z=20 shell on the shell-evolution mechanism in this region, it is necessary to study the neutron-rich Sc isotopes around, and even beyond, neutron number N=34. Investigation of exotic nuclei in this region was the goal of the third SEASTAR campaign at RIKEN-RIBF. Neutron-rich isotopes in the vicinity of ^{53}K were produced by fragmentation of a primary ^{70}Zn beam on a ^{9}Be target. Known and new γ-ray transitions of the isotope ^{55}Sc were observed and γ-rays from ^{57,59}Sc were identified for the first time. γ-ray spectra together with proposal for level schemes will be presented and compared to calculations in the framework of the SPDF-MU shell model.

Supported by BMBF under Grant No. 05P21RDFN9.

HK 31: Nuclear Astrophysics II

Time: Tuesday 17:30–19:00 Location: HBR 19: C 103

Group Report HK 31.1 Tue 17:30 HBR 19: C 103

Quark-hadron phase transition in neutron star cooling — •Melissa Mendes[1,2], Jan-Erik Christian[3], Farrukh Fattoyev[4], Andrew Cumming[5], Jürgen Schaffner-Bielich[6], and Charles Gale[5] — [1]Technische Universität Darmstadt, Germany — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum fu*r Schwerionenforschung GmbH, Germany — [3]Universität Hamburg, Germany — [4]Manhattan College, United States — [5]McGill University, Canada — [6]Goethe-Universität, Frankfurt, Germany

The study of neutron stars has proved complex, both from a theoretical point of view as well as from an observational one. Nonetheless, major advances have been achieved lately with research initiatives, such as NICER and LIGO, which provided relevant constraints to the nuclear equation of state (EOS) with astronomical observations. We give a brief overview of the state-of-the-art data constraints to the neutron star EOS and introduce the possibility of constraining these EOS even further with neutron star temperature measurements. We claim that investigating the cooling of already cold neutron stars is crucial for a better understanding of the nuclear EOS, in particular regarding the existence of a possible quark-hadron phase transition. In this talk, we describe the cooling signature of a quark phase in neutron star temperature evolution considering quark-hadron hybrid equations of state with a first-order phase transition. We compare our calculations with current neutron star luminosity data and obtain estimates for phase transition density. MM funded by the ERC Grant Agreement No. 101020842.

HK 31.2 Tue 18:00 HBR 19: C 103

Generating ultra compact boson stars with modified scalar potentials — •Sarah Louisa Pitz and Jürgen Schaffner-Bielich — Goethe Universität, Frankfurt am Main, Deutschland

The properties of self-interacting boson stars with different scalar potentials going beyond the commonly used ϕ^4 ansatz are studied. The scalar potential is extended to different values of the exponent n of the form $V \propto \phi^n$. Two stability mechanism for boson stars are introduced, the first being a mass term and the second one a vacuum term. In this talk analytic scale-invariant expressions for these two classes of equations of state are presented. The resulting properties of the boson star configurations differ considerably from previous calculations. The maximal compactness can reach extremely high values going to the limit of causality $C_{\max} = 0.354$ asymptotically for $n \to \infty$. The maximal compactnesses exceed previously calculated values of $C_{\max} = 0.16$ for the standard ϕ^4-theory and $C_{\max} = 0.21$ for vector-like interactions and is in line with previous results for solitonic boson stars. Hence, boson stars even described by a simple modified scalar potential in the form of $V \propto \phi^n$ can be ultra compact black hole mimickers where the photon ring is located outside the radius of the star.

HK 31.3 Tue 18:15 HBR 19: C 103

Hyperons in binary neutron star mergers — •Hristijan Kochankovski[3], Sebastian Blacker[1,2], Andreas Bauswein[2,4], Angels Ramos[3], and Laura Tolos[5] — [1]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64291 Darmstadt, Germany — [3]epartament de Fisica Quàntica i Astrofisica and Institut de Ciències del Cosmos, Universitat de Barcelona, Mart** i Franquès 1, 08028, Barcelona, Spain — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Darmstadt, 64291 Darmstadt, Germany — [5]Institute of Space Sciences (ICE, CSIC), Campus UAB, Carrer de Can Magrans, 08193 Barcelona, Spain

The coalescence of a neutron star binary system is an ideal situation for studying extremely dense and hot matter. It is possible that exotic species like hyperons exist in these extreme conditions. In this talk, I will discuss how the appearance of hyperons affects the equation of state and, in turn, what kind of signatures they can leave in the observables that are measured from astrophysical phenomena. I will pay close attention to the signatures originating from the thermal behavior of hyperons in matter. The thermal pressure significantly decreases when hyperons are present. As a result, in comparison to purely nucleonic EoS models, this effect causes a characteristic increase of the dominant postmerger gravitational-wave frequency by as much as 150 Hz.

HK 31.4 Tue 18:30 HBR 19: C 103

Nuclear Matter Equation of State from Delta-full Chiral Interactions — •Yannick Dietz[1,2], Jonas Keller[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

We report results for infinite homogeneous nuclear matter calculations for the energy per particle and pressure at zero and finite temperature using Delta-full interactions based on chiral effective field theory. Our computations are carried out in many-body perturbation theory, where we include nucleon-nucleon and three-nucleon forces up to third order. Our results at zero temperature are consistent with previous studies of the equation of state based on Delta-less chiral potentials and lead to an improved convergence of uncertainty of the energy per particle.

This work was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245.

HK 31.5 Tue 18:45 HBR 19: C 103

γ-ray angular distribution of the ^{2}H$(p,\gamma)^3$He reaction studied at Felsenkeller lab — •Till Lossin[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Antonio Caciolli[3,4], Eliana Masha[1], Konrad Schmidt[1], Steffen Turkat[2], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden — [3]INFN Sezione di Padova, Italy — [4]Università degli Studi di Padova, Italy

The ^{2}H$(p,\gamma)^3$He reaction is one of the main destruction channels of deuterium (^{2}H) during Big Bang Nucleosynthesis (BBN) and sensitively affects the primordial ^{2}H abundance found at the end of BBN. Its cross section has recently been measured precisely at LUNA, using a large detector at 90° angle. Here, we report on preliminary data from a measurement of the γ-ray angular distribution of this reaction in the proton beam energy range 300-1200 keV. The experiment has been carried out at the Felsenkeller 5 MV shallow-underground accelerator lab in Dresden. The preliminary data are compared with *ab initio* calculated angular distributions.

HK 32: Heavy-Ion Collisions and QCD Phases VI

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 03

Group Report HK 32.1 Tue 17:30 HBR 62: EG 03

Non-perturbative insights into the spectral properties of QCD within the chiral crossover region — •Peter Lowdon[1], Owe Philipsen[1], Olaf Kaczmarek[2], Dibyendu Bala[2], and Tristan Ueding[2] — [1]Institut für Theoretische Physik, Goethe-Universität, Germany — [2]Fakultät für Physik, Universität Bielefeld, Germany

Determining the type of excitations that can exist in a thermal medium is key to understanding how hadronic matter behaves at extreme temperatures. Here I report on a recent approach which utilises the non-perturbative constraints imposed by causality. By analysing finite-temperature lattice QCD data for spatial correlators of pseudo-scalar mesons comprised of light-light, light-strange, and strange-strange quarks, we find evidence for the existence of distinct low-energy stable particle-like excitations, so-called thermoparticles. These excitations are shown to be present around the chiral crossover region, and correspond to the collisionally-broadened vacuum ground states, which for the light-light and light-strange channels are the pion and kaon. Over-

all, these findings suggest that at high temperatures light pseudo-scalar mesons in QCD still have a bound-state-like structure.

HK 32.2 Tue 18:00 HBR 62: EG 03

Spectral Reconstruction with Gaussian Process Regression — •Jonas Turnwald[1], Julian M. Urban[2,3], and Nicolas Wink[1] — [1]Institut für Kernphysik, Technische Universität Darmstadt — [2]Center for Theoretical Physics, Massachusetts Institute of Technology — [3]The NSF AI Institute for Artificial Intelligence and Fundamental Interactions

In order to understand the dynamics of QCD, knowledge about non-perturbative real-time correlation functions is necessary. These correlation functions can be accessed by reconstructing the spectral function from Euclidean data. Since this is an ill-conditioned problem, sophisticated techniques are necessary to ensure reliable results.

In this talk, we will present a method facilitating Gaussian Process regression for reconstructing spectral functions. Additionally, we will introduce a Python package that allows for an immediate implementation of this method for different linear inverse problems.

As an illustration, we present the reconstruction of different spectral functions and compute the thermal photon rate of the quark-gluon plasma.

HK 32.3 Tue 18:15 HBR 62: EG 03

Heavy-quark distribution function via a Maximum Entropy approach — •Federica Capellino[1], Andrea Dubla[2], Stefan Floerchinger[3], Eduardo Grossi[4], Andreas Kirchner[5], and Silvia Masciocchi[1,2] — [1]Physikalisches Institut Heidelberg, Heidelberg, Germany — [2]GSI, Darmstadt, Germany — [3]Theoretisch-Physikalisches Institut Universität Jena, Jena, Germany — [4]Università di Firenze, Sesto Fiorentino, Italy — [5]Institut für Theoretische Physik Heidelberg, Heidelberg, Germany

Heavy quarks (i.e. charm and beauty) are powerful tools to characterize the quark-gluon plasma (QGP) produced in heavy-ion collisions. They are initially produced out of kinetic equilibrium via hard partonic scattering processes. In this work, we first show that a fluid-dynamic approach can be applied to study the dynamics of charm quarks in the QGP and describe their relaxation towards kinetic equilibrium. Furthermore, we propose a description of the heavy-quark distribution function out of equilibrium via a Maximum Entropy method. This approach relies on the assumption that the distribution function maximizes a functional of the entropy current in any reference frame and does not require the distribution function to be close to local kinetic equilibrium. This description can be used to construct the momentum distribution of heavy-flavor hadrons at freeze-out, including consistently the impact of out-of-equilibrium corrections on the freeze-out surface.

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

HK 32.4 Tue 18:30 HBR 62: EG 03

Ω_c^0 production in pp collisions at $\sqrt{s} = 13$ TeV with ALICE — •Tiantian Cheng for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Central China Normal University, Wuhan, China

Recent measurements of the production of charm hadrons at midrapidity in pp collisions at $\sqrt{s} = 5.02$ and 13 TeV showed that baryon-to-meson yield ratios are significantly larger than those measured in e^+e^- collisions for different charm-baryon species. These observations suggest that the charm fragmentation fractions are not universal and that the baryon-to-meson ratios depend on the collision systems.

Currently, a significant limitation to measurements of strange-charm baryon Ω_c^0 production is the absence of precise branching ratio (BR) measurements. In this talk, the new measurement of the inclusive p_T-differential cross section times branching ratio of the Ω_c^0 baryon measured in the decay channels $\Omega_c^0 \to \Omega^- e^+ \nu_e$ and $\Omega_c^0 \to \Omega^- \pi^+$ in pp collisions at $\sqrt{s} = 13$ TeV will be reported, together with the fraction $BR(\Omega_c^0 \to \Omega^- e^+ \nu_e)/BR(\Omega_c^0 \to \Omega^- \pi^+)$. The final result will be compared with theoretical calculations and experimental measurements from other Collaborations.

HK 32.5 Tue 18:45 HBR 62: EG 03

Charm quark thermalization in the quark gluon plasma at RHIC — •Rossana Facen for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

Hadrons containing heavy quarks, i.e. charm or beauty, are unique probes to study the properties of the hot and dense QCD medium produced in heavy-ion collisions, the quark-gluon plasma (QGP). Due to their large masses, heavy quarks are produced at the initial stage of the collision, almost exclusively via hard partonic scattering processes. Therefore, they experience the full collision history propagating through the QCD medium and interacting with its constituents. These interactions may lead heavy quarks to thermalize within the QGP. While various evidences supporting the thermalization of charm quarks at the LHC have been collected in recent years, the thermalization process highly depends on the colliding system and energy. In this study we focus on the possible thermalization of charm quarks at RHIC in Au-Au collisions at a center-of-mass energy of $\sqrt{s_{NN}} = 200$GeV. The local thermalization of charm quarks is examined using a fluid-dynamic approach, describing charm quarks as part of the QGP medium itself. The output of our analysis is then compared to the available experimental results of STAR collaboration. This work is funded via the DFG ISOQUANT Collaborative Research Center (SFB 1225).

HK 33: Heavy-Ion Collisions and QCD Phases VII

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 05

Group Report HK 33.1 Tue 17:30 HBR 62: EG 05

Production and fluctuation of protons and light nuclear clusters in Ag+Ag reactions measured by HADES — •Marvin Nabroth for the HADES-Collaboration — Goethe-Universität, Frankfurt, Germany

The HADES (High-Acceptance-Dielectron-Spectrometer) experiment at SIS18/GSI measures the reaction products from heavy-ion collisions at kinetic beam energies around 1A GeV. This allows probing the QCD phase diagram at high net-baryon densities and moderate temperatures. The matter formed in such collisions is believed to reach pressures and temperatures as they are expected to occur in binary neutron star mergers. This group report presents the reconstructed phase space distributions of protons and light nuclei in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55\ GeV$. Furthermore, the focus is put on the analysis of the event-by-event proton (free and bound) multiplicity fluctuations. Covered are techniques for fluctuations analyses based on a Bayesian ansatz (Identity Mehtod), as well as various unfolding methods, employed to account for particle reconstruction inefficiencies. Moreover, the dynamical fluctuations are distorted by the fluctuations of the system size. Hence, a correction procedure that circumvents contributions from the system size fluctuations is also discussed. Higher-order cumulants of net-baryon number distribution are of particular interest as they are sensitive to the vicinity of a phase transition and the potential critical endpoint.

This work has been supported by BMBF (05P21RFFC2), GSI F&E and HFHF.

HK 33.2 Tue 18:00 HBR 62: EG 05

Modeling charged-particle spectra of pp collisions with deep neural networks — •Maria A. Calmon Behling — Institut für Kernphysik, Goethe-Universität Frankfurt

During the data-taking campaigns Run 1 and Run 2 of the Large Hadron Collider (LHC), the ALICE collaboration collected a large amount of proton-proton (pp) collisions across a variety of center-of-mass energies ($\sqrt{s}$). This extensive dataset is well suited to study the energy dependence of particle production. Deep neural networks (DNNs) provide a powerful regression tool to capture underlying multidimensional correlations inherent in the data. In this contribution, DNNs are used to parameterize recent ALICE measurements of charged-particle multiplicity (N_{ch}) distributions and transverse momentum (p_T) spectra. These observables are predicted by means of an ensemble method, extrapolating the measurements towards higher N_{ch} and p_T values as well as to unmeasured $\sqrt{s}$ from 0.5 to 100 TeV. We demonstrate that the predicted p_T spectra can serve as a reference for future heavy-ion measurements, e.g. the O–O campaign planned in LHC Run 3, where no dedicated pp data-taking at the same $\sqrt{s}$ is currently foreseen.

Supported by BMBF and the Helmholtz Association.

HK 33.3 Tue 18:15 HBR 62: EG 05

Determining centrality in heavy-ion collisions measured with HADES - A method suitable to compare experimental data and model predictions — •Simon Spies for the HADES-Collaboration — Goethe-Universität Frankfurt

Centrality is a very important concept for the classification of heavy-ion collisions as it is closely correlated to the amount of nucleons participating in the reaction and therefore the size of the emitting particle source. While in transport models the centrality is perfectly determined by the impact parameter, in experimental data one has to rely on observables like amounts of tracks or detector hits in combination with models to estimate the centrality. Therefore, the centrality classes estimated for experimental data are blurred compared to the actual centrality classes, which results in systematic differences when comparing experimental data with model predictions.
In this contribution we compare the emission of protons and light nuclei from Au+Au collisions at $\sqrt{s_{NN}} = 2.42$ GeV and Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV measured by HADES to state-of-the art transport model predictions. Therefore, we apply a newly developed method to reproduce the centrality classes estimated for experimental data in models to eliminate potential systematic differences from the definition of the centrality class estimation.
This work has been supported by BMBF (05P21RFFC2), GSI, HFHF and the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

HK 33.4 Tue 18:30 HBR 62: EG 05

Measurement of Net-Proton Fluctuations in Pb-Pb Collisions with ALICE — •Ilya Fokin for the ALICE Germany-Collaboration — Physikalisches Institut, 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. Recent results from LQCD suggest that in strong magnetic fields, fluctuations of the baryon number might be increased.

In this talk, measurements of the second-order cumulant of the (anti-)proton and net-proton number in Pb–Pb collisions with the ALICE detector at the LHC are presented. The moments of the net-proton number, which are used as a proxy for the baryon number, are calculated using the Identity Method to avoid the problem of misidentification. The new results cover a larger momentum acceptance and the centrality range than previous ALICE measurements of net-proton fluctuations.

HK 33.5 Tue 18:45 HBR 62: EG 05

Neutral pion production in p+p collisions at 1.58 GeV beam energy with the HADES experiment — •Lena Marie Albohn for the HADES-Collaboration — Justus-Liebig-Universität Gießen

In February 2022 p+p collisions with a kinetic beam energy of 1.58 GeV were recorded with the HADES (High Acceptance DiElectron Spectrometer) experiment at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, Germany. This measurement is important for providing a p+p reference for the Ag+Ag collisions taken at the same energy in 2019. Dielectrons do not interact strongly and are therefore excellent probes for the hot dense phase of particle collisions. The background of the dielectron spectra at low invariant masses is dominated by Dalitz decays of pions and other neutral mesons. Hence the objective of this work is to calculate the multiplicity of neutral pions in p+p collisions through their decay into two photons detected in the electromagnetic calorimeter. The calculation of this multiplicity is done via a multidifferential analysis of the invariant mass spectra of photon pairs, dependent on transverse momentum and rapidity.

HK 34: Heavy-Ion Collisions and QCD Phases VIII

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 18

Group Report HK 34.1 Tue 17:30 HBR 62: EG 18

Real-time methods for critical dynamics — Mattis Harhoff[3], Frederic Klette[3], Patrick Niekamp[1], •Johannes Roth[1], Sören Schlichting[3], Leon Sieke[1], Lorenz von Smekal[1,2], and Yunxin Ye[3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen — [3]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany

In this group report, I will give an overview on the non-perturbative real-time methods we use to study the universal critical dynamics relevant for the chiral transition and the QCD critical point, following our general goal of bringing the phenomenology of heavy-ion collisions closer to the theory of the QCD phase diagram. In addition to the corresponding static universality classes, the relevant universal dynamics is believed to be given by that of a four-component Heisenberg antiferromagnet (Model G, in the classification by Halperin and Hohenberg) and of a single-component fluid (Model H). Our main calculational methods are the functional renormalization group, both directly formulated on the Schwinger-Keldysh contour or analytically continued from Euclidean spacetime, and ab-initio classical-statistical lattice simulations. I will show how our calculated real-time observables such as spectral functions can be used to gain insight into the universal dynamics of QCD matter close to a second-order phase transition.

HK 34.2 Tue 18:00 HBR 62: EG 18

Dynamic critical behavior of the chiral phase transition from the real-time functional renormalization group — •Yunxin Ye[1], Johannes Roth[2], Soeren Schlichting[1], and Lorenz von Smekal[2] — [1]Universitaet Bielefeld, D-33615 Bielefeld, Germany — [2]Justus-Liebig-Universitaet, Heinrich-Buff-Ring 16, 35392 Gießen, Germany

In the chiral limit the complicated many-body dynamics around the second- order chiral phase transition of two-flavour QCD can be understood by appealing to universality. We present a novel formulation of the real-time functional renormalization group that describes the stochastic hydrodynamic equations of motion for systems in the same dynamic universality class, which corresponds to Model G in the Halperin-Hohenberg classification. Our approach preserves all relevant symmetries of such systems with reversible mode couplings. We show that the calculations indeed produce the non-trivial value $z = d/2$ for the dynamic critical exponent, where d is the number of spatial dimensions. From the momentum and temperature dependence of the diffusion coefficient of the conserved charge densities, we extracted the dimensionless universal scaling function.

HK 34.3 Tue 18:15 HBR 62: EG 18

Dynamic critical behavior of the O(4) chiral transition — •Frederic Klette[1], Sören Schlichting[1], and Lorenz von Smekal[2] — [1]Bielefeld University, Bielefeld, Germany — [2]Justus Liebig University, Gießen, Germany

Evidence suggest that in the chiral limit, the QCD phase transition becomes a second order phasetransition in the Op4q universality class. Since real world QCD is not too far from the chiral limit, it is thus interesting to explore the consequences for static and dynamic correlation functions. Since, in the vicinity of the critical point, the physics is governed by universal scaling exponents and scaling functions, we can exploit this universality to address this question. We employ classical-statistical realtime simulations to extract the dynamic critical behavior of an O(4) linear sigma model in the static and dynamic universality class of QCD in the chiral limit. By comparing results for the dynamics with and without a conversed energy and O(4) charges, we can realize the Model A and Model G dynamic universality classes in the classification scheme of Halperin and Hohenberg, for which we compute the dynamic critical exponent z of and further extract the relevant dynamic scaling functions for the spectral function of the order parameter. Furthermore, we explore the intricacies of the dynamics of the charges in model G, focusing on the difference in the diffusive behaviour between vector and axial components, caused by the coupling between axial charges and the O(3) symmetric pion components of the order parameter field.

HK 34.4 Tue 18:30 HBR 62: EG 18

Bayesian inference of quark-gluon plasma transport coefficients from transverse momentum spectra and flow observables — •Rafet Kavak for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Deutschland

Heavy-ion collisions provide a window into the properties of the quark-gluon plasma (QGP), a state of matter in which quarks and gluons are deconfined. Understanding the collective properties of the QGP is possible by comparing models of heavy-ion collisions to experimental measurements of the distribution of particles produced at the end of the collisions. Bayesian inference provides a rigorous statistical framework to constrain the properties of nuclear matter by systematically comparing models and measurements. In this talk, our latest analysis of the experimental data for transverse momentum spectra and flow observables of identified charged hadrons in Pb-Pb and Xe-Xe collisions at the LHC will be presented. Our Bayesian framework is used to constrain transport coefficients of the QGP, such as shear and bulk viscosities, initialization time, and kinetic and chemical freezeout temperatures.

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

HK 34.5 Tue 18:45 HBR 62: EG 18

Description of p_T spectra of pions, kaons and protons in pp, p*Pb, and Pb*Pb collisions at the LHC with Pythia — •Tim Stellhorn and Anton Andronic — Institut für Kernphysik, Universität Münster

PYTHIA is a general-purpose Monte-Carlo event generator which is broadly used to generate high-energetic pp, p-Pb, and Pb-Pb collision events. In this study, p_T spectra resulting from PYTHIA simulations are compared with data from the ALICE experiment at CERN. A particular focus is placed on QGP-like effects such as collective flow which is schematically modelled in PYTHIA via the string shoving mechanism. This model extends the Lund string model by introducing a transverse effect in string interactions in densely populated regions of phase space.

A comparison shows that the MC-generated p_{T} spectra resulting from pp collisions reproduce the ones measured in ALICE within ±30 % depending on p_{T} and particle species. With the string shoving model, the data-model comparison is partially improved but not consistently over p_{T} and particle species. A possible reason for this is an increased multiplicity due to the generation of excitation gluons in string interactions. One should note, that PYTHIA does not include a consistent tune for the string shoving model yet.

HK 35: Hadron Structure and Spectroscopy V

Time: Tuesday 17:30–19:00 Location: HBR 62: EG 19

Group Report HK 35.1 Tue 17:30 HBR 62: EG 19

The study of unconventional baryon structure in the light quark sector with the BGOOD experiment — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The existence of exotic multi-quark states beyond the conventional 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 may suggest a dominant role of meson-baryon dynamics which has an equivalence to the P_C states in the charmed sector. This includes structure in $K^0\Sigma^0$ and $K^+(\Lambda(1405) \rightarrow \pi^0\Sigma^0)$ photoproduction at the K^*Y thresholds.

In the non-strange baryon-baryon sector, coherent meson photoproduction off the deuteron enables access to proposed dibaryon states, including the recently discovered $d^*(2380)$. Our measured differential cross sections at forward angles challenge conventional descriptions of coherent photoproduction, which should be suppressed due to the large momentum transferred to the deuteron.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 35.2 Tue 18:00 HBR 62: EG 19

Search for stable sexaquarks at the LHCb experiment — •Ellinor Eckstein — HISKP, Bonn University

One of the most prominent questions in the astrophysics and particle physics communities is the nature of dark matter (DM).

This talk will give an introduction to the sexaquark (S), a hypothetical particle with *uuddss* quark content, first proposed by Glennys R. Farrar. In contrast to the so called H-dibaryon, sharing the same quark content, the S is assumed to be a tightly bound state. Its unique symmetry structure implies strong binding, thus, a state so low in mass that it is stable on cosmological scales could be possible. Experimental searches to date are not able to rule out such a long lived state. In addition to the S being an excellent DM candidate, it could also shed some light into the $(g-2)$ muon puzzle. As a missing hadronic final state in R measurements, it would narrow the gap between standard model prediction and the experimental value of the anomalous magnetic moment of the muon.

The various predictions regarding requirements the S has to fulfil to be eligible as DM candidate as well as constraints on S DM from astronomical observations and particle physics experiments will be discussed. Further, discovery strategies of the S at the LHCb experiment will be explored, with emphasis on its production in heavy flavoured baryon decays.

HK 35.3 Tue 18:15 HBR 62: EG 19

Hyperon-production in proton-proton collisions at 4.5 GeV with HADES — •Snehankit Pattnaik[1], Johan Messchendorp[1], and James Ritman[1,2] for the HADES-Collaboration — [1]GSI, Darmstadt, Germany — [2]Ruhr-Universität Bochum, Germany

This work presents a preliminary analysis of the $\Lambda + K^0_S + p + \pi^+$ final state in proton-proton scattering using data collected at T = 4.5 GeV with HADES at GSI in Darmstadt, Germany. The production of hyperons is of particular interest since it provides information about the role of N* resonances in strangeness production in NN interactions. Furthermore, this study could be relevant in describing the dynamics of high-density matter such as that located at the core of neutron stars.

This talk will introduce some of the data-driven analysis procedures that have been developed to select the final-state of interest. In particular, a kinematic fitter has been used to efficiently select the signal for this exclusive state. Additionally, the efficiency-corrected Dalitz plot will be discussed.

HK 35.4 Tue 18:30 HBR 62: EG 19

Investigation of the coherent $\gamma d \rightarrow 3\pi^0 d$ photoproduction for hints of dibaryon states — •Richard Volk for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The existence of dibaryon states beyond the deuteron was proposed shortly after the development of the quark model. The recently discovered $d^*(2380)$ in the non-strange sector is a candidate and can possibly be accessed via coherent meson photoproduction off a deuteron, such as $\gamma d \rightarrow 2\pi^0 d$ or $\gamma d \rightarrow 3\pi^0 d$.

The $\gamma d \rightarrow 3\pi^0 d$ channel was measured using the BGOOD photoproduction experiment at ELSA. BGOOD is comprised of a central calorimeter for neutral particle reconstruction and complemented by a magnetic spectrometer in forward directions for charged particle identification.

The $\gamma d \rightarrow 3\pi^0 d$ coherent reaction could be sensitive to intermediate isovector & isoscalar dibaryon candidates. If present, this may be most apparent at forward angles where conventional coherent reaction mechanisms are suppressed due to the large momentum transfer to the deuteron. Using data from BGOOD the reaction is reconstructed using identification techniques for the deuteron in the forward spectrometer and π^0 decays in the central calorimeter.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 35.5 Tue 18:45 HBR 62: EG 19

Photoproduction of Σ^+K^0 off the proton with the CBELSA/TAPS experiment — •Nicolas Kolanus for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, 53115 Bonn

The CBELSA/TAPS experiment is especially well suited to measure photons from neutral meson decays to study N^*- and Δ^*-resonances which are created via photoproduction. By looking at triple neutral pion photoproduction it is also possible to investigate the kaon-hyperon final state, Σ^+K^0. Data in the strange sector is of specific interest not only to investigate strange decays of non-strange baryons but also for coupled-channel partial wave analyses used to extract the resonances from the data.

Investigating the photoproduction of Σ^+K^0 poses some challenges since its cross section is significantly lower than the cross section for many non-strange final states while the number of particles to be measured is relatively high. As the particles containing strangeness are detected in the $p3\pi^0$-final state, the signal of interest needs to be carefully separated from the background of other triple neutral pion events.

This talk will focus on the selection of $\gamma p \to \Sigma^+K^0 \to p3\pi^0$ events and discuss preliminary results on the differential cross section as well as on polarisation observables.

HK 36: Focus Session II: Emergence of Collectivity in Few-Body Hadron Systems

Time: Wednesday 14:00–15:30 Location: HBR 14: HS 1

Invited Talk HK 36.1 Wed 14:00 HBR 14: HS 1
Hydrodynamic attractors and transport in small systems — •Aleksas Mazeliauskas — Institut für Theoretische Physik, Universität Heidelberg, Heidelberg, Germany

The emergence of a hydrodynamic attractor–a universal far-from-equilibrium fluid behaviour–is one of the dominant explanations for the success of hydrodynamic models in heavy-ion collisions [1]. QCD kinetic simulations have shown rapid thermalisation of Quark-Gluon Plasma and the applicability of hydrodynamic descriptions at times of 1fm/c in heavy-ion collisions. However, very similar computations indicate that in smaller proton-proton collisions hydrodynamics is inapplicable [2]. This poses the fundamental question on the origins of observed collectivity in few-body systems. Ultracold quantum gas experiments provide unique access to precisely investigate the applicability of different hydrodynamic frameworks in mesoscopic systems [3,4]. In this talk, I will discuss the status and prospects of testing different interpretations of collectivity using utracold gas experiments and what these systems can tell us about few-body hadronic collisions.

Refs.:
1. J. Berges, M.P. Heller, A. Mazeliauskas and R. Venugopalan, Rev. Mod. Phys. 93 (2021) 035003
2. V.E. Ambrus, S. Schlichting, C. Werthmann, Phys.Rev.Lett. 130 (2023) 15, 152301
3. S. Floerchinger, G. Giacalone, L.H. Heyen, L. Tharwat, Phys.Rev.C 105 (2022) 4, 044908
4. S. Brandstetter, P. Lunt et al., arXiv:2308.09699v1 (2023)

Invited Talk HK 36.2 Wed 14:30 HBR 14: HS 1
Multi-particle correlations: from hot-and-dense quark-gluon matter to an ultracold-and-dilute system with few atoms — •Ilya Selyuzhenkov — GSI, Darmstadt

Multi-particle azimuthal correlations proved to be a powerful tool to study the hydrodynamic flow of the quark-gluon matter created in heavy-ion collisions and probe the collective behaviour in proton-proton interactions. Recently azimuthal correlations were used to search for collectivity in an even smaller hadronic system created in the ep and e+e- interactions. Experiments with ultracold atoms also revealed collective behaviour in a macroscopic system, and recently for a system with only a few atoms. These experiments have unique control over initial conditions and access to the time evolution, which opens a possibility to apply the existing correlation techniques to the cold-atom data and develop new observables, which could be later applied in heavy-ion experiments.

In this talk, after a brief introduction to the multi-particle azimuthal correlation techniques, the recent results for different hadronic collisions will be reviewed. A feasibility study of the two-particle correlations and the first application of the heavy-ion flow measurement techniques to extract time evolution of the spatial eccentricity and the elliptic flow in a system of 5+5 lithium atoms imaged at different expansion times will also be presented. An outlook towards the multi-differential analysis of the time evolution of the short- and long-range correlations to obtain new insights about collective phenomena and the equation of state for a few-body system will be discussed.

Invited Talk HK 36.3 Wed 15:00 HBR 14: HS 1
Observing the emergence of elliptic flow — •Sandra Brandstetter, Philipp Lunt, Carl Heintze, Maciej Galka, Keerthan Subramanian, Marvin Holten, Philipp Preiss, and Selim Jochim — Physikalisches Institut, Universität Heidelberg

Elliptic flow, the redistribution of energy between axes during the expansion due to anisotropic pressure gradients, is considered a signature of hydrodynamics. It has been observed in systems ranging from ultracold quantum gases (1) to heavy ion collisions (2), where surprisingly small systems show elliptic flow. Our cold atom experiment opens up a new pathway to study elliptic flow in few body systems with an unprecedented control over its microscopic parameters.

We start by deterministically preparing a small number of ultracold fermionic Li6 in the ground state of an elliptically-shaped optical trap and study the dynamics of the system after release from the trap at different interaction strengths and particle numbers (3). Owing to our experimental ability to measure both momentum- and real- space density with single particle resolution we observe the redistribution of momenta as well as the inversion of the aspect ratio over time. Additionally, we observe a formation of pairs as the system expands. In the near future, this will allow us to study the connection between the formation of pairs, entanglement and the emergence of collectivity in few body systems.

(1)K. M. OHara et al. Science 298.5601 (2002)
(2)Braun-Munzinger, P., Stachel, J. Nature 448, 302-309 (2007)
(3)S. Brandstetter, P. Lunt et al. arXiv: 2308.09699v1 (2023)

HK 37: Nuclear Astrophysics III

Time: Wednesday 15:45–17:15 Location: HBR 14: HS 1

Group Report HK 37.1 Wed 15:45 HBR 14: HS 1
Cross-section measurements at the HORUS γ-ray spectrometer and the Cologne Clover Counting setup — •Martin Müller, Felix Heim, Benedikt Machliner, Svenja Wilden, Pina Wüstenberg, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The detailed modeling of nucleosynthesis networks requires a vast amount of information on nuclear properties that is not available from experiments. Instead, theoretical calculations are required to predict quantities like masses, lifetimes, and reaction cross sections far away from stability [1]. To make these calculations reliable, theoretical models have to be thoroughly tested and adjusted to experimental data. In order to provide high precision data, especially on the proton rich side of the nuclear chart relevant to the astrophysical γ process, the University of Cologne operates the HORUS γ-ray spectrometer for in-beam spectroscopy and the Cologne Clover Counting setup for activation experiments [2]. While the latter method is limited by the lifetime of the reaction products, a technique using decay chains can be applied. Time resolved decay curves enable the disentanglement of cross sections associated with the production of a nucleus in its ground state and a metastable state. Combining in-beam and activation experiments opens up a broad range of reactions to investigation through which theoretical models can be constrained. Supported by the DFG

(ZI 510/8-2).

[1] M. Arnould *et al.*, Prog. Part. Nucl. Phys. **112** (2020) 103766.
[2] F. Heim *et al.*, Nucl. Instrum. Methods A **966** (2020) 163854.

HK 37.2 Wed 16:15 HBR 14: HS 1

Target tests for ^{12}C + ^{12}C fusion studies underground — •Annika Willer[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Federico Ferraro[3], Matthias Junker[3], Eliana Masha[1], Denise Piatti[4], Konrad Schmidt[1], Steffen Turkat[2], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden — [3]INFN Laboratori Nazionali del Gran Sasso, Italy — [4]Università degli studi di Padova and INFN Sezione di Padova, Italy

The ^{12}C(^{12}C,p)^{23}Na and ^{12}C(^{12}C,α)^{20}Ne fusion reactions play an important role in explosive carbon burning, including in cosmologically important supernovae of type Ia. The cross section of these reactions is poorly constrained at energies of astrophysical interest. Their precise measurement is a major aim of the LUNA-MV 3.5 MV underground accelerator in Gran Sasso, Italy that was officially opened for scientific use in 2023. Here, we report on data from a test irradiation carried out at the Felsenkeller 5 MV underground ion accelerator in Dresden. We test the stability of solid carbon targets under intensive carbon ion beam in a dedicated, watercooled setup and check for beam-induced γ-ray background.

HK 37.3 Wed 16:30 HBR 14: HS 1

Advanced data analysis techniques for the $^{12}C(\alpha,\alpha')$ reaction — •Alessandro Salice[1], David Werner[1], Peter Reiter[1], Konrad Arnswald[1], Maximilian Droste[1], Pavel Golubev[2], Rouven Hirsch[1], Hannah Kleis[1], Nikolas Königstein[1], Dirk Rudolph[2], Timo Biesenbach[1], Joe Roob[1], Madalina Ravar[1,3], 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

In order to resolve and understand the inner structure of ^{12}C and its production during stellar nucleosynthesis, the decay properties of ^{12}C's excited 0_2^+ state, the so called Hoyle state, are studied. Excited states in ^{12}C are populated via ^{12}C(α,α') reactions at 27 MeV beam energy at the FN-tandem accelerator at the University of Cologne. A set of 18 highly-segmented Double Sided Silicon Strip Detectors (DSSSD) of the Lund-York-Cologne-Calorimeter enabled a huge solid angle coverage with high angular resolution. Data analysis of a high statistics experiment required best center-of-mass energy resolution and high angular resolution for momentum reconstruction. For this purpose in-beam calibrations of the DSSSDs were performed on a pixel level. Beam-spot tracking, dead layer corrections and a precise detector position determination of individual DSSSDs were mandatory for best detector performance. Examples for improvements concerning Q value, position of the reaction plane, angular correlations and the final Dalitz plot of three α decay will be presented.

HK 37.4 Wed 16:45 HBR 14: HS 1

Jet thickness measurements at the Felsenkeller windowless gas target system — •Maxim Hilz[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Sören Göhler[1], Eliana Masha[1], Konrad Schmidt[1], Steffen Turkat[2], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden

For low-energy nuclear astrophysics cross section measurements, in addition to low background and high ion beam intensity, stable and high-purity target assemblies are needed. A windowless gas target including a wall-like gas jet is currently undergoing *ex situ* commissioning for the Felsenkeller underground ion accelerator. The contribution will report on gas thickness measurements using the α energy loss technique for various gas nozzles and nozzle inlet pressures. De Laval type nozzles gave wall thicknesses of a few times 10^{17} cm^{-2}. Tests using interferometric techniques will be reported on, as well.

HK 37.5 Wed 17:00 HBR 14: HS 1

Towards high resolution simulations of the ejecta of neutron star mergers — •Christian Schwebler[1,2], Gabriel Martínez-Pinedo[1,2,3], Andreas Bauswein[1], and Oliver Just[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64289 Darmstadt, Germany — [2]Institut für Kernphysik (Theoriezentrum), Fachbereich Physik, Technische Universität Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR, GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, 64291 Darmstadt, Germany

Binary neutron star mergers (BNS) are currently the most promising sites for r-process nucleosynthesis. To determine the nucleosynthesis yields and confront simulations to kilonova observations it is fundamental to have an accurate description of the ejecta properties. Typical hydrodynamical simulations cover the timescales tens of milliseconds after merger and suffer from limited resolution particularly in the ejecta. In order to evolve the ejecta for a longer time and improve their resolution, we have implemented in our smoothed-particle hydrodynamics code (SPH) an equation of state extended to low densities and a particle splitting technique that increases the effective resolution in the ejecta. Several tests of the implementation will be presented.

This project is supported and funded by the European Research Council(ERC) under the European Union's Horizon research and innovation programme (ERC Advanced Grant KILONOVA No. 885281, ERC Grant HEAVYMETAL No. 101071865)

HK 38: Structure and Dynamics of Nuclei VIII

Time: Wednesday 15:45–17:15 Location: HBR 14: HS 4

Group Report HK 38.1 Wed 15:45 HBR 14: HS 4

R3B Developments towards the FAIR Early Science campaign — •Lukas Ponnath for the R3B-Collaboration — Technische Universität Darmstadt

The R3B (Reactions with Relativistic Radioactive ion Beams) experiment, as a major instrumentation of the NUSTAR collaboration at the research facility FAIR in Darmstadt, is designed to tackle a wide range of fundamental questions in modern nuclear physics. The large geometric acceptance, the bending power of its superconducting magnet GLAD, and its versatile high-resolution detector components allow for kinematically complete studies of reactions with high-energy radioactive beams.

This presentation includes an introduction to the experiment and its key components and will give an overview of various experiments recently performed during the FAIR Phase-0 campaign. Most recent developments will outline the strategy to run the first NUSTAR experiments in the early science program using the FAIR Super-FRS facility.

The project was supported by the BMBF via Project No. 05P21RDFN2 & 05P21WOFN1, the Helmholtz Research Academy Hessen for FAIR, and the GSI-TU Darmstadt cooperation agreement.

HK 38.2 Wed 16:15 HBR 14: HS 4

PRISMA analysis of heavy Ne isotopes — •Floris Drent for the LNL EXP 015-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung

In 1975, mass measurements on sodium isotopes ^{30,31,32}Na showed a significant difference between the measured mass excess and the calculated mass excess using various nuclei models. This was the first voyage towards discovering a phenomenon in nuclear physics called the Island of Inversion. The Island of Inversion is a group of nuclei at N = 20 shell closure whereby the ground states are characterised by particle-hole configurations with excitations across the shell gap. These configurations are counterintuitive compared to naively filling the shell as expected. Such configurations also give rise to intruder states which are also present in the nuclei surrounding the Island. Investigating these intruder states can give information on the borders of the Island. In april 2023, a ^{22}Ne upon ^{238}U beam experiment was performed to perform spectroscopy and lifetime measurements on ^{23,24,25}He using AGATA+PRISMA. This was also a pilot experiment to get familiar with using PRISMA for light ions and to prepare for future experiments using ^{28}Mg and ^{30}Si beams. In this presentation, I will give an overview of the ^{22}Ne-experiment, discuss the modification we apply to the PRISMA analysis procedure regarding the light ions and give an outlook of the ^{28}Mg-beam experiment.

HK 38.3 Wed 16:30 HBR 14: HS 4

Projectile fragmentation cross-sections of 1 GeV/u ^{208}Pb on ^{9}Be measured at the FRS — •Suraj Kumar Singh for the S450-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability are of interest because they provide insight into nuclear reactions and nuclear structure relevant for various fields of physics ranging from fundamental physics, nuclear astrophysics up to applications in medicine. Therefore, it is important to produce and study such exotic nuclides at the edges of stability to get an inside of their sometimes new or unexpected properties. The rate and yield estimates for studies of the exotic isotopes are based on their production cross-sections. As calculations are difficult, production cross-section measurements are the first step towards research with isotopes far away from the valley of stability and the knowledge of accurate production cross-sections is essential for each proposal for new experiments. In this contribution, the evaluation and first results of production cross-sections of exotic nuclei in the vicinity of isotones with “magic number” N=126, produced in fragmentation of a 1 GeV/u ^{208}Pb beam on a ^{9}Be target and separated in-flight at fragment separator FRS at GSI, will be presented.

HK 38.4 Wed 16:45 HBR 14: HS 4

Investigation of low-lying states in ^{214}Po and ^{214}Bi — •Arwin Esmaylzadeh[1], Mario Ley[1], Vasil Karayonchev[2], Lukas Knafla[1], Andreas Harter[1], Franziskus von Spee[1], Christoph Fransen[1], Andrey Blazhev[1], Jan Jolie[1], and Casper-David Lakenbrink[1] — [1]Universität zu Köln, Institut für Kernphysik — [2]Argonne National Laboratory

Lifetimes of low-energy excited states in even-even nuclei in the region around and above ^{208}Pb are difficult to measure, because most of the nuclei in this region cannot be populated by fusion evaporation reactions. Therefore, a seven-day measurement of the standard ^{226}Ra source was performed at the HORUS spectrometer equipped with eight HPGe and six LaBr detectors. In this measurement, the lifetimes 2^+_1, 4^+_1, 3^-_1, 2^+_2, 0^+_2, 2^+_5 ^{214}Po and the 1^- state in ^{214}Bi were determined employing the fast-timing method. Furthermore, upper limits for the 2^+_3 and 1^+_1 states in ^{214}Po and for the (0^-_1, 1^-_1) state in ^{214}Bi were obtained. The lifetimes and upper limits were used to calculated transition strengths to explain structural phenomena in these nuclei. The transition strengths were also compared to shell model calculations using the appraisal of Kuo-Herling interaction [1]

[1] E. K. Warburton and B. A. Brown, Phys. Rev. C 43, 602 (1991)

HK 38.5 Wed 17:00 HBR 14: HS 4

Test of the prolate-oblate transition: the 2^+_1 lifetime of ^{190}W — E. Sahin[1,2,3], •V. Werner[1,3], A.K. Mistry[1,2,3], M. Rudigier[1], K. Nomura[4], J. Jolie[5], N. Pietralla[1], and P.H. Regan[6,7] for the S452-Collaboration — [1]TU Darmstadt — [2]GSI — [3]HFHF Darmstadt — [4]Hokkaido U, Japan — [5]U Cologne — [6]U Surrey, UK — [7]NPL, UK

The region of isotopes toward the doubly-magic ^{208}Pb has been discussed as a candidate region to observe the (phase) transition from prolate to oblate structures. ^{190}W has been identified as an isotope for potentially being close to the transition point (e.g., Refs. [1-3]), having a maximal γ-soft structure. Within the DESPEC, FAIR Phase-0 experiment S452 ^{190}W in its isomeric state has been implanted into the AIDA active stopper, surrounded by the FATIMA array and complementary EUROBALL Cluster detectors. The lifetime of its first excited 2^+ state has been determined through a fast-timing analysis and is brought into context by comparison to an EDF-IBM model approach [4].

[1] J. Jolie and A. Linnemann, Phys. Rev. C **68**, 031301 (2003).
[2] P.J.R. Mason *et al.*, Phys. Rev. C **88**, 044301 (2013).
[3] N. Alkhomashi *et al.*, Phys. Rev. C **80**, 064308 (2009).
[4] K. Nomura *et al.*, Phys. Rev. C **83**, 054303 (2011).

HK 39: Instrumentation IX

Time: Wednesday 15:45–17:15 Location: HBR 19: C 1

Group Report HK 39.1 Wed 15:45 HBR 19: C 1

Advancements and application of Monolithic Active Pixel Sensors (MAPS) for future tracking detectors using the example of the ALICE ITS3 — •Pascal Becht for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

This talk provides an insight in cutting-edge developments of Monolithic Active Pixel Sensors (MAPS) and the potential for their application in future tracking detectors. Offering mechanical flexibility and a low power consumption in combination with a high detection efficiency and good position resolution, these CMOS pixel sensors pave the way for novel detector concepts. A prominent example is the planned truly cylindrical, bent-silicon tracker (ITS3) for the ALICE experiment in LHC Run 4. Featuring wafer-scale, stitched sensors, the ITS3 pushes the limits in terms of detection performance while dramatically reducing the material budget.

Starting from the basic detector concepts, via the characterisation of small-scale pixel sensor prototypes produced in 65 nm CMOS technology node, to first results of large-area (1.4 cm x 26 cm) stitched sensors, milestones of the ITS3 development are presented. Here, the focus will be on the radiation hardness and the power consumption of the prototypes as well as in-beam characterisation of wafer-scale sensors. Furthermore, a perspective for MAPS being used for material budget imaging or the measurement of the proton interaction cross section is given.

HK 39.2 Wed 16:15 HBR 19: C 1

An Improved Integration and Reparation Technique for the CBM MVD* — •Franz Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) of the Compressed Baryonic Matter Experiment (CBM) will consist of four planar stations, each built of four independent quadrants, that will be equipped with dedicated CMOS pixel sensors (MIMOSIS) and will operate in vacuum. Each detector plane will feature a material budget x/X_0 ranging between 0.3 and 0.5 %. The sensors will be glued onto 380 μm thick TPG (Thermal Pyrolytic Graphite) carriers that provide the necessary mechanical stiffness and a high thermal conductivity in the geometrical acceptance to cool the sensors below 0 °C. The sensor will then be wire-bonded to dedicated flex cables connecting the front end electronics which will be mounted on a heat sink sitting outside the acceptance. The integration is mechanically challenging as the sensors have to be glued and bonded on both sides of the carrier to maximize the acceptance.

This contribution will present an improved integration technique that is based on laser-hatched pockets in the carrier rather than dedicated jigs. The hatches allow for a simple placement of the thinned sensors with very high precision and great alignment of front- and back-side using laser-cut fiducial marks. Using the same technique even allows to rework single sensors on modules to significantly improve on the integration yield.

*This work has been supported by BMBF (05P21RFFC2), GSI and Eurizon.

HK 39.3 Wed 16:30 HBR 19: C 1

Characterizing Cluster Behavior and Alignment Strategies in Cylindrical MAPS Detectors for ALICE at the LHC — •Berkin Ulukutlu — Technische Universität München, Munich, Germany

The ALICE experiment at CERN is upgrading its Inner Tracking System (ITS) to ITS3, replacing tracking layers with wafer-scale, cylindrically bent MAPS chips. This innovation significantly reduces material, enhancing vertexing resolution. Extensive R&D addresses challenges with this unique geometry. The ITS3, a miniature telescope with five bent ALPIDE chips, underwent testing at the Bronowice Cyclotron Center. This experiment assessed bent detectors with 80, 120, and 200 MeV protons, investigating cluster size response from highly ionizing particles. Alignment strategies, including novel machine learning approaches, were extensively investigated. The aligned detector achieved a vertexing resolution near 50 micrometers, nearing the lower limit due to scattering effects. The research was funded by the DFG Sachmittel FA 898/5-1

HK 39.4 Wed 16:45 HBR 19: C 1

Cooling studies for the Outer Barrel of ALICE3 — •Laszlo Varga for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

In the upcoming ALICE3 experiment a completely new large area tracker fully based on MAPS technology will be installed. The largest area will be covered by the Outer Tracker (OT) which consists of four large barrels around mid rapidity and discs in forward and backward direction. The barrel part will be built from a stave structure approximating a cylindrical geometry. The layout of these staves and especially the cooling of 33 square meters of active surface will have a strong influence on the total design of the device. In this contribution, possible cooling methods for the OT barrel layers will be discussed. Large scale simulations have been carried out using the COMSOL Multiphysics finite element tool. We will discuss different concepts which have to balance strict constraints in temperature, material budget and complexity of the integration.
This research was supported by the Excellence Cluster ORIGINS funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy EXC-2094-390783311 and Bundesministerium für Bildung und Forschung, BMBF-05P21WOCA1 ALICE.

HK 39.5 Wed 17:00 HBR 19: C 1

Development of a Dummy Chip for the ALICE 3 Outer Tracker — •Lars Döpper[1,2], Malte Grönbeck[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 — [2]Forschungs- und Technologiezentrum Detektorphysik, Universität Bonn

The ALICE Collaboration currently plans a complete overhaul of the whole experiment for LS4 called ALICE 3. In this new setup tracking of charged particles will be done by a full pixel detector based on 65 nm MAPS technology.

The unprecedented estimated active area of around 60m^2 calls for new production approaches in collaboration with partners from industry, as it is not feasible to test and produce the necessary amounts of sensors in the involved institutes alone. In order to test different gluing and bonding processes and also evaluate various cooling approaches we plan to design and produce a simple dummy chip at Bonn. This chip has the same dimensions as the final sensor chip and is able to generate a realistic heat profile, which can be used to test the effectiveness of various cooling solutions.

In this talk, we will present design considerations for the dummy chip, their implementation, and discuss the production at the FTD. In addition, we will report on our plans for industrialization of module production.

HK 40: Instrumentation X

Time: Wednesday 15:45–17:15 Location: HBR 19: C 2

HK 40.1 Wed 15:45 HBR 19: C 2

Magnetic field performance of recent 2-inch MCP-PMTs — •Steffen Krauss, Merlin Böhm, Mirijam Götz, Katja Gumbert, Albert Lehmann, and Daniel Miehling — FAU Erlangen

The PANDA experiment at FAIR will employ two Cherenkov detectors of the DIRC-type for pion/kaon separation. Since the focal planes of both DIRC detectors are located in a $\gtrsim$1 Tesla B-field, Microchannel-Plate Photomultipliers (MCP-PMTs) are the only viable option to detect the generated Cherenkov photons. Their magnetic field performance is a key feature of the MCP-PMTs and was investigated at conditions similar to those of the later experiment. MCP-PMTs from Photonis with 10 micrometer pores and an anode layout with 8x8 and 3x100 pixels were compared.

An important characteristic is the gain behavior as a function of the B-field strength and direction. But also the effect of the B-field on the electron trajectories inside the PMT need to be studied. This includes the focussing and spatial displacements of the charge cloud which lead to geometric shifts (e.g. Lorentz) of its center of gravity. The effects of electron focussing and shift were measured and compared to dedicated simulations.

In addition, afterpulses were studied as a function of the B-field strength by analyzing measurements with a CAEN digitizer (and a TRB/PADIWA DAQ system).

- Funded by BMBF and GSI -

HK 40.2 Wed 16:00 HBR 19: C 2

Performance of the latest series production MCP-PMTs for the PANDA Barrel DIRC — •Katja Gumbert, Merlin Böhm, Mirijam Götz, Steffen Krauss, Albert Lehmann, and Daniel Miehling for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

The PANDA detector at FAIR will use two DIRC detectors for particle identification through Cherenkov light. Given the placement of the photosensors within magnetic fields of $\gtrsim$1 Tesla, the designated sensors are Microchannel-Plate Photomultipliers (MCP-PMTs). The Barrel DIRC, which surrounds the beam line and the interaction point, will apply 128 MCP-PMTs of the type XP85112-S-BA manufactured by Photonis. These sensors have an active area of 2x2 inch^2 with an 8x8 anode pixel configuration and two MCPs with a pore diameter of 10 μm. 155 MCP-PMTs of this type have been ordered and are subject to a quality control process in Erlangen before deployment in PANDA. This process includes among other measures test measurements of both the quantum and the collection efficiency, gain distribution analysis as well as measurements of the time resolution, the dark count rate, the afterpulse probability and the rate capability. The start of series production of these sensors led to new challenges and revealed new effects that require thorough analysis. The first >30 sensors have arrived in Erlangen and faced the quality control. The perfomance results obtained with the latest tubes will be presented in this talk. Furthermore, an update on the lifetime performance of the latest MCP-PMTs will be shown. - Funded by BMBF and GSI -

HK 40.3 Wed 16:15 HBR 19: C 2

Development of microchannel plate detectors for ion identification for slowed down beams at FAIR with minimal interaction with the beam — •Dennis Bittner[1], Gereon Hackenberg[1], Micheal Weinert[1], Micheal Armstrong[2], and Jan Jolie[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Darmstadt, Germany

At FAIR/GSI ion beams have energies of hundreds of MeV/u. To perform Coulomb excitation experiments the beam will be slowed down with a thick Degrader. Secondary reactions and scattering within the degrader result in a beam containing many secondary reaction products and a wide angular spread. For the experiments it is crucial to know the position, velocity, and direction of the single ions. The approach is to place two foil-MCP (micro channel plate) detectors with delay lines for position sensitivity in front of the experiment. The ions passing the foils generate secondary electrons, which are accelerated towards the MCP. Due to the great distance between the foil and the MCP, permanent magnets are used to force the electrons on circular trajectories. This increases the resolution of the detectors. This talk discusses the ongoing development focusing on the positional resolution and signal quality with a ^{32}S Beam at the IKP Cologne. Support by BMBF is acknowledged under ErUM Verbundprojekt 05P2021 (ErUM"-FSP T07) grant 05P21PKFN1.

HK 40.4 Wed 16:30 HBR 19: C 2

Characterization and trigger system of a SiPM-based RICH camera prototype — •Jesús Peña Rodríguez for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

Ring Imaging Cherenkov detectors are moving towards new photodetection technologies to explore more accurate timing, spatial and amplitude resolutions. Silicon photomultipliers (SiPMs) can play such a role, traditionally played by vacuum-based photomultiplier tubes. SiPMs measure light intensities down to single photon-level with picosecond timing percision. Their photodetection efficiency surpasses those of traditional vacuum-based photomultiplier tubes, reaching up to 50% (even 60% in Near Ultra-Violet). The main SiPM drawbacks are temperature dependency and high dark count rates. In this talk, we present the noise characterization (dark count, afterpulse and crosstalk) and temperature dependency of three different SiPMs. In addition, we analyze the performance of the coincidence-based trigger system of a 4 x 4 SiPM matrix.

*Work supported by BMBF 05P21PXFC1, "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia, and GSI.

HK 40.5 Wed 16:45 HBR 19: C 2

Noise anaylsis of Silicon photomultipliers* — •Jan Hendrik Lietz for the CBM-Collaboration — Bergische Universität Wuppertal

Silicon-Photomultiplier sensors (SIPMs) have evolved over the last years, providing large photon detection efficiency (up to 60%), good spacial fill factor, and excellent timing precision (down to picosecond level). In the form of pixelated arrays (MPPC-SiPMs) they are also potentially interesting for spatially resolved single photon counting in Ring imaging Cherenkov detectors. However, the large and strongly temperature dependent dark count rate (DCR) poses severe challenges for single photon detection, in particular if combined with a self-triggered, free-streaming readout concept as it is being implemented for the CBM RICH detector at the future FAIR facility.

As a first step towards a possible future upgrade of the CBM RICH photon detector using SiPMs we have started to evaluate several sensors from different vendors. In this talk we will discuss first measurement results on the DCR and cross talk at different operating temperatures and for different bias voltages.

* Work supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia.

HK 40.6 Wed 17:00 HBR 19: C 2

A normalization detector for the neutron lifetime experiment τSPECT — •Martin Engler[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [3]Paul Scherrer Institute, Villigen PSI, Switzerland

The τSPECT experiment aims to measure the free neutron lifetime, using fully magnetic storage. Neutrons with energies of ≈ 50 neV are stored in a magnetic field gradient and then counted after varying storage times. The amount of neutrons filled into the trap in each measurement has to be normalized, in order to account for statistical and systematical changes in the yield of the neutron source. To monitor the flux of storable neutrons during the filling process, an in-situ neutron detector, has been built and installed into the experimental setup. The detector uses a ^{10}B-coated ZnS:Ag scintillator coupled to an array of silicon photomultipliers. Neutrons are then detected by utilizing the neutron capture reaction ^{10}B (n,α)^{7}Li and detecting the light from the scintillator caused by the reaction's products. In October 2023 first measurements were taken with τSPECT and the normalization detector both in operation at the same beam port.

This talk will cover the detector's design, the results of the simultaneous run, as well as initial approaches to normalization.

HK 41: Instrumentation XI

Time: Wednesday 15:45–17:15 Location: HBR 19: C 5a

Group Report HK 41.1 Wed 15:45 HBR 19: C 5a

With mCBM towards the CBM experiment at FAIR — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to measure nucleus-nucleus collisions at unprecedented interaction rates of up to 10 MHz which will allow study of extremely rare probes with high precision. To achieve this high rate capability, CBM will be equipped with fast and radiation-tolerant detector systems, readout by a free-streaming data acquisition system, transporting data with a bandwidth of up to 1 TB/s to a large scale computer farm for event reconstruction and first level event selection. The mCBM experiment, a CBM demonstrator and full-system test-setup was constructed 2017/18 at the SIS18 facility of GSI/FAIR, taking data within the FAIR Phase-0 program since 2019, to commission and optimize the complete CBM data chain under realistic experiment conditions. mCBM comprises prototypes and pre-series productions of all CBM detector systems with their read-out electronics, transporting synchronized data streams into the Green IT Cube of GSI/FAIR. To further validate CBM's read-out and data processing concept, the production yield of rare Λ baryons is studied in nucleus-nucleus collisions serving as a benchmark observable, which will allow comparison with published data. Hence, latest results on Λ reconstruction as well as performance studies of the detector systems will be presented. Furthermore, detector upgrades and a first online system prototype for the upcoming 2024 beam campaign will be introduced.

Group Report HK 41.2 Wed 16:15 HBR 19: C 5a

Status of the CBM Time-of-Flight system — •Ingo Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Uni. Heidelberg

In order to provide an excellent particle identification (PID) of charged hadrons at the future high-rate Compressed Baryonic Matter (CBM) experiment the CBM-TOF group has developed a concept of a 120 m^2 large Time-of-Flight (ToF) wall with a system time resolution below 80 ps based on Multi-gap Resistive Plate Chambers (MRPC). The MRPC detectors were extensively tested in several beam campaigns at particle Fluxes of up to a 30 kHz/cm^2 and reached by now the close to final design. Prior to its destined operation at the Facility for Antiproton and Ion Research (FAIR), a pre-production series of MRPCs is being used for physics research at two scientific pillars of the FAIR Phase0 program. At STAR, the Fixed-target program of the Beam Energy Scan II (BES-II) relies on 108 CBM MRPC detectors enabling forward PID for center of mass energies in the range of 3 to 7.7 AGeV Au+Au collisions. At mCBM, high-performance benchmark runs of Λ production at top SIS18 energies (1.5/1.9 AGeV for Au/Ni beams) and CBM design interaction rates of 10 MHz became feasible. Apart from the physics perspectives, these FAIR Phase-0 involvements allowed for high rate detector tests and long term stability tests. Observations and conclusions for the upcoming mass production will be discussed. The project is partially funded by BMBF contract 05P21VHFC1.

HK 41.3 Wed 16:45 HBR 19: C 5a

PANDA — •Thorsten Erlen, Kai-Thomas Brinkmann, and Hans-Georg Zaunick for the PANDA-Collaboration — II.Physikalisches Institut Justus Liebig Universität, Giessen, Deutschland

The Electromagnetic Calorimeter (EMC) of the future PANDA-Experiment at the FAIR complex in Darmstadt will use 2nd generation lead tungstate scintillator crystals (PWO II) to convert energy into a proportional amount of light in the visible spectrum. Two Large Area Avalanche Photo Diodes (LAAPD) per crystal are used to measure the amount of light created. Main characteristics of both the scintillator and the photosensors are temperature dependent. With decreasing temperature the light yield (photons per MeV) of the scintillators increases and the noise of the photosensors is reduced, while their gain-factor at a fixed voltage also increases. The nominal operating temperature for the EMC is -25 degree celsius to meet the desired properties and allow the EMC to perform according to the needs of the experiment. Energy resolution and threshold depend on a system that is capable of achieving and maintaining stable crystal and photosensor temperatures. Topic of this talk will be the results of test measurements with the first-in-its-kind slice (one of sixteen) for the barrel part of the calorimeter, using the latest (pre)production versions of the cooling, monitoring and front end electronic systems. Cooling and monitoring system design solutions will be presented in more detail.

Supported by BMBF

HK 41.4 Wed 17:00 HBR 19: C 5a

Intermediate results from the series calibration of the Front-end Electronics of the barrel part of the PANDA EMC* — •Christopher Hahn[1,2], Kai-Thomas Brinkmann[1,2], and Hans-Georg Zaunick[1,2] for the PANDA-Collaboration — [1]Justus Liebig Universität, Giessen, Deutschland — [2]II. Physikalisches Institut, Giessen, Deutschland

The Electromagnetic Calorimeter (EMC) inside a 2T solenoid will be the main component of the upcoming PANDA experiment at the future FAIR complex in Darmstadt. Due to the targeted energy resolution, timing and spatial constraints, individual high-voltage adjustments for the Large Area Avalanche Photodiodes (LAAPDs) and specifically tailored settings and architectures have to be chosen. In order to achieve optimal performance, a thorough understanding of the customized electronics as well as its behavior is crucial. Among others, the individual bias voltage adjustment of the photodiodes needs to be known with high accuracy. Simultaneously, space constraints limit the cable routing and connections, such as for the LAAPD bias voltage and control signals. The setup for the calibration of the high-voltage distribution and the test algorithm for the front-end electronics will be described. Furthermore, the intermediate results of the functionality tests and pre-calibration of the first 198 high-voltage distribution PCBs will be presented. *supported by BMBF, GSI und HFHF.

HK 42: Structure and Dynamics of Nuclei IX

Time: Wednesday 15:45–17:15 Location: HBR 19: C 5b

HK 42.1 Wed 15:45 HBR 19: C 5b

Mass spectrometry as a tool for nuclear structure and astrophysics studies at TRIUMF — •Timo Dickel for the TITAN-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH — Justus-Liebig-Universität Giessen

A high-performance multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS) is used for mass measurements of exotic nuclides at the TITAN experiment at the ISOL facility ISAC at TRIUMF, Canada. The system was developed at Justus Liebig University Gießen. The increased sensitivity due to very high efficiency and a novel method for background suppression applied in this MR-TOF-MS allows nuclear structure and nuclear astrophysics studies at the extremes of the nuclear chart. A wide range of results will be presented, from investigations of the astrophysical scenario of the r-process to nuclear structure effects like the island of inversion or the shell structure at the outskirts of the nuclear chart. Moreover, the first discovery of an isotope with an MR-TOF-MS will be discussed.

HK 42.2 Wed 16:00 HBR 19: C 5b

Discovery of isotopes and first broadband measurements of neutron-deficient light lanthanides via high precision mass spectrometry — •Christine Hornung for the S482-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

The structure and properties of nuclei approaching the drip-lines is of great interest and attracts a lot of attention from both, experiment and theory. In a recent experiment carried out in FAIR Phase-0, new isotopes towards the proton drip-line could be identified in the elements between Nd and Tb at the fragment separator FRS via event-by-event particle identification in-flight. In the same experiment, direct mass measurements were carried out with the MR-TOF-MS at the FRS Ion Catcher. A new technical approach, the so called mean range bunching, was applied, which allows efficient stopping of exotic nuclei; in the present experiment, it enabled the simultaneous broadband measurement of more than 35 nuclides in a single setting. The masses of more than 10 nuclides were measured for the first time, and the mass uncertainties of more than 10 nuclides were significantly reduced. These results give an insight into the nuclear structure and for the first time allow tracking of the proton drip line between 100Sn and 150Lu. In this contribution, these recent results and the new technical approaches will be reported.

HK 42.3 Wed 16:15 HBR 19: C 5b

Laser spectroscopy in the ruthenium isotopic chain — •Bernhard Maass for the ATLANTIS-Collaboration — TU Darmstadt

Neutron-rich mid-shell nuclei of refractory metals below the magic number Z=50, such as ruthenium, exhibit rich phenomena such as ground-state deformations, shape coexistence, and triaxiality and thus are ideal testing grounds for theories describing these collective properties. Laser spectroscopy of isotopes and isomers in this region can contribute valuable and complementary data with high precision on nuclear shapes, sizes, and electromagnetic moments.

The talk will present an overview of the ATLANTIS setup, positioned at the low-energy branch of the CARIBU fission source at ATLAS, capable of generating sufficiently intense beams of refractory elements. The main emphasis will be the discussion of the results of laser spectroscopic measurements within the ruthenium isotopic chain. Differential mean-squared nuclear charge radii, moments, and shape parameters have been successfully extracted, spanning nine radioactive isotopes from mass 107 to 114.

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 42.4 Wed 16:30 HBR 19: C 5b

First laser spectroscopy measurements across N=32 in the calcium isotopic chain — •Tim Lellinger for the COLLAPS-Collaboration — EP-SME-IS, CERN — TU-Darmstadt

Over a decade ago, the first experimental evidence for the N=32 sub shell closure in the calcium isotopic chain emerged [1,2]. Subsequent experimental and theoretical investigations have confirmed this finding. However, in laser spectroscopy measurements extending up to ^{52}Ca (N=32), no indications of this shell gap were apparent [3]. Crossing the shell gap with laser spectroscopy setups has proved difficult due to the simultaneous requirement of a sensitivity of approximately 10 ions/s and a measurement uncertainty on the order of MHz.

This contribution presents the first laser spectroscopy measurements of ^{53}Ca, facilitated by an extension of the collinear laser spectroscopy technique employed at the COLLAPS setup at ISOLDE/CERN. This technique, termed as *radioactive detection after optical pumping and state selective charge exchange* (ROC), combines the high sensitivity of a particle detection scheme with the high resolution of low-power, continuous wave lasers utilized in a collinear geometry. The methodology of this technique will be explained, followed by the presentation and discussion of preliminary values for the charge radius and magnetic dipole moment of ^{53}Ca in the context of the robustness of the N=32 sub shell closure.

[1] Wienholtz, F. et al. Nature vol. 498, 346-349 (2013)
[2] Steppenbeck, D. et al. Nature vol. 502, 207-210 (2013)
[3] R.F. Garcia Ruiz et al, Nature Physics vol. 12, 594-598 (2016)

HK 42.5 Wed 16:45 HBR 19: C 5b

Application of eigenvector continuation to nuclear many-body problems — •Margarida Companys Franzke[1,2,3], Kai Hebeler[1,2,3], Takayuki Miyagi[1,2,3], Alexander Tichai[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 design of emulation techniques for the evaluation of many-body observables is attracting increasing attention over the past years. In particular the framework of eigenvector continuation (EC) has been identified as a powerful tool once the system's Hamiltonian admits for a parametric dependence. Since Hamiltonians generated by effective field theory have a parametric dependence on low-energy constants (LECs), EC is applicable. In this application the emulator is trained on a small set of data generated by the Hatree-Fock method for varying LECs. Once the ground state is emulated, it can be used to obtain other observables, such as radii, and explore the sensitivity to the LECs in nuclear forces.

* Funded by the ERC Grant Agreement No. 101020842

HK 42.6 Wed 17:00 HBR 19: C 5b

Collinear Laser Spectroscopy of $^{155-175}$Tm^{+} — •Hendrik Bodnar[1], Kristian König[1], Klaus Blaum[6], Andrey Bondarev[5], Bradley Cheal[3], Tim Lellinger[2], Edward Matthews[2], Patrick Müller[1], Gerda Neyens[7], Wilfried Nörtershäuser[1], Julian Palmes[1], Peter Plattner[6], Laura Renth[1], Liss Vázquez Rodríguez[2], and Deyan Yordanov[4] — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]Experimental Physics Department, CERN, Geneva, Switzerland — [3]Oliver Lodge Laboratory, University of Liverpool, Liverpool, UK — [4]Universite Paris-Saclay, CNRS/IN2P3, IJCLab, 91405 Orsay, France — [5]Helmholtz Institute Jena, Jena, Germany — [6]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [7]Instituuut voor Kern- en Stralingsfysica, Celestijnenlaan 200D, 3001 Leuven, Belgium

Collinear Laser Spectroscopy of $^{155-175}$Tm$^+$ was performed at COLLAPS/ISOLDE (CERN). Through measurements of the isotopic shifts and the hyperfine splitting, the magnetic dipole moments, electrical quadrupole moments, nuclear spin and charge radii relative to the stable ^{169}Tm were determined. ^{169}Tm was previously investigated in detail at the high-precision setup COALA at TU Darmstadt to identify suitable transitions for the online campaign. Results from both parts of the experiments are presented. The ultimate goal is the determination of the charge radius of the proton emitter ^{147}Tm since charge radii of nuclei exhibiting this decay channel have not been performed so far. Funding from the BMBF under contracts 05P21RDCI1 and 05P21RDFN1 is acknowledged.

HK 43: Outreach I

Time: Wednesday 15:45–17:15 Location: HBR 19: C 103

HK 43.1 Wed 15:45 HBR 19: C 103

"Faszinierende Teilchenphysik" ("faszinating particle physics"): A book on theories, experiments and methods addressed to a general public — Philip Bechtle[1], Florian Bernlochner[1], Herbi Dreiner[1], •Christoph Hanhart[2], Josef Jochum[3], Jörg Pretz[2,4], and Kristin Riebe[5] — [1]Universität Bonn — [2]Forschungszentrum Jülich — [3]Universität Tübingen — [4]RWTH Aachen — [5]AIP Potsdam

The book *Faszinierende Teilchenphysik (in German - the English version, *Fascinating particle physics" is in preparation) was recently published. The book is structured in 150 largely self-contained doublepages sorted into 12 chapters. It is addressed at the interested general public and contains an overview over various aspects of particle, hadron and nuclear physics, like an in depth introduction to the Standard Model, an introduction to theoretical and experimental methods in particle and hadron physics, including what it takes to extract valuable information from data, an overview of spin offs that emerged from this kind of fundamental science as well as some discussions on more philosophical implications related to the subject. In the talk I will present how we settled on the content of the book, present some representative examples and mention some challenges we faced in the preparation of the book.

HK 43.2 Wed 16:00 HBR 19: C 103

Annual Meeting of Young Scientists in High Energy Physics (yHEP) — Dima El Khecken[1], •Farah Afzal[2], Felipe Peña[3,4], Leonel Morejon[5], Meike Küssner[6], Michael Lupberger[2], Ruth Jacobs[3], and Srijan Sehgal[5] — [1]Karlsruhe Institute of Technology — [2]University of Bonn — [3]DESY — [4]University of Hamburg — [5]University of Wuppertal — [6]University of Bochum

We will present our activities from the last year, would like to discuss plans for the coming year with you and hear your ideas and thoughts. Topics of discussion are current and future developments in high and low energy physics, i.e. particle, astroparticle, hadron and nuclear physics, as well as accelerator physics, including topics of the situation of early-career researchers, environmental sustainability, networking and shaping the future of our fields.

All doctoral candidates, post-docs and scientists on non-permanent contracts are cordially invited.

Please register to our mailing list which can be found from yhep.desy.de to receive details on the meeting.

HK 43.3 Wed 16:15 HBR 19: C 103

Die Rolle von Peer Teaching in der Nachwuchsförderung der Kern- und Teilchenphysik — •David Borgelt, Joceline Reimann und Christian Klein-Bösing für die Netzwerk Teilchenwelt-Kollaboration — Institut für Kernphysik, Münster, Deutschland

Im Deutschen Schulsystem ist es üblich, dass die Schülerinnen und Schüler sich vor dem Wechsel in die Sekundarstufe II entscheiden müssen, ob sie Physik weiterhin als Schulfach behalten möchten. Hierbei fällt die Entscheidung eher selten für das Fach Physik und so fehlt der aktiven Forschung frühzeitig der Nachwuchs. Dies ist ein Grund dafür, dass Initiativen wie das Netzwerk Teilchenwelt oder NRW-FAIR schon in der Sekundarstufe I über moderne Grundlagenforschung am Beispiel der Kern- und Teilchenphysik informieren. Laut Lehrkräfte-Feedback mit Erfolg. Neuerdings übernehmen in Münster sogar Jugendliche Teile der Workshops als Dozentinnen und Dozenten und können frühzeitig aktiv am Outreach der Kern- und Teilchenphysik teilhaben. Durch diese Zusammenarbeit auf Augenhöhe können die Interventionen zielgruppengerecht überarbeitet werden und ermöglichen für interessierte Schülerinnen und Schüler einen niedrigschwelligen Einstieg in die Kern- und Teilchenphysik. Die jugendlichen Dozentinnen und Dozenten können darüber hinaus eine direkte Vorbildfunktion in der Peer-Group einnehmen und erleben eine hohe Selbstwirksamkeit. Andere Jugendliche werden durch diese Role-Models motiviert, ebenfalls zu partizipieren. In diesem Beitrag wird das Konzept von Workshops in der Sekundarstufe I kurz vorgestellt und von einer Fellow des Netzwerk Teilchenwelt die Perspektive aus der Sekundarstufe I vorgestellt.

HK 43.4 Wed 16:30 HBR 19: C 103

Nuclear Astrophysics Masterclasses - A Journey through the Elements — •Hannes Nitsche[1], Uta Bilow[1], Daniel Bemmerer[2], and Lana Ivanjek[3] for the Netzwerk Teilchenwelt-Collaboration — [1]Technische Universität Dresden, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [3]Linz School of Education, Austria

Masterclasses are one-day outreach events for high school students, introducing them to topics of current research. Within the framework of the EU project ChETEC-INFRA, Masterclasses on Nuclear Astrophysics have been developed. This interdisciplinary field of science provides a new didactic perspective on nuclear and astrophysical processes by addressing the link between these two subjects. The Nuclear Astrophysics Masterclasses pick up this didactic potential. They include the spectroscopic analysis of metal poor stars with WebSME. Furthermore, the processes behind the formation of the first chemical elements are reconstructed with the help of various gamification elements as well as hands-on activities. Emphasis is placed on current research topics in nuclear astrophysics, in particular the primordial lithium problem. The talk will present the teaching materials, the didactic concept and the experiences made so far in the implementation of the Masterclasses.

HK 43.5 Wed 16:45 HBR 19: C 103

Teilchenphysik-Akademie - SchülerInnen an der Uni — •Heike Vormstein für die Netzwerk Teilchenwelt-Kollaboration — JGU, Mainz, Deutschland

Jedes Jahr kommen 16 Jugendliche an die Uni-Mainz, um sich 10 Tage lang intensiv mit Teilchenphysik zu beschäftigen. In Vorlesungen und Workshops lernen sie Grundlagen der Elementarteilchenphysik, des Detektorbaus sowie der Datenerfassung. Mit dem gelernten Wissen werden dann unter Anleitung von erfahrenen Wissenschaftlerinnen und Wissenschaftlern eigene Teilchendetektoren konstruiert, die am Elektronbeschleuniger MAMI eingebaut und verwendet werden. In dem Vortrag wird auf die Umsetzung und Durchführung der Teilchenphysik-Akademie eingegangen und verschiedene Gestaltungsformen präsentiert.

HK 43.6 Wed 17:00 HBR 19: C 103

An Innovative Introduction into Hadron Physics: The LHCb Quark Puzzle — •Lukas Julian Exner and Sebastian Neubert — LHCb Bonn, University of Bonn

The LHCb Quark Puzzle provides a 3D visualisation of quarks of the Standard Model of particle physics and the conditions under which quarks form hadrons, given by quantum chromodynamics. Quark flavour, quark generations, the electric charges, colour charges, colour neutrality of hadrons, two- and three-quark states are illustrated impressively. Furthermore, top quarks are designed such that they cannot be formed into hadrons. Students, learners and interested people discover symmetries of particle physics inductively and experimentally by skilfully assembling puzzle pieces. Thus, this model offers a vital addition to outreach and explanations of particle physics without any mathematics and specific vocabulary background.

As a representation of the SU(3) symmetry, the predisposed symmetry of a platonic solid, the (spherical) dodecahedron is used to build all hadrons from the same basic shape.

The 3D printable puzzle consists of a total of 36 unique pieces in total with different plug-in mechanisms. Originally developed for a LHCb Masterclass, all shapes are freely available under an open source licence.

HK 44: Heavy-Ion Collisions and QCD Phases IX

Time: Wednesday 15:45–17:15 Location: HBR 62: EG 03

HK 44.1 Wed 15:45 HBR 62: EG 03

Lambda hyperon polarization in heavy-ion collisions within a hybrid approach — •Nils Sass[1], David Wagner[1], Masoud Shokri[1], Dirk Rischke[1,4], and Hannah Elfner[1,2,3,4] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [3]FIAS, Ruth-Moufang-Strasse 1, 60438 Frankfurt, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Max-von-Laue-Straße 12, 60438 Frankfurt, Germany

In 2017, the STAR collaboration at the Relativistic Heavy Ion Collider (RHIC) has emphasized the role of spin in heavy-ion collisions by the measurement of global polarization of Λ hyperons. This measurement revealed, for the first time, a high angular momentum of heavy ions in the quark-gluon plasma (QGP), providing experimental evidence for a strong vortical structure in the fireball, integral to the manifestation of Λ polarization. Current investigations focus on delineating the mechanisms governing angular momentum deposition and the consequent emergence of polarization observables. Within a framework of second-order relativistic spin hydrodynamics, recent studies by Weickgenannt et al. [PhysRevD.106.096014] have extended the Pauli-Lubanski vector, to include dissipative spin effects. Introducing this updated formulation of the Pauli-Lubanski vector into a full hybrid approach for the first time, our work facilitates the direct exploration of Lambda hyperon polarization from the particlization hypersurface.

HK 44.2 Wed 16:00 HBR 62: EG 03

CBM Performance for Λ Yield Analysis using Machine Learning Techniques — •Axel Puntke for the CBM-Collaboration — Universität Münster

The Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram at high net-baryon densities ($\mu_B >$ 500 MeV) with heavy-ion collisions in the energy range of $\sqrt{s_{NN}} =$ 2.9 - 4.9 GeV. Precise determination of dense baryonic matter properties requires multi-differential measurements of strange hadron yields, both for the most copiously produced K^0_s and Λ as well as for rare (multi-)strange hyperons and their antiparticles.

In this talk, the analysis of the Λ baryon yield measurement is presented. The Λ hadrons are reconstructed using methods based on a Kalman Filter algorithm that has been developed for the reconstruction of particles via their weak decay topology. The large combinatorial background is suppressed by applying selection criteria tuned to the topology of the decay. This selection is optimized by training a machine learning model based on boosted decision trees with simulated samples from two heavy-ion event generators, UrQMD and DCM-QGSM-SMM. A routine is implemented to extract multi-differentially Λ yields corrected for detector acceptance and efficiency. This analysis chain is validated by the GEANT4 Monte Carlo simulations of particle transport through the CBM detector material.

HK 44.3 Wed 16:15 HBR 62: EG 03

CBM performance for the measurement of strange hadron and hypernuclei in 3 GeV Au+Au collisions at FAIR — •Yingjie Zhou for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The main goal of the CBM experiment at FAIR is to study the behavior of nuclear matter at very high baryonic density. This includes the exploration of the high-density equation of state (EoS), search for the transition to a deconfined and chirally restored phase and critical endpoint. The promising diagnostic probes for this new state are the enhanced production of multi-strange (anti-)particles. The CBM detector is designed to measure such rare diagnostic probes multi-differentially with unprecedented precision and statistics. Important key observables are the production of hypernuclei. The discovery and investigation of new (doubly strange-)hypernuclei and hyper-matter will shed light on the hyperon-nucleon and hyperon-hyperon interactions.

In this presentation, performance studies for strange hadron and hypernuclei production in 3 GeV Au+Au collisions with the CBM experiment at FAIR will be presented. The CBM performance is compared with that of the STAR experiment and projections for statistical uncertainties with high statistics data at CBM are presented.

HK 44.4 Wed 16:30 HBR 62: EG 03

Measurement of $A = 4$ (anti-)hypernuclei production in heavy-ion collisions at the LHC — •Janik Ditzel — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN, light (anti-)hypernuclei are produced abundantly in Pb-Pb collisions. The production of such (anti-)hypernuclei has recently become a topic of high interest, connecting for instance to the possible strangeness content in neutron stars. The most prominent example is the (anti-)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon and the main (anti-)hypernucleus to study at the LHC. Nevertheless, there are heavier (anti-)hypernuclei whose production yields are suppressed with respect to the (anti-)hypertriton. However, they could give further insights into the formation mechanism and the nature of the hyperon-nucleon or hyperon-hyperon interaction. The existence of excited states of the two A=4 (anti-)hypernuclei makes their measurement in heavy-ion collisions in the investigated dataset become feasible. These (anti-)hypernuclei decay weakly after a few centimeters into two or more daughter particles and are reconstructed by their decay products. With the excellent performance of the ALICE apparatus, a clear particle identification of the daughters and a precise reconstruction of the decay vertex is possible. We will present new results on the measurement of (anti-)hypernuclei within the $A = 4$ mass region, namely the (anti-)hyperhydrogen-4 and the (anti-)hyperhelium-4.

HK 44.5 Wed 16:45 HBR 62: EG 03

Constraining Strangeness Production with Machine Learning — •Carl Rosenkvist[2] and Hannah Elfner[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [3]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany

In heavy-ion collisions, strange particles, which are absent in normal matter, are produced during or shortly after the collision, making them vital probes for understanding the underlying physics.

This project focuses on investigating strangeness production using the SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) model. At lower collision energies, SMASH incorporates short-lived particles, known as resonances, to describe the production of strange particles through resonance decay.

However, the properties of resonance particles have uncertainties from experimental measurements, affecting simulations of low-energy observables sensitive to strangeness production. To address this, we employ machine learning algorithms and emulators to fit numerous resonance parameters simultaneously to experimental data, mainly exclusive elementary cross-sections.

Additionally, a recent study comparing SMASH with experimental data on pion beams colliding with carbon and tungsten revealed significant deviations. To understand this observed discrepancy, we will also investigate strangeness production in pion-nuclei collisions.

HK 44.6 Wed 17:00 HBR 62: EG 03

Strangeness tracking with the upgraded ALICE Inner Tracking System in Run 3 at the LHC — •Carolina Reetz for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg

A precise reconstruction of particles containing strangeness in high energy proton-proton and heavy-ion collisions is crucial not only for measurements of (multi-)charm baryons via their decays into strange baryons but also for measurements of strange hypernuclei such as the hypertriton $^{3}_{\Lambda}$H.
A novel technique called *strangeness tracking* is introduced making use of the upgraded silicon tracker (ITS2) of the ALICE detector in LHC Run 3. The new reconstruction approach allows to directly track weakly decaying charged strange hadrons and hypernuclei in the silicon layers closest to the beam pipe before they decay. The combination of the daughter track information with the measured hits of the parent particle trajectory in the ITS2 layers leads to significant improvements in the reconstruction performance and specifically the impact parameter resolution.
The strangeness tracking performance for ALICE Run 3 proton-proton collisions and simulations is presented with an emphasis on the reconstruction of charged Ξ-baryons.

HK 45: Heavy-Ion Collisions and QCD Phases X

Time: Wednesday 15:45–17:15 Location: HBR 62: EG 05

HK 45.1 Wed 15:45 HBR 62: EG 05

Towards locating the (real) critical end point — •Friederike Ihssen[1] and Jan Martin Pawlowski[1,2] — [1]Institut für Theoretische Physik, Philosophenweg 16, 69120 Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, GSI, Planckstr. 1, 64291 Darmstadt, Germany

Lattice simulations and functional approaches established that QCD has no phase transition at small baryon chemical potential. However, second order phase transitions are expected at the conjectured critical endpoint at larger chemical potential and in the chiral limit at vanishing chemical potential.

These phase transitions leave an imprint as Lee-Yang edge singularities and can be found at high temperatures $T > T_c$ for complex magnetisation and complex chemical potential. For an increasing real part of the chemical potential, the edge singularity moves towards the real μ_B-axis, potentially allowing for an extrapolation to the critical endpoint.

As a precursor for a quantitative study in QCD we discuss the impact of fluctuations in a low energy effective theory. We show that in this model the location of the phase transition can accurately be determined by tracking the Lee-Yang singularities in the complex plane. We close by discussing the remaining task of extending this computation to full QCD.

HK 45.2 Wed 16:00 HBR 62: EG 05

In-Medium Mixing and the Phase Structure of QCD — •Fabian Rennecke[1], Lorenz von Smekal[1], and Maximilian Haensch[2] — [1]Justus-Liebig-Universität Giessen, Institut für Theoretische Physik — [2]Ludwig-Maximilians-Universität München

Interactions in the hot and dense QCD medium give rise to extensive mixing between hadronic and gluonic degrees of freedom. This modifies the analytic structure of the systems and leads to a non-Hermitian mass matrix, with potential far-reaching consequences for the phase diagram. For example, regimes with spatial modulations and instabilities towards inhomogeneous phases can be induced by such a mixing.

HK 45.3 Wed 16:15 HBR 62: EG 05

The phase diagram of QCD and its critical endpoint — •Franz Richard Sattler[1], Jan Martin Pawlowski[1,2], Friederike Ihssen[1], and Nicolas Wink[3] — [1]Institut für Theoretische Physik, Philosophenweg 16, 69120 Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, GSI, Planckstr. 1, 64291 Darmstadt, Germany — [3]Institut für Kernphysik, Technische Universität Darmstadt, D-64289 Darmstadt, Germany

We investigate the location of the conjectured critical endpoint of QCD by using the functional renormalization group. This allows to access the high-density region, as this approach does not suffer from the sign problem of lattice QCD.

In this setup, we can systematically identify and include all relevant physical degrees of freedom.

We discuss both quantitative results in the vacuum as well as the extension to the phase diagram up to intermediate densities.

Finally, for calculations at even higher densities, we discuss future extensions of our setup, such as other potentially relevant composite particles.

HK 45.4 Wed 16:30 HBR 62: EG 05

The QCD chiral phase transition with imaginary baryon chemical potential — •Reinhold Kaiser[1,2], Owe Philipsen[1,2], Alfredo D'Ambrosio[1,2], and Michael Fromm[1] — [1]Institut für theoretische Physik, Goethe-Universität Frankfurt — [2]John von Neumann Institute for Computing (NIC) at GSI

In order to constrain the QCD phase diagram with physical quark masses, the QCD chiral phase transition in the massless limit is investigated using lattice QCD with staggered fermions. In 1984, Pisarski and Wilczek predicted a first-order transition for $N_\mathrm{f} \geq 3$, based on RG investigations of a linear sigma model in three dimensions, which was supported by lattice QCD simulations on coarse lattices. However, the order of the thermal chiral transition in lattice QCD depends strongly on the cutoff. Recent lattice QCD results from our group provide strong evidence for a second order chiral phase transition for $N_\mathrm{f} = 2 - 6$ massless quark flavors. It was found that the first-order chiral transitions, observed on coarse lattices, terminate at a tricritical lattice spacing, and are thus not connected to the continuum chiral limit. As a consequence, the chiral transition in the continuum is of second order, unless additional first-order transitions are found on finer lattices or with chiral lattice actions. Adopting the same strategy, we investigate the nature of the chiral phase transition as a function of the number of quark flavors and the lattice spacing for a fixed imaginary baryon chemical potential. The same behavior as at zero chemical potential is observed, which implys a second order chiral phase transition also for imaginary chemical potential in the continuum.

HK 45.5 Wed 16:45 HBR 62: EG 05

QCD Phase Transitions in the Light-Quark Chiral Limit — •Julian Bernhardt[1,2] and Christian S. Fischer[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany

In this talk, I report on meson-backcoupling effects in the chiral regions of the Columbia plot. To this end, an extension of a sophisticated combination of Lattice Yang–Mills theory and a (truncated) version of Dyson–Schwinger equations in Landau gauge for 2 + 1 quark flavours was employed that does not suffer from the sign problem. This analysis encompasses the chiral limit of the light quarks for different strange-quark masses at small (real and imaginary) chemical potentials. I also present a first exploratory study for chiral strange and non-chiral light quarks.

HK 45.6 Wed 17:00 HBR 62: EG 05

The temperature of the QCD chiral phase transition at its tricritical point — •Jan Philipp Klinger and Owe Philipsen — Institut für theoretische Physik, Goethe Universität Frankfurt

The nature of the QCD phase transition in the chiral limit constitutes a challenging problem for lattice QCD as it is not directly simulable. Its study, however, provides constraints on the phase diagram at the physical point. Recently, the thermal transition for massless fermions was shown to be of second order for all numbers of flavours $N_f \lesssim 7$. For this, the lattice chiral limit was approached by mapping out the chiral critical surface separating the first-order region from the crossover region in an enlarged parameter space, which consists of the gauge coupling, a variable number of quark flavours, their masses, and the lattice spacing. Based on simulations of lattice QCD with standard staggered quarks, it was found that for all $N_f \lesssim 7$ there exists a minimal and tricritical lattice spacing a^{tric}, where the chiral transition changes from first order (above) to second order (below). The first-order region thus constitutes a cutoff effect and the transition in the continuum chiral limit is of second order for all $N_f \lesssim 7$. In the current work we determine the associated temperatures $T(N_f^{tric}, a^{tric})$ at those lattice spacings. We confirm an expected decrease in the critical temperature for increasing number of flavours. Running simulations on finer lattices will allow us to determine the location of the tricritical point in the continuum limit and let us resolve the question whether the conformal window is approached by a first or second order phase transition.

HK 46: Heavy-Ion Collisions and QCD Phases XI

Time: Wednesday 15:45–17:15 Location: HBR 62: EG 18

HK 46.1 Wed 15:45 HBR 62: EG 18

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 $500\,\mathrm{MeV/c^2}$. Furthermore, by analyzing elastic $p+p$ collisions, a normalization procedure for differential cross sections has been established.

The cross section spectrum shows a satisfactory agreement to previous HADES measurements as well as theoretical calculations from GiBUU. Furthermore this spectrum 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 46.2 Wed 16:00 HBR 62: EG 18

Dielectron production in Pb–Pb collisions with ALICE — •Jerome Jung for the ALICE Germany-Collaboration — Goethe University Frankfurt

Dielectrons are an exceptional tool for studying the evolution of the medium created in heavy-ion collisions as they are produced at all stages of the collision with negligible final-state interactions. In central collisions, the energy densities are sufficient to create a quark-gluon plasma (QGP). Thermal e^+e^- pairs radiating from this medium can be observed as an excess over the hadronic decay cocktail beyond the pion region.

For invariant masses above 1.2 GeV/c^2, correlated heavy-flavour (HF) hadron decays are expected to dominate the dielectron yield. Their contribution is modified in the medium compared to elementary collisions to an unknown extent, leading to large uncertainties in the subtraction of known hadronic sources. To control this contribution, a topological separation based on the distance-of-closest approach (DCA) to the primary vertex is crucial to disentangle the thermal dielectron from HF contributions based on their characteristic proper decay lengths.

In this talk, the final results on dielectron production in central Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV with ALICE in Run 2 will be presented. The measurements are compared to expectations from hadronic decays and calculations from theory. Finally, the topological separation of e^+e^- pairs is applied to extract a prompt thermal contribution in the intermediate-mass region.

HK 46.3 Wed 16:15 HBR 62: EG 18

Towards reconstructing dilepton flow in Au+Au collisions at low energies with HADES* — •Sukyung Kim for the HADES-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

In March 2024, the High Acceptance DiElectron Spectrometer (HADES) at GSI Darmstadt, Germany will collect data on dielectron production in Au+Au collisions at beam energies ranging from 0.2 to 0.8 A GeV. One specific focus will be to characterize the collision system studying dielectron flow. In the HADES experiment, the Ring-Imaging CHerenkov (RICH) detector is responsible for efficient electron identification. Thus, the performance of the RICH will be the first crucial factor in dielectron flow extraction. In this contribution we will discuss the calibration and performance of the HADES RICH used for electron identification. Additionally, we will discuss preparatory simulation studies produced using the SMASH transport model.

*Work supported by “Netzwerke 2021”, an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P21PXFC1).

HK 46.4 Wed 16:30 HBR 62: EG 18

Polarization of thermal dilepton radiation — •Florian Seck[1], B. Friman[2,1], T. Galatyuk[2,1], H. van Hees[3,4], E. Speranza[5], R. Rapp[6], and J. Wambach[1] — [1]Technische Universität Darmstadt — [2]GSI, Darmstadt — [3]Universität Frankfurt — [4]Helmholtz Research Academy Hesse for FAIR, Frankfurt — [5]Theoretical Physics Department, CERN, Switzerland — [6]Texas A&M University, College Station, USA

Multi-differential measurements of dilepton spectra serve as a unique tool to characterize the properties of matter in the interior of the hot and dense fireball. An important property of virtual photons is their spin polarization defined in the rest frame of the virtual photon for a chosen quantization axis. While the total yield and observable spectra are proportional to the sum of the longitudinal and transverse components of the spectral function, the polarization depends on their difference. As the processes that drive the medium effects in the spectral function change with invariant mass and momentum, this becomes a powerful tool for studying the medium composition.

In this contribution, we present the polarization observables of thermal virtual photons as a function of mass and momentum, compare the results to existing measurements from HADES and NA60, and provide predictions for upcoming HADES data. Finally, we discuss the prospects of using dilepton polarization to disentangle the contributions of hadronic and partonic origin to thermal radiation.

This work has been supported by VH-NG-823, HGS-HIRe, and the DFG through grant CRC-TR 211.

HK 46.5 Wed 16:45 HBR 62: EG 18

Measurement of dielectrons in pp collisions at $\sqrt{s}$ = 13.6 TeV with ALICE in Run 3 — •Florian Eisenhut — Goethe Universität Frankfurt

Dielectrons are a unique tool to study the space-time evolution of the hot and dense matter created in relativistic heavy-ion collisions. In pp collisions, measurements of the dielectron production serve as reference for heavy-ion studies, providing some insight into the different e^-e^+ background sources. In high charged-particle multiplicity events, dielectron measurements allow us to search for thermal radiation in small systems. Thanks to the upgrades performed during the LHC Long Shutdown 2, ALICE is now capable to read out pp collision data at an acquisition rate 1000 times faster than previously. The larger data samples recorded during the Run 3 data taking period, together with the improved tracking capabilities at low transverse momenta and pointing resolution of the detector, allow us to study the e^+e^- pair production of dielectrons originating from displaced open heavy-flavour hadron decays or prompt decays.

This talk will give an overview of the first results on dielectron production in pp collisions at $\sqrt{s}$ = 13.6 TeV obtained with ALICE Run 3 data. It will summarize the techniques used to select electrons and improve the signal-to-background ratio in the dielectron analysis, as well as present the separation power of the new detector for prompt and non-prompt dielectron sources.

HK 46.6 Wed 17:00 HBR 62: EG 18

Measurement of dielectrons in Pb-Pb collisions with ALICE in Run 3 — •Emma Ege for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Dielectrons are a unique probe to study the properties of strongly-interacting matter produced in heavy-ion collisions, especially of the quark-gluon plasma (QGP), as they do not interact strongly and are created in all stages of the collision. Thermal radiation from the QGP carries information about the early temperature of the medium. At LHC energies, it is nevertheless dominated by a large background from correlated heavy-flavor hadron decays.

With the upgrades of the ALICE detector for the LHC Run 3 data taking period, an improved pointing resolution and a higher data acquisition rate, by up to a factor 100 for Pb-Pb collisions, are achieved. Both will help to reduce significantly the statistical and systematic uncertainties of dielectron measurements and understand the contribution from displaced correlated open heavy-flavor hadron decays.

In this talk the status of the current analysis of Pb-Pb data from 2023 with ALICE will be presented. In particular the first dielectron spectra will be shown. Additionally we will investigate the distance of closest approach (DCA) of the electrons to the primary vertex of the collision in different invariant mass ranges.

HK 47: Hadron Structure and Spectroscopy VI

Time: Wednesday 15:45–17:15 Location: HBR 62: EG 19

Group Report HK 47.1 Wed 15:45 HBR 62: EG 19
Multi-meson photoproduction with the CBELSA/TAPS experiment — •Tobias Seifen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

One important step in understanding the baryon spectrum is a precise knowledge of the excited states and their decays. In order to extract the contributing resonances from experimental data a partial wave analysis needs to be performed. To resolve ambiguities, the measurement of polarization observables is indispensable. In the regime of high-mass baryon resonances multi-meson final states are of particular importance. Here sequential decays of resonances are observed.

The CBELSA/TAPS experiment is ideally suited to measure the photoproduction of neutral mesons decaying into photons due to its good energy resolution, high detection efficiency for photons, and the nearly complete solid angle coverage. In combination with a longitudinally or transversely polarized target and an energy tagged, linearly or circularly polarized photon beam the experiment allows the measurement of a large set of polarization observables.

This talk will focus on results on neutral double pion production obtained with a linearly polarized photon beam and either an unpolarized hydrogen target or a transversely polarized butanol target. Part of the results were included in the Bonn-Gatchina partial wave analysis. Observed systematic differences in the branching ratios for decays of N* and Δ* resonances are attributed to the internal structure of these excited nucleon states.

HK 47.2 Wed 16:15 HBR 62: EG 19
Coherent $\pi^0\eta$ photoproduction off the deuteron at the BGOOD experiment — •António João Clara Figueiredo for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The BGOOD photoproduction experiment at the ELSA facility is uniquely designed to explore kinematics where a charged particle is identified in the forward spectrometer and a recoiling hadronic system is reconstructed in the central calorimeter at low momentum transfer.

The setup enables studies of coherent reactions off the deuteron at forward deuteron angles. This kinematic region would be expected to be suppressed due to the large momentum transfer to the deuteron. Measurements at BGOOD however have found this to not be the case.

Results on the coherent $\pi^0\eta$ photoproduction off the deuteron at the BGOOD experiment are presented. A full kinematic reconstruction was made, with final state deuterons identified in the forward spectrometer and π^0 and η decays in the central calorimeter. The differential cross section is an order of magnitude higher than expected. The distribution is described well by a simple model of a quasi-free reaction followed by pion exchange and the subsequent coalescence of the proton and neutron to the deuteron.

Supported by DFG projects 388979758/405882627 and the European Union's Horizon 2020 programme, grant 824093.

HK 47.3 Wed 16:30 HBR 62: EG 19
Determination of the polarization observables Σ, I_c and I_s in the reaction $\gamma p \to p\pi^0\eta$ — •Georg Urff for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, 53115 Bonn

The excited states of the nucleon appear as broad and overlapping structures in the experimental data. The challenge of extracting information from the data is tackled by partial wave analyses (PWA) used to disentangle the contributing resonances and aiming to find unambiguous solutions. Whether unambiguous solutions can be found strongly depends on additional constraints provided by polarization observables. In addition, to gain a complete picture of baryon resonances and their properties, multi-meson decays are of large interest, particularly at higher energies.

The CBELSA/TAPS experiment provides an energy tagged linearly or circularly polarized photon beam impinging on a longitudinally or transversally polarized target, allowing for the determination of single and double polarization observables. The Crystal Barrel calorimeter combined with the MiniTAPS calorimeter in forward direction provide a nearly 4π angular coverage. Due to their high photon detection efficiency and good energy resolution the experiment is ideally suited to find states with neutral mesons decaying into photons.

This presentation covers results for polarisation observables Σ, I_c and I_s in the $p\pi^0\eta$ final state obtained with a linearly polarized photon beam at coherent edge positions of 1750 MeV and 1850 MeV with an unpolarized target.

HK 47.4 Wed 16:45 HBR 62: EG 19
Partial Wave Analysis for Pion-Induced Resonance Studies in the HADES Experiment — •Ahmed M. Foda for the HADES-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

The High Acceptance Di-lepton Spectrometer (HADES) collaboration at GSI employs a pion beam to examine the characteristics of baryonic resonances and their decay channels. This pion-beam facility possess a significant advantage over proton-induced reactions and provides complementary information to photo-induced studies. Furthermore, HADES has a particular interest in studying the role and medium modification of vector mesons in heavy-ion collisions in baryon-dense matter. Elementary pion-induced studies on the proton combined with a partial wave analysis (PWA) will provide insights into the couplings of baryonic resonances to ρN and ωN final states in greater detail, will provide insights into the impact of the melting of the ρ meson in heavy ion collisions and the involvement of intermediary vector mesons in dilepton emissions.

In anticipation of conducting a more comprehensive exploration of the resonance regions in pion-proton collisions, a new implementation of the K-Matrix & N/D frameworks is currently under development. This updated implementation aims to offer a refined mapping of these regions. Example fits will be presented showing the current status and the potential of the new framework.

HK 47.5 Wed 17:00 HBR 62: EG 19
Truncated partial-wave analysis with Bayesian inference — •Philipp Krönert, Yannick Wunderlich, Farah Afzal, and Annika Thiel — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Nussallee 14-16, 53115 Bonn

In Baryon spectroscopy, several models for partial-wave analysis are available for extracting physical quantities from measured polarization observables. Notable examples are the Bonn-Gatchina K-matrix model, the Jülich-Bonn dynamical coupled-channel approach, and the Eta-MAID unitarised isobar-model. All of these models incorporate an energy-dependent parameterization for the complex spin amplitudes. Truncated partial-wave analysis provides a model-independent approach.

Truncated partial-wave analysis has been combined with Bayesian inference for the first time, allowing for unrivalled estimation of parameter uncertainty and a unique interpretation of results in comparison to the traditional maximum likelihood approach. In addition, this approach facilitates the investigation of the structure of so-called ambiguities in the analysis results.

The talk will discuss the challenges of using Bayesian inference with a multimodal posterior. Furthermore, model independent estimates of multipole parameters and predictions of yet unmeasured polarization observables for the reaction $\gamma p \to \eta p$ just above the production threshold.

HK 48: Heavy-Ion Collisions and QCD Phases XII

Time: Wednesday 17:30–19:00 Location: HBR 14: HS 1

HK 48.1 Wed 17:30 HBR 14: HS 1

Vorticity in heavy-ion reactions from a coarse-grained transport approach — •Robin Sattler[1], Nils Sass[1], and Hannah Elfner[1,2,3,4] — [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 2017, the STAR collaboration at the Relativistic Heavy Ion Collider (RHIC) measured the polarization of Λ (and $\bar{\Lambda}$) hyperons and deduced an estimate for the vorticity in heavy ion collisions (HICs). Their findings suggest that the fluid produced in HICs is a highly vortical system due to the large deposition of angular momentum in the interaction medium of non-central collisions. In this work, the vortical flow structure of HICs is examined applying the hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons) within a coarse-grained framework. The thermal vorticity in non-central Au+Au collisions is calculated. In order to compare the results to the experimental data of the STAR collaboration, the polarization of the Λ hyperons is determined on the freeze-out hypersurface. In addition, the results are compared to a similar study within the UrQMD (Ultra-relativistic Quantum Molecular Dynamics) approach.

HK 48.2 Wed 17:45 HBR 14: HS 1

QCD topology and axions — Bastian Brandt, Gergely Endrődi, •José Javier Hernández Hernández, Gergely Markó, and Laurin Pannullo — Universität Bielefeld

A possible solution to the strong CP problem is the axion mechanism. Axions are widely studied since they are also candidates for dark matter and they are susceptible to experimental detection, e.g. through their coupling with photons. Moreover, the axion mass is a source of cosmological information during the early universe. Using Lattice QCD simulations with staggered quarks at the physical point, we explore the impact of electromagnetic fields on topological observables related to axions. Our focus is on the topological susceptibility ($\propto m_a^2$) and the axion-photon coupling. The current status in the determination of the magnetic field dependence of the axion mass at finite temperature, with a focus in the crossover region, is shown. We also present the result of the first non-perturbative calculation of the QCD corrections to the axion-photon coupling.

HK 48.3 Wed 18:00 HBR 14: HS 1

On the validity of Ohm's law in relativistic plasmas — •Ashutosh Dash, Masoud Shokri, Luciano Rezzolla, and Dirk Rischke — Goethe university, Institute for theoretical physics, 60438 Frankfurt am Main

Relativistic plasmas play a significant role in high-energy phenomena, including heavy-ion collisions, black-hole magnetospheres, relativistic jets, and the early universe. The coarse-grained framework for describing the motion of charged fluid is known as relativistic magnetohydrodynamics (MHD). The MHD equations, which comprise the particle conservation law, the energy/momentum conservation laws, and Maxwell*s equations, must also be complemented by Ohm*s law. The usual Navier-Stokes form of Ohm's law is acausal and needs to be replaced with an evolution equation of the charge diffusion current with a finite relaxation time, which ensures causality and stability.

This, in turn, leads to transient effects in the charge-diffusion current, the nature of which depends on the particular values of electrical conductivity and the charge-diffusion relaxation time. We will investigate in a simplified 1+1-dimensional setting in the context of heavy-ion collision, where matter and electromagnetic fields are assumed to be transversely homogeneous and are initially expanding according to a Björken scaling. We will see how the scale invariance is broken by the ensuing self-consistent dynamics of matter and electromagnetic fields. Implications of these findings on the recent measurement of charged particle directed flow by the STAR experiment will also be discussed.

HK 48.4 Wed 18:15 HBR 14: HS 1

Critical dynamics of non-equilibrium phase transitions — •Leon Sieke[1], Mattis Harhoff[3], Sören Schlichting[3], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Research Academy for FAIR (HFHF), Campus Gießen, 35392 Gießen, Germany — [3]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany

In context of the search for the QCD critical endpoint in heavy-ion collisions, a deep understanding of the out-of-equilibrium dynamics of the system is necessary to make well-grounded predictions for signatures in final states. To this end, we investigate the dynamic critical behavior of a classical scalar field theory with Z_2 symmetry in the dynamic universality class of Model A in two and three spatial dimensions. The critical dynamics of the system is studied under a linear quench protocol, where the external symmetry breaking field is changed at a constant rate through the critical point. We discuss the connection to the Kibble-Zurek mechanism and determine the dynamic critical exponent z as well as universal scaling functions. These fully describe the non-equilibrium evolution of the system near the critical point for all quench rates under consideration. We find that while the scaling functions are non-trivial, the corresponding scaling exponents are fully determined by the static critical exponents and the dynamic critical exponent. Finally, we perform a finite-size scaling analysis and observe good collapse of the data onto universal finite-size scaling functions.

HK 48.5 Wed 18:30 HBR 14: HS 1

Critical Dynamics from the Analytically Continued FRG — •Patrick Niekamp[1], Lorenz von Smekal[1,2], and Johannes Roth[1] — [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 48.6 Wed 18:45 HBR 14: HS 1

Non-relativistic stochastic hydrodynamics — •Mattis Harhoff[1], Sören Schlichting[1], and Lorenz von Smekal[2,3] — [1]Fakultät für Physik, Universität Bielefeld, 33615 Bielefeld, Germany — [2]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [3]Helmholtz Research Academy for FAIR (HFHF), Campus Gießen, 35392 Gießen, Germany

Understanding dynamic critical phenomena is a crucial ingredient to finding signatures of a QCD critical endpoint in final states of non-equilibrium processes such as heavy ion collisions. If such a system exhibits the right conservation laws, its non-equilibrium dynamics in the vicinity of a critical point can be understood hydrodynamically, corresponding to Model H in the classification scheme by Halperin and Hohenberg. Since fluctuations of the order parameter diverge near a critical point, including stochastic fluctuations into the underlying hydrodynamic equations is essential to describe critical phenomena correctly. We propose a novel approach to the numerical simulation of non-relativistic stochastic hydrodynamics on a lattice in two spatial dimensions. Our method features a Metropolis-type algorithm to sample stochastic fluxes of the conserved quantities, ensuring that fluctuations follow the correct microcanonical probability distribution. Tuning input parameters using an entropy production argument generates the desired transport coefficients. We present how the algorithm can be used to simulate problems such as stochastic diffusion and give an outlook on applications in the context of non-equilibrium phase transitions.

HK 49: Nuclear Astrophysics IV

Time: Wednesday 17:30–19:15 Location: HBR 14: HS 4

Group Report HK 49.1 Wed 17:30 HBR 14: HS 4
First study of the ^{139}Ba(n,γ)^{140}Ba reaction to constrain the conditions for the astrophysical i process — •Dennis Muecher[1], Artemis Spyrou[2], Pavel Denissenkov[3], Falk Hervig[3], Magne Guttormsen[4], Ann-Ceceilie Larsen[4], and Mathis Wiedeking[5] — [1]Institut für Kernphysik, Universität zu Köln — [2]FRIB, Michigan State University, USA — [3]Department of Physics and Astronomy, University of Victoria, Canada — [4]Department of Physics, University of Oslo, Norway — [5]SSC Laboratory, iThemba LABS, South Africa

The intermediate "i" process was proposed as a plausible scenario to explain some of the unusual abundance patterns observed in metal-poor stars (Denissenkov et al, ApJ Letters 2017). The most important nuclear physics properties entering i-process calculations are the neutron-capture cross sections and they are almost exclusively not known experimentally. In this talk we demonstrate results (Spyrou et al., under review at PRL, 2023) from an experiment using RIBs from CARIBU, Argonne National Laboratory, allowing to experimentally constraint the ^{139}Ba(n,γ)^{140}Ba reaction rate using the newly developed "Shape" method (Muecher et al., PRC 107, L011602, 2023). Our results remove the dominant source of uncertainty for the production of lanthanum, a key indicator of i-process conditions. Our results show that the observed elemental abundances in metal-poor stars are consistent with an i-process scenario at neutron densities of $10^{13} n/cm^3$.

HK 49.2 Wed 18:00 HBR 14: HS 4
A Trap System for Measuring Neutron Capture Cross Sections for the r-process — •Heinrich Wilsenach[1,4], Timo Dickel[1,2], Israel Mardor[4,5], Emma Haettner[2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2,3], and Mikhail Yavor[6] — [1]Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]HFHF, Gießen, Germany — [4]Tel Aviv University, Tel Aviv, Israel — [5]Soreq Nuclear Research Center, Yavne, Israel — [6]St. Petersburg, Russia

One of the current limitations of predicting the nuclear astrophysics r-process abundance is the lack of experimental data of neutron-capture cross-sections of radioactive neutron-rich isotopes. Their measurement is currently considered very challenging due to the instability of the targets and projectile. To overcome this limitation, we plan to stop and thermalise fission fragments in a cryogenic stopping cell. These fragments will then form a cooled low-energy beam, which will be transported into an RF trap system (coined “NG-Trap”). An intense neutron beam will consequently irradiate this trapped “cloud target”. The reacted ions will be mass-selected, identified and counted using a multiple-reflection time-of-flight mass-spectrometer (MR-TOF-MS), thus extracting (n,γ) cross-sections. The talk will discuss the current status of a triple-RFQ system operating at Tel-Aviv University and present a measured trap capacity of more than 10^{10} ions. The system is the first step in designing the final NG-Trap system to be installed at the Soreq Applied Research Accelerator Facility (SARAF).

HK 49.3 Wed 18:15 HBR 14: HS 4
Towards direct measurements of astrophysical neutron capture rates in unstable nuclei — •Timm-Florian Pabst[1], Abdallah Karaka[1], Markus Schiffer[1], Stefan Heinze[1], Erik Strub[2], and Dennis Mücher[1] — [1]University of Cologne, Institute of Nuclear Physics, Cologne, Germany — [2]University of Cologne, Division of Nuclear Chemistry, Cologne, Germany

The intermediate neutron capture process (i process) is presumably taking place in AGB stars and is required to explain elemental abundances of certain CEMP stars. With most quantities along the i process being well constrained experimentally, neutron capture rates are among the largest unknowns in terms of the nuclear physics input. While indirect measurements suffer from higher uncertainties, direct measurements are hindered by the fact that many key nuclei along the i process are unstable.

In this talk we will discuss the possibilities for direct measurements of neutron capture cross sections for selected long-lived target nuclei, with the goal to constrain the astrophysical conditions of the i process. We discuss the status and first tests of a new beamline for the production of a high density secondary neutron beam at the CologneAMS 6MV tandetron. Cross sections will be measured via a new activation technique based on beta-decay electron detection. Our first physics case is the $^{137}\mathrm{Cs}(n,\gamma)^{138}\mathrm{Cs}$ cross section with the goal to shed light into understanding the observed Lanthanum and Barium abundances in AGB stars.

HK 49.4 Wed 18:30 HBR 14: HS 4
Neutron-star merger models including all phases of matter ejection — •Oliver Just[1,2], Vimal Vijayan[1,3], Zewei Xiong[1], Stephane Goriely[4], Theodoros Soultanis[1], Andreas Bauswein[1,5], Jerome Guilet[6], Hans-Thomas Janka[7], and Gabriel Martinez-Pinedo[1,5,8] — [1]GSI, Darmstadt, German — [2]RIKEN, Saitama, Japan — [3]Ruprecht-Karls-Universität, Heidelberg, Germany — [4]ULB, Brussels, Belgium — [5]FAIR HFHF, Darmstadt, Germany — [6]Paris University, France — [7]MPA, Garching, Germany — [8]IKP, Darmstadt, Germany

Collisions of two neutron stars, as first observed in 2017, are unique nuclear physics laboratories. The material ejected during these events is believed to undergo the rapid neutron-capture (r-) process, and the nuclear equation of state (EOS) has a crucial impact on the lifetime of the hyper-massive merger remnant until it collapses to a black hole. In order to predict the observational signature, e.g. the kilonova signal, of r-process nucleosynthesis and the nuclear EOS, detailed numerical simulations are necessary, ideally covering all phases of matter ejection. Most existing simulations, however, focus only on the first tens of milliseconds and neglect the subsequent ("post-merger") evolution. This contribution presents our recent study where we developed models of delayed-collapse mergers, which cover about 100 seconds, i.e. all relevant phases of matter ejection. Such "end-to-end" models are essential for reliably predicting the total r-process yields, the geometric distribution of different chemical elements in the ejecta, and for assessing the impact of the remnant lifetime on the kilonova.

HK 49.5 Wed 18:45 HBR 14: HS 4
Decoding the HESS J1731-347 compact object's equation of state — •Ishfaq Ahmad Rather[1], Grigoris Panotopoulos[2], and Ilidio Lopes[3] — [1]Institute of Theoretical Physics, Goethe University, Frankfurt am main — [2]Departamento de Ciencias Fisicas, Universidad de la Frontera, Casilla 54-D, 4811186 Temuco, Chile — [3]CENTRA, Instituto Superior Tecnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal

The recently announced measurement of HESS J1731-347 with $M = 0.77^{+0.20}_{-0.17} M_\odot$ and $R = 10.4^{+0.86}_{-0.78}$ km challenges our understanding of the EoS at densities (1-2) times the nuclear saturation density [1]. This estimate of maximum mass, 0.77 $M_\odot$, is intriguing, given the previous analysis revealed that the minimum possible mass of a neutron star is 1.17M*. The HESS J1731-347 measurement is also interesting as the first simultaneous measurement of the mass, radius, and surface temperature of a compact star and opens the possibility to study its thermal evolution. We examine the nature of HESS J1731-347 as a strange star and study the radial properties at its maximum mass [2]. We also explore the possibility of HESS J1731-347 CCO to be a Dark Matter admixed Strange star.

References:
1) V. Doroshenko, V. Suleimanov, G. Pühlhofer, A. Santangelo, Nat.

Astron. 6(12), 1444-1451 (2022)
2) I. A. Rather, G. Panotopoulos, I. Lopes, EPJ C, 83:1065 (2023)

HK 49.6 Wed 19:00 HBR 14: HS 4

Towards a Doppler shift measurement of the 1 fs lifetime of the 6.79 MeV state in ^{15}O — •Max Osswald[1,2], Daniel Bemmerer[1], Antonio Caciolli[3,4], Eliana Masha[1], Jakub Skowronski[3,4], Elia Pilotto[3,4], Steffen Turkat[2], and Bruno Poser[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden — [3]INFN Sezione di Padova, Italy — [4]Università degli Studi di Padova, Italy

The 6.79 MeV excited state in ^{15}O plays an important role in nuclear astrophysics, because it is a subthreshold resonance that is significant for the low-energy extrapolation of the ^{14}N$(p,\gamma)^{15}$O reaction. This reaction controls the rate of the Bethe-Weizsäcker cycle of hydrogen burning. Its lifetime is on the level of 1-3 fs, with many recent experiments giving conflicting data. The present contribution will report on the first steps of the data analysis of a recent experiment using the AGATA γ-ray tracking array coupled with the CD silicon detector at Legnaro National Lab, Italy. The contribution will also cover some target stability measurements carried out at Dresdener Felsenkeller, Germany, prior to the Legnaro experiment.

HK 50: Instrumentation XII

Time: Wednesday 17:30–19:00 Location: HBR 19: C 1

Group Report HK 50.1 Wed 17:30 HBR 19: C 1

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

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

The CBM detector systems are free-running and self-triggered, delivering time-stamped data streams. As there is no inherent event separation, timeslice building takes the place of global event building. The FLES combines the data from approximately 5000 input links to self-contained, overlapping processing intervals and distributes them to compute nodes. It employs a high-bandwidth InfiniBand network as well as dedicated custom FPGA input boards providing time-addressed access to buffered data. Subsequently, specialized algorithms analyze these processing intervals in 4-D, identify events, and select those relevant for storage. The developed hardware and software solutions are already being applied productively on a smaller scale in the mCBM experiment (FAIR Phase-0).

This presentation summarizes the status of the CBM First-level Event Selector project and includes results from recent mCBM campaigns. This work is supported by BMBF (05P21RFFC1).

HK 50.2 Wed 18:00 HBR 19: C 1

A FLES Interface Module for the CBM Common Readout Interface Card — •Dirk Hutter for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM First-level Event Selector (FLES) is the central data handling and event selection entity of the upcoming CBM experiment at FAIR. Constructed as a scaleable high-performance computing cluster, it is designed for online analysis of unfiltered physics data at rates exceeding 1 TByte/s.

Data from the detector systems enters the FLES via custom FPGA PCIe boards, the common readout interface. As part of the FPGA design, the FLES interface module (FLIM) implements the interface between subsystem-specific readout logic and the generic FLES data handling. It receives packaged detector messages and performs data transfers to the host's memory via a low-latency, high-throughput PCIe DMA engine. The custom design enables a true zero-copy data flow.

The first version of the FLIM is fully implemented and is in active use in CBM test setups as well as the FAIR Phase-0 experiment mCBM. The upcoming second generation of the FLIM optimizes the data flow and is designed to work with the next-generation interface card. An overview of the FLES input interface, performance studies, and plans for the next-generation FLIM will be presented.

This work is supported by BMBF (05P21RFFC1).

HK 50.3 Wed 18:15 HBR 19: C 1

Simple readout system of ALICE silicon detectors — •Bent Buttwill for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

The Outer Barrel Module (OBM) used in the the outermost four layers of ALICE Inner Tracking System (ITS2) utilizes interconnected Monolithic Active Pixel Sensors (MAPS) ALPIDE. The operational ITS2 has a surplus of spare modules available which could be used outside of the ALICE experiment. For this, a simpler readout was required to make use of the modules in tabletop experiments.

This talk introduces a readout system using the widely accessible microcontroller RP2040, with communication exclusively managed via the chip's slow control interfaces, enabling full configuration and data readout at reduced rates. A small scale proton-nucleus reaction cross section measurement proposed for 2024 at the Marburger Ionenstrahl-Therapiezentrum (MIT) will greatly profit from the large active area offered by the OBM and from the new readout system.

HK 50.4 Wed 18:30 HBR 19: C 1

The Data Acquisition for PANDA FAIR Phase-0 at MAMI — Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Samet Katilmis[1], Frank Maas[1,2,3], •Oliver Noll[1,2], David Rodriguez Piñeiro[1], Paul Schöner[1], Christoph Rosner[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 PANDA FAIR Phase-0 experiment at the Mainz Microtron Facility (MAMI) is set to determine the double-virtual transition formfactor (TFF) of the pion. As a result, the uncertainty in the hadronic light-by-light (HLbL) calculation can be reduced. Consequently, the experiment will give new input to the hadronic corrections of the anomalous magnetic moment of the muon (g_μ-2 puzzle). The detector system for the experiment is a modified version of the PANDA backward calorimeter, which was designed by the electromagnetic process group (EMP) at HI-Mainz. In contrast to the PANDA experiment, the detector will operate in forward direction within a strong electromagnetic environment. The PANDA FAIR Phase-0 data acquisition is optimised to record the exclusive signal channel under high-background conditions. The talk addresses the readout chain with the analogue frontend, the digitisation using the PANDA SADC, the digital signal processing on FPGAs and the efficient data transmission via the Trigger Bus Synchronisation System (TRB).

HK 50.5 Wed 18:45 HBR 19: C 1

Data acquisition rate enhancement for experiments with exotic nuclei at GSI — •Martin Bajzek[1,2] and Nikolaus Kurz[1] for the Super-FRS Experiment-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Justus-Liebig-Universitat Gießen, Gießen, Germany

In the search for ever more exotic nuclei, and probing into various physics phenomena at very low cross sections, one of the main limiting factors is the acquisition rate at which the detector systems can operate. Usually, the sampling rate is limited by the digital electronics' side, rather than analog detector hardware. We have integrated and adapted the MVLC Mesytec VME Controller into the standard GSI data acquisition system MBS (Multi Branch System), which is used for essentially all experiments on exotic nuclei at the fragment separator FRS. The expected goal is to enhance the acquisition rate capability by a factor 2...3. In this contribution, first results obtained with pulsed triggers and beams are discussed.

HK 51: Instrumentation XIII

Time: Wednesday 17:30–19:15 Location: HBR 19: C 2

HK 51.1 Wed 17:30 HBR 19: C 2

Developing temperature simulations to optimize cluster-jet and droplet target designs — •Jost Froning, Elena Lammert, Christian Mannweiler, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

Internal hydrogen cluster-jet and droplet targets are widely applied in accelerator experiments in nuclear and particle physics. For example, both target types are to be used in the future PANDA experiment at FAIR.
Hydrogen at cryogenic temperatures is a mandatory requirement for the operation of cluster-jet and droplet targets in order to enable hydrogen liquefaction. The temperature demands on the target designs are therefore very high, so that proven design concepts have been relied on up to now. By simulating the temperature distributions of different target geometries, their performance can be predicted cost-effectively instead of constructing a new geometry without knowing its temperature behavior in advance.
This talk shows developed temperature simulations of current target designs using Autodesk CFD, comparisons between simulated and measured temperatures and optimization possibilities for future constructions.
The research project was supported by BMBF (05P21PMFP1) and the EU's Horizon 2020 programme (824093).

HK 51.2 Wed 17:45 HBR 19: C 2

Simulations of adiabatic fast passage spin flippers for the neutron lifetime experiment τSPECT — •Niklas Pfeifer[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

The τSPECT experiment aims to measure the free neutron lifetime with an uncertainity goal of sub second by storing ultra-cold neutrons in a fully magnetic bottle. A key element of the experiment is the adiabatic fast passage spin flipper. It is used to convert the neutrons into the storable, low-field-seeking spin state by applying a radiofrequency field in a magnetic field gradient region. To study and understand systematic effects and reduce uncertainties of the current design, simulations of neutron dynamics during the spin flip process are needed. Based on the PENTrack software we developed a simulation framework to accurately simulate the trajectories as well as the spin dynamics of ultra-cold neutrons in complex electromagnetic fields.

This talk will present the underlying theory, latest results and challenges of neutrons spin-flipping simulations for τSPECT as well as possible future optimizations and performance improvements.

HK 51.3 Wed 18:00 HBR 19: C 2

Evaluation of the precision of the NeuLAND positional calibration using different methods — •Yanzhao Wang[1], Igor Gasparic[2], Håkan Johansson[3], Konstanze Boretzky[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Germany — [3]Chalmers University of Technology, Sweden

The New Large-Area Neutron Detector NeuLAND, as part of the R^3B experiment at FAIR, aims at providing a high detection efficiency and spatial-temporal resolution of neutrons generated from the high-intensity radioactive beam[1]. Multiple calibration processes of NeuLAND, such as energy calibration and positional calibration, rely heavily on the reconstruction of local muon tracks from cosmic radiation. In this talk, we introduce two major methods for positional calibrations: the first method reconstructs local muon tracks using only the geometrical information of the NeuLAND scintillator array while the second method utilizes the Millipede algorithm in the reconstruction, irrespective of the large number of local parameters of muon tracks. The precisions from both methods will be compared based on the same experimental data from a R^3B experiment.
Supported by the BMBF (05P21PKFN1).

[1] K. Boretzky *et al.*, Nucl. Instrum. Methods Phys. Res. A1014 (2021) 165701

HK 51.4 Wed 18:15 HBR 19: C 2

Vacuum studies on the $\overline{\text{P}}$ANDA cluster-jet target considering flash evaporation and cluster bursting — •Michael Weide, Philipp Brand, 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 $\overline{\text{P}}$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 ≤ 10 microns in diameter.

A challenge of such an experiment is minimizing background reactions due to the costly production of antiprotons, thus good vacuum conditions are mandatory. Residual gas sources in a CJT include flash evaporation, i.e., the evaporation of H_2 due to thermal radiation and the pressure difference between the cluster and its surroundings, and cluster bursting, i.e., the burst of H_2 during the interaction between the accelerator beam and a cluster.

To analyze the gas load caused by flash evaporation, a simulation software was developed that computes the outgassing rate per cluster size along the entire cluster-jet. Additionally, measurements at the Cooler Synchrotron (COSY) at FZ Jülich were performed, to study the accelerator beam induced pressure increase in the interaction chamber.

The research project was supported by BMBF (05P21PMFP1) and the EU's Horizon 2020 program (824093).

HK 51.5 Wed 18:30 HBR 19: C 2

Beam and Target Optimization for the KOALA Experiment — •Ruijia Yang[1,2], Frank Goldenbaum[1,2], and Huagen Xu[2] for the PANDA-Collaboration — [1]Bergische Universität Wuppertal — [2]Forschungszentrum Jülich GmbH

The KOALA experiment is aimed to measure (anti)proton-proton elastic scattering over a wide range of four momentum transfer squared $0.0008 < |t| < 0.1(GeV/c)^2$ in order to precisely determine the differential cross section. The wide range of |t| is achieved by measuring the total kinetic energy as well as the recoil angle α(=90°-θ) from -1.8° to 15° of the recoil protons with a recoil detector consisting of silicon and germanium single-sided strip sensors. The large background at small |t| can be suppressed by measuring the elastically scattered beam particles in the forward direction close to the beam axis with a forward detector, which contains two layers of plastic scintillators. It is noted that the finite thickness of the target profile and the residual gas in the scattering chamber play critical roles at such small recoil angles (α<1.2°), while attempting to achieve the expected smallest |t|. Meanwhile it is also observed that the beam imperfection such as large profile and offset to beam axis introduces a non-negligible impact on the measurement precision. As a compensation for the missing acceptance at the forward region, a larger scintillator detector has been implemented. The simulation study based upon KoalaSoft for the influence of the realistic target profile, residual gas in the scattering chamber as well as the beam imperfection is ongoing. The latest results of the study will be presented.

HK 51.6 Wed 18:45 HBR 19: C 2

Characterisation and optimisation of the MDT-H droplet target — •Christian Mannweiler, Daniel Bonaventura, Jost Froning, Anna Luna Hannen, and Alfons Khoukaz for the PANDA-Collaboration — Universität Münster

Internal target systems enjoy widespread use in various different fields of physics, such as plasma or particle physics. A prominent example will be the $\overline{\text{P}}$ANDA experiment at FAIR which will make use of both hydrogen cluster-jet and droplet/pellet target systems.

The operating principle of a hydrogen droplet target is to force cryogenic liquid hydrogen through a nozzle with an aperture size of around 10 microns. By inducing vibrations in the nozzle through a piezoelectric element the resultant liquid hydrogen beam is then broken up into droplets which can then propagate over ranges of several meters through vacuum.

The MDT-H is a newly constructed droplet target prototype currently set up in Münster. Through a novel, modular gas system design which allows for a higher standard of purity this target is considerably more reliable than previous designs and allows for quick progress in the characterisation and optimisation of its properties.

In our contribution we will present the MDT-H in detail and show some first results of our characterisation and optimisation endeavours.

This project has received funding from the EU Horizon 2020 programme (824093).

HK 51.7 Wed 19:00 HBR 19: C 2

Advancing Nuclear Technology: Applications and Studies of High Entropy Alloys — •Gizem Öztürk[1], Hüseyin Ozan Tekin[2], Baki Akkuş[3], and Ömer Güler[4] — [1]Department of Physics, Faculty of Science, Istanbul University, 34134, Istanbul, Turkey — [2]Department of Medical Diagnostic Imaging, College of Health Sciences, University of Sharjah, 27272, Sharjah, United Arab Emirates — [3]Department of Physics, Faculty of Science, Istanbul University, 34134, Istanbul, Turkey — [4]Rare Earth Elements Application and Research Center, Munzur University, 62000 Tunceli, Turkey

High Entropy Alloys (HEAs) have emerged as a frontier for innovative advancements, particularly in nuclear applications. This presentation commences with a foundational overview of HEAs, elucidating their unique compositional and structural attributes. These alloys offering remarkable attributes such as high strength, corrosion resistance, and thermal stability. Our research group members have employed cutting-edge techniques such as additive manufacturing and advanced characterization methods to understand the microstructural and mechanical properties of these alloys. Our findings reveal that specific HEA compositions exhibit enhanced radiation tolerance and mechanical robustness, making them suitable for nuclear applications. In conclusion, our research underscores the transformative potential of High Entropy Alloys in nuclear applications. By offering novel insights into their properties and applications, this presentation aims to pave the way for safer, more efficient, and sustainable nuclear technologies.

HK 52: Structure and Dynamics of Nuclei X

Time: Wednesday 17:30–19:00 Location: HBR 19: C 5a

HK 52.1 Wed 17:30 HBR 19: C 5a

Absolute photon flux determination for nuclear resonance fluorescence experiments above the neutron separation threshold — •K. Prifti[1], J. Kleemann[1], U. Friman-Gayer[2,3,4], J. Isaak[1], N. Pietralla[1], V. Werner[1], A. D. Ayangeakaa[2,5], T. Beck[1,6], M. L. Cortes[1], S. W. Finch[2,3], M. Fulghieri[2,5], D. Gribble[2,5], K. E. Ide[1], X. James[2,5], R. V. F. Janssens[2,5], S. R. Johnson[2,5], P. Koseoglou[1], FNU Krishichayan[2,3], O. Papst[1], D. Savran[7], and W. Tornow[2,3] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]Duke University, Durham, NC, USA — [4]ESS, Lund, SE — [5]UNC, Chapel Hill, NC, USA — [6]FRIB, East Lansing, MI, USA — [7]GSI, Darmstadt

The giant dipole resonance (GDR) is a fundamental nuclear excitation that dominates the dipole response of all nuclei. The present work aims at quantifying the branching ratio of the decay of the GDR of ^{154}Sm and ^{140}Ce, via emission of γ-rays or neutrons as a function of excitation energy. An activation measurement has been performed simultaneously to a nuclear resonance fluorescence (NRF) measurement in the energy range from 11.22 MeV to 17.5 MeV at the HIγS facility. Natural samples of Sm, Ce and Au were used as targets in the activation measurements. By determining their activation after irradiation and then comparing it to the GDR-NRF events that are observed, the γ- to neutron-decay branching ratio was determined.

Supported by the State of Hesse within Cluster project ELEMENTS and the LOEWE project, DFG Project-ID 499256822-GRK 2891 and U.S. DOE grant Nos DE-FG02-97ER41041 and DE-FG02-97ER41033.

HK 52.2 Wed 17:45 HBR 19: C 5a

Investigation of the Pygmy Dipole Resonance near the magic $N = 82$ shell closure — •Florian Kluwig[1], Miriam Müscher[1], Deniz Savran[2], Ronald Schwengner[3], Tanja Schüttler[1], 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) is part of the electric dipole response in atomic nuclei. However, despite being a subject of significant interest in both theoretical and experimental domains over recent decades [1-3], several questions regarding its structure and origin remain open. Systematic studies are therefore crucial for enhancing our understanding of this excitation mode. Such studies have been performed on isotopes near the magic $N = 82$ shell closure, e.g., ^{144,146}Nd and ^{142}Ce, using real-photon scattering experiments, commonly denoted as Nuclear Resonance Fluorescence (NRF). Photons are a well-suited probe for the investigation of the PDR since they only transfer small angular momenta [4]. In this contribution, the results of NRF experiments on ^{144}Nd and comparisons with other experiments on neighbouring isotopes and isotones will be presented.

This work is partly supported by the BMBF (05P21PKEN9).

[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 52.3 Wed 18:00 HBR 19: C 5a

γ-decay Behavior of the Giant Dipole Resonances of ^{154}Sm and ^{140}Ce — •J. Kleemann[1], U. Friman-Gayer[2,3,4], J. Isaak[1], O. Papst[1], N. Pietralla[1], V. Werner[1], A. D. Ayangeakaa[2,5], T. Beck[1,6], M. L. Cortés[1], S. W. Finch[2,3], M. Fulghieri[2,5], D. Gribble[2,5], K. E. Ide[1], X. James[2,5], R. V. F. Janssens[2,5], S. R. Johnson[2,5], P. Koseoglou[1], FNU Krishichayan[2,3], D. Savran[7], and W. Tornow[2,3] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]Duke University, Durham, NC, USA — [4]ESS, Lund, SE — [5]UNC, Chapel Hill, NC, USA — [6]FRIB, MSU, East Lansing, MI, USA — [7]GSI, Darmstadt

The giant dipole resonance (GDR) is one of the most fundamental nuclear excitations and dominates the dipole response of all nuclei. Geometrically it is pictured as an isovector oscillation of the proton against the neutron body. Recently, novel data on the γ-decay of the GDR of the well-deformed nuclide ^{154}Sm and the spherical nuclide ^{140}Ce were obtained through photonuclear experiments at the HIγS facility. Individual regions of the GDR were selectively excited by HIγS's intense, linearly-polarized and quasi-monochromatic γ-ray beam. The obtained data allow for a novel close experimental assessment of the geometrical model of the GDR, in particular for ^{154}Sm with its double-humped GDR and respective K-quantum-number assignments.

Supported by the BMBF under grant No. 05P21RDEN9, by the DFG under GRK 2891, Project-ID 499256822 and the U.S. DOE under grant Nos. DE-FG02-97ER41041 and DE-FG02-97ER41033.

HK 52.4 Wed 18:15 HBR 19: C 5a

Studying the internal conversion decay of the ^{229}Th isomer in the bulk of VUV-sensitive SiPMs — •Lilli Löbell[1], Daniel Moritz[1], Georg Holthoff[1], Mahmood Hussain[1], Sandro Kraemer[1], Tamila Rozibakieva[1], Kevin Scharl[1], Benedict Seiferle[1], Lars von der Wense[2], Markus Wiesinger[1], and Peter G. Thirolf[1] — [1]Ludwig-Maximilians-Universität München — [2]Johannes-Gutenberg-Universität Mainz

^{229}Th has a nuclear isomer with an exceptionally low excitation energy of only 8.338 ± 0.024 eV ($\lambda = 148.71 \pm 0.42$ nm). This makes ^{229m}Th the so far only candidate for a nuclear clock, which has potential applications ranging from dark matter research and searching for a time dependence of fundamental constants to improving geodesy and satellite-based navigational systems. For the decay of the thorium isomer to the ground state, the dominant decay channel in neutral ^{229m}Th atoms is internal conversion (IC). The half-life of the IC decay measured on a metallic surface was found to be 7 ± 1 μs, but there are indications of a dependence on the electronic environment surrounding the thorium atom. We are currently investigating the IC lifetime of ^{229m}Th within a solid state environment by implanting ^{229m}Th atoms into the depletion region of VUV-sensitive silicon photomultipliers, where the IC electrons can be detected. In case of a significantly longer IC lifetime, this could be an approach for a solid-state nuclear clock based on internal conversion. The talk presents the current status of this project. This work was supported by the European Research Council (ERC): ERC Synergy Grant 'ThoriumNuclearClock'.

HK 52.5 Wed 18:30 HBR 19: C 5a

Preparations and first results using fast-timing lifetime

analysis within the nu-Ball2 fission campaign — •Julia Fischer[1], Andrey Blazhev[1], Corentin Hiver[2], Jan Jolie[1], Andi Messingschlager[3], Sorin Pascu[4], Martin von Tresckow[3], Nigel Warr[1], and Jonathan Wilson[2] for the nu-Ball2 N-SI-120-Collaboration — [1]IKP Cologne — [2]IJCLab Orsay — [3]TU Darmstadt — [4]U Surrey

Nuclei beyond the band of stability are crucial to our understanding of the atomic nucleus and nuclear forces. Over the years, neutron-rich krypton isotopes have been studied as part of various campaigns [1,2]. Recently, high-resolution and fast-timing measurements were performed at the IJCLab Orsay as part of the nu-Ball2 fission campaign. The novel hybrid γ-spectrometer nu-Ball2 consists of HPGe and $LaBr_3$(Ce) detectors which provide excellent energy and timing information, respectively. The nuclei of interest were produced with a fast-neutron-induced fission reaction ^{238}U(n,f). Before new results can be reliably extracted, the time-walk of the $LaBr_3$(Ce) detectors had to calibrated and the performance of the setup to be validated using the known lifetimes of excited states. The calibration and validation of the nu-Ball2 fast-timing analysis, as well as some preliminary results will be presented. *Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21PKFN1.

[1] R.-B. Gerst et al., PRC 102, 064323 (2020).
[2] R.-B. Gerst et al., PRC 105, 024302 (2022).

HK 52.6 Wed 18:45 HBR 19: C 5a

Lifetime measurement of excited states in ^{150}Gd — •Felix Dunkel, Arwin Esmaylzadeh, Christoph Fransen, Jan Jolie, Casper-David Lakenbrink, Richard Novak, and Franziskus Spee — Institut für Kernphysik, Köln, Deutschland

To investigate the evolution of deformation along the Z = 64 (Gd) subshell closure between N = 82 and N = 90 lifetimes of low-lying excited states in ^{150}Gd were measured utilizing the Recoil Distance Doppler-Shift (RDDS) method. The excited states were populated using the ^{142}Ce(^{12}C,4n)^{150}Gd fusion-evaporation reaction at the FN Tandem accelerator at the IKP Cologne. Measured γ-γ coincidence data were analyzed with the differential decay-curve method (DDCM). It was possible to determine the lifetimes of the 2_1^+,4_1^+,3_1^- states. In this contribution we will present the results, discuss the evolution of collectivity along the isotopic chain and compare the results with theoretical calculations. Work supported by BMBF under grant 05P21PKFN1.

HK 53: Structure and Dynamics of Nuclei XI

Time: Wednesday 17:30–19:00 Location: HBR 19: C 5b

Group Report HK 53.1 Wed 17:30 HBR 19: C 5b

The lowest-lying mixed-symmetry 2^+ state in the N=80 isotones — •T. Stetz[1], H. Mayr[1], N. Pietralla[1], G. Rainovski[2], V. Werner[1], and R. Zidarova[1] — [1]Technische Universität Darmstadt, Germany — [2]Sofia University St. Kliment Ohridski, Bulgaria

Quadrupole collectivity near closed shells manifests in the known 2_1^+ proton-neutron symmetric one quadrupole-phonon excitation of the valence shell and its isovector proton-neutron mixed-symmetric $2^+_{\mathrm{ms},1}$ counterpart. Their respective character is quantified by the F-spin quantum number. A direct influence of subshell structure on the properties of the $2^+_{\mathrm{ms},1}$ state has first been observed in ^{138}Ce by Rainovski *et al.* [1]. This lack of shell stabilization leads to a distribution of the M1 strength of the $2^+_{\mathrm{ms},1}$ configuration to the 2_1^+ state over several excited 2^+ states of ^{138}Ce. In contrast, the B(M1;$2_i^+ \to 2_1^+$) strength in other N=80 isotones below the $g_{7/2}$ subshell closure is isolated in a single 2^+ state [2,3]. A recent two neutron-transfer experiment to determine the B(M1;$2_2^+ \to 2_1^+$) of ^{132}Te supports these observations. Furthermore, a single pronounced one-quadrupole phonon $2^+_{\mathrm{ms},1}$ state has been found in ^{140}Nd and ^{142}Sm through Coulomb-excitation experiments, showing a restoration of F-spin symmetry above ^{138}Ce [4,5].

[1] G. Rainovski *et al.*, Phys. Rev. Lett. 96 (2006) 122501
[2] T. Ahn *et al.*, Phys. Lett. B 679 (2009) 1
[3] N. Pietralla *et al.*, Phys. Rev. C 58 (1998) 796
[4] R. Kern *et al.*, Phys. Rev. C 102 (2020) 041304(R)
[5] R. Kern *et al.*, J. Phys.: Conf. Ser. 1555 (2020) 012027
*Supported by BMBF 05P18RDCIA and 05P21RDCI2

HK 53.2 Wed 18:00 HBR 19: C 5b

Sub-picosecond lifetimes of excited states in ^{116,118}Sn — •Sarah Prill, Anna Bohn, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

In recent years, lifetimes of excited states of various nuclei in the mass region A=100 and above have been determined with the well established coincidence Doppler-shift attenuation method (CDSAM) in Cologne [1,2]. Following the study of ^{112,114}Sn [3], four experiments were performed on ^{116,118}Sn to determine sub-picosecond lifetimes. Inelastic scattering experiments with both alpha particles and protons were employed. The resulting coincidence data was recorded with the SONIC@HORUS detector array [4] at the University of Cologne. Herein, the emitted Doppler-shifted photons were detected in HORUS in coincidence with the back-scattered beam particles, recorded by SONIC. From these coincidences, the reaction kinematics can be reconstructed. Single levels can be targeted directly in the analysis via energy constraints which enables feeding exclusion. Numerous level lifetimes in ^{116,118}Sn were determined with the CDSA method and the results will be presented in this contribution.
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] M. Spieker *et al.*, Phys. Rev. C **97**, 054319 (2018).
[4] S. G. Pickstone *et al.*, Nucl. Instr. Meth. A **875**, 104 (2017).

HK 53.3 Wed 18:15 HBR 19: C 5b

Excited states in 56Ti, 58Ti populated in one proton knockout — •Wiktor Poklepa and Martha Reece for the HiCARI-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The neutron-rich Ti isotopes lie within the interests of nuclear physicists for several reasons. One of the reasons studied in previous works is the region of validity of the new neutron magic numbers N=32,34. The other one is approaching the island of inversion around N=40 with the most exotic Ti isotopes. The E(2_1^+) energies for even-even Ti isotopes have been measured up to N=40 and in contrast to Ca and Ar isotopes, there is no enhancement of E(2_1^+) for ^{56}Ti. At the same time the B(E2) values for this set of isotopes have been established only up to N=34. The currently known trend in B(E2) values in Ti isotopes shows a staggering behaviour, but experimental uncertainties are too large to draw conclusions. Thus further investigation is needed. In this experiment, B(E2) values and lifetimes of states in ^{56,58}Ti were studied employing proton knockout reactions from ^{57,59}V at the RIBF facility in Japan. Secondary beams produced from ^{70}Zn at 345 MeV/u were transported through the BigRIPS spectrometer. Gamma rays emitted by the reaction products were detected by the HiCARI HPGe detector array. The reaction products were identified using the ZeroDegree spectrometer. In this talk, the first preliminary results on the spectroscopy and lifetime measurements for ^{56,58}Ti will be presented.

HK 53.4 Wed 18:30 HBR 19: C 5b

Lifetime measurement of the 4_1^+ state of ^{132}Te — •H. Mayr[1], T. Stetz[1], V. Werner[1], M. Beckers[2], A. Blazhev[2], A. Esmaylzadeh[2], B. Falk[2], J. Fischer[2], R.-B. Gerst[2], K. Gladnishki[3], K.E. Ide[1], V. Karayonchev[4], E. Kleis[2], H. Kleis[2], L. Klöckner[2], P. Koch[2], D. Kocheva[3], C.M. Nickel[1], A. Pfeil[2], N. Pietralla[1], G. Rainovski[3], F. Spee[2], M. Stoyanova[3], and R. Zidarova[1] — [1]TU Darmstadt — [2]U Cologne — [3]U Sofia, Bulgaria — [4]TRIUMF Vancouver, Canada

Valuable information on the structure of atomic nuclei can be obtained from comparatively simple experimental information, such as ratios of excitation energies ($R_{4/2}$) or $E2$ transition rates ($B_{4/2}$) of the first 2^+ and 4^+ states of even-even nuclei. The measurement of lifetimes of the 2_1^+ and 4_1^+ states is necessary to calculate the $B_{4/2}$ ratio. Experimental data for the lifetimes of the 4_1^+ states in the tellurium isotopes towards $N = 82$ is scarce. The measurement of the lifetime of the 4_1^+ state of ^{132}Te would yield its $B_{4/2}$ ratio. It would expand the data on the evolution of this quantity in the chain of tellurium isotopes. Therefore, an experiment was performed at the IKP Cologne to produce ^{132}Te in the two-neutron transfer reaction ^{130}Te(^{18}O, ^{16}O)^{132}Te and determine the desired 4_1^+ lifetime via the Recoil Distance Doppler-Shift method. The results will be presented and compared to a recent publication that obtained the lifetime of the 4_1^+ state with the γ-γ fast-timing approach [1].

[1] D. Kumar *et al.* In: *Phys. Rev. C* 106 (3 2022).

*Supported by the BMBF under grant number 05P21RDFN9.

HK 53.5 Wed 18:45 HBR 19: C 5b

Resolving discrepancies in $E2$-excitation strengths of mid-shell tin isotopes — •M. Beuschlein[1], O. Papst[1], J. Kleemann[1], N. Pietralla[1], V. Werner[1], U. Ahmed[1], T. Beck[1,2], M. Berger[1], I. Brandherm[1], M.L. Cortes[1], A. D'Alessio[1], U. Friman-Gayer[1,3], I. Jurosevic[1], J. Hauf[1], M. Hilcker[1], K. E. Ide[1], J. Isaak[1], R. Kern[1], P. Koseoglou[1], C.M. Nickel[1], F. Niederschuh[1], K. Prifti[1], P. C. Ries[1], G. Steinhilber[1], T. Stetz[1], J. Vogel[1], J. Wiederhold[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt, Germany — [2]FRIB, East Lansing, MI, USA — [3]ESS, Lund, Sweden

Data and theory for the electric quadrupole excitation strength of the proton closed-shell Sn isotopes show an enhancement of the $B(E2, 0_1^+ \rightarrow 2_1^+)$ values towards $N = 50$, and a seniority-type behavior towards $N = 82$. However, in the transitional region around $N = 66$ various sets of data and theory differ significantly. In particular, lifetime data using the Doppler-shift attenuation method [1] are at variance with data from Coulomb excitation. In this work we present final results of a series of experiments on ^{112,116,120}Sn, utilizing the nuclear resonance fluorescence (NRF) technique, which offers a model-independent way of measuring $E2$ strengths. The new data generally support the trend measured in Coulomb excitation experiments, and is in favor of a smooth transition between the different regions.

Supported by the DFG through the research grants SFB 1245 and GRK 2891.

[1] A. Jungclaus *et al.*, Phys. Lett. B **695**, 110 (2011)

HK 54: Computing II

Time: Wednesday 17:30–19:00 Location: HBR 19: C 103

HK 54.1 Wed 17:30 HBR 19: C 103

Real-time calibrations for future detectors at FAIR — •Valentin Kladov[1,2], Johan Messchendorp[2], and James Ritman[1,2,3] — [1]Ruhr-Universität Bochum — [2]GSI Helmholtzzentrum fur Schwerionenforschung GmbH — [3]Forschungszentrum Jülich

The online data processing of the next generation of experiments, such as those conducted at FAIR, requires a reliable reconstruction of event topologies and, therefore, will depend heavily on in-situ calibration procedures. In this study we present a neural network-based tool designed to provide real-time predictions of calibration constants, which rely on continuously available environmental data. To enhance regularization, we incorporate information about previous environmental states into the Long Short-Term Memory (LSTM) architecture. LSTM is combined with Graph Convolutions to facilitate predictions across multiple channels simultaneously and to account for correlations between the channels. A proof-of-principle of this approach has been demonstrated using data from the Drift Chambers of the HADES detector obtained during the February 2022 experiment. Our method demonstrated the ability to provide fast and stable calibration predictions with a precision comparable to that obtained using traditional offline, time-consuming approaches. We plan to apply the proposed methodology in a real-time experimental setting during the next HADES beam time scheduled for Feb-Mar 2024.

HK 54.2 Wed 17:45 HBR 19: C 103

ASAPO: A high-speed streaming framework to support an automated data-processing pipeline. — •Mikhail Karnevskiy — DESY, Hamburg, Germany

Modern high-speed and high-resolution detectors produce a significant data rate, thereby increasing the need for online data processing and data reduction. A well-developed common data processing framework, provided as a service, minimizes the cost of implementing different use cases, enables more efficient scientific work due to a higher degree of automation, and enhances the reliability of the overall system.

ASAPO is a high-performance streaming framework actively developed at DESY to enable online and offline data processing using TCP/IP and RDMA over Ethernet and Infiniband. It efficiently facilitates high-bandwidth communication between detectors, the storage system, and independent analysis processes. User-friendly interfaces are available for C/C++, Python on all major platforms. A high-level Python library reduces boilerplate code when writing independent analysis workers, which can be combined into complex pipelines. ASAPO supports users with automatic retransfer, trivial parallelization on a per-image basis, multi-module detectors, and web-based monitoring.

Several experimental facilities at Petra III already use ASAPO for various data-processing pipelines. Involved algorithms include azimuthal integration of X-ray scattering data, peak finding, and indexing of diffraction patterns.

HK 54.3 Wed 18:00 HBR 19: C 103

The Event Processing Nodes: technical operation and performance of the ALICE GPU-based processing farm and computing model for synchronous and asynchronous data reconstruction — •Federico Ronchetti for the ALICE Germany-Collaboration — CERN, Esplanade des Particules 1, 1211 Geneva, CH

The Large Hadron Collider (LHC) returned to operation on July 5^{th}, 2022. During LHC Long Shutdown 2 (2019-2021), the ALICE detector underwent a major upgrade that increased the sustainable hadronic rate from 1 to 50 kHz for Pb-Pb collisions in continuous readout mode.

The improved detector performance and the change of the data taking paradigm required the operation of a completely new computing model which merges online (synchronous) and offline (asynchronous) data processing into a single software framework.

After a short introduction of the ALICE upgrade an overview of the current ALICE computing model will be given together with a technical description with the supporting hardware facility which makes extensive use of GPU computing since due to the increased data volumes, storing all the produced raw data is infeasible. The ALICE computing model has the unique feature to be able to exploit GPU processing also for offline data reconstruction hence energy efficiency considerations on the wide-spread use of GPUs will be formulated.

HK 54.4 Wed 18:15 HBR 19: C 103

Modern C++ with SYCL as Multi Paradigm Programming Language for FPGA-Based Detector Readout — •Thomas Janson and Udo Kebschull for the ALICE Germany-Collaboration — IRI, Goethe-Universität Frankfurt am Main, Max-von-Laue-Straße 12, 60438 Frankfurt am Main, Germany

Recent developments in high-level synthesis for FPGA targets enable new methods of implementing detector readout in high-energy physics. In this talk, different methods are shown to develop complex algorithms using high-level synthesis and the Intel oneAPI framework based on SYCL2020, which can be used to develop, test, and implement complex algorithms. SYCL is a programming model using C++ for heterogeneous hardware like GPUs, CPUs, and FPGAs. SYCL inherits many of the Modern C++ features, like generic programming with templates, lambda expressions for functional programming, and many more. We evaluate the usability of Modern C++ features with SYCL and the Intel oneAPI FPGA IP Authoring Flow for FPGAs. First experiences and results are shown and discussed.

HK 54.5 Wed 18:30 HBR 19: C 103

An online GPU hit finder for the STS detector in CBM — •Felix Weiglhofer for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM experiment is expected to run with a data rate exceeding 500 GB/s after averaging. At this rate storing raw detector data is not feasible and an efficient online reconstruction is required instead. GPUs have become essential for HPC workloads. Higher memory bandwidth and parallelism can provide significant speedups over traditional CPU applications. These properties also make them a promising target for the planned online processing in CBM.

We present an online hit finder for the STS detector capable of running on GPUs. The hit finder consists of four steps using STS Digis (timestamped detector messages) as input. Digis are sorted by sensor, within each sensor, they are sorted by channel and timestamp. Neighboring Digis are combined into clusters. Finally, after time sorting clusters on each sensor are combined into hits.

Each of those steps is trivially parallel across STS sensors or even sensor sides. To fully utilize GPU hardware, we modify the algorithms to be parallel on Digi or cluster level. This includes a custom implementation of parallel merge sort allowing full parallelism within GPU blocks.

Our implementation achieves speedup of 24 on mCBM data compared to the same code on a single CPU core. The exact achieved throughput will be shown during the presentation.

This work is supported by BMBF (05P21RFFC1).

HK 54.6 Wed 18:45 HBR 19: C 103

Data challenges at CBM - towards scalable workflows — •Andreas Redelbach for the CBM-Collaboration — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

Operating the CBM experiment at interaction rates up to 10 MHz requires data reduction in real-time. This necessitates highly efficient online processing of measurements and the underlying algorithms. More specifically, since the free-streaming readout data are processed in software, the performance of the reconstruction algorithms is a critical issue. A promising option for acceleration is based on an efficient parallelization of data processing developed for both CPU and GPU architectures. A number of measures have been taken to minimize runtimes of reconstruction algorithms and to optimize the scaling of some time-critical workflows.

Using the mCBM full-system test setup at SIS18 allows testing of all relevant components connected to study all processing steps. It is interesting to note that progress has been achieved in particular using test data from mCBM beamtimes. In this contribution, some of the concepts and recent progress towards high throughput processing in the CBM reconstruction chain are summarized.

This work is supported by BMBF (05P21RFFC1).

HK 55: Heavy-Ion Collisions and QCD Phases XIII

Time: Wednesday 17:30–19:00 Location: HBR 62: EG 03

HK 55.1 Wed 17:30 HBR 62: EG 03

Feasibility Studies for Di-Electron Spectroscopy with CBM at FAIR — •Cornelius Feier-Riesen for the CBM-Collaboration — GSI, Darmstadt, Germany — Justus-Liebig-Universität, Gießen, Germany

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to explore the QCD phase diagram at high net baryon densities and moderate temperatures by means of heavy ion collisions with energies from 2-11 AGeV beam energy (Au+Au collisions) and interaction rates up to 10 MHz, provided by the SIS100 accelerator.

Leptons as penetrating probes not taking part in the strong interaction leave the fireball without being modified, thus carrying information from the dense baryonic matter. However, di-leptons are rare probes, therefore calling for high efficiency and high purity identification capabilities. In CBM, electron identification will be performed by a Ring Imaging Cherenkov Detector (RICH), a Transition Radiation Detector (TRD) and a Time-of-Flight detector (ToF).

In this contribution, feasibility studies of di-electron spectroscopy from low mass vector meson decays will be presented. Special emphasis is put on the application of Fast Simulations to achieve higher statistics for the rare di-electrons in order to evaluate the feasibility of e.g. temperature measurements in the intermediate mass region beyond 1 GeV/c^2.

HK 55.2 Wed 17:45 HBR 62: EG 03

Prospects of reconstructing low-momentum and low-mass dileptons in HADES — •Iuliana-Carina Udrea for the HADES-Collaboration — TU Darmstadt, Darmstadt, Germany

The dileptons resulting from the decay of virtual photons are not subject to the strong force, thus their mean-free path is much longer than the size of the fireball. This allows them to leave the medium without rescattering and be the direct source of information. The transport properties of the hot and dense matter, e.g. its electrical conductivity, can be extracted via the yield of virtual photons in the low mass, low momentum limit: $p_{ee} = 0$ MeV/c, $M_{ee} \to 0$ MeV/c^2.

In this contribution, we will present the analysis of low-momentum and low-mass dilepton spectra using the data collected by the HADES experiment in March 2019 of Ag+Ag collisions at $\sqrt{s_{NN}}$=2.42 GeV. Moreover, we will present a feasibility study of dielectrons with a reduced magnetic field.

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

HK 55.3 Wed 18:00 HBR 62: EG 03

Improved electron identification in CBM RICH* — •Pavish Subramani for the CBM-Collaboration — Bergische Universität Wuppertal, Germany

The Compressed Baryonic Matter(CBM) experiment is a future fixed target experiment built as part of FAIR phase-1 at GSI, Darmstadt. The aim of the CBM experiment is to probe the QCD phase diagram at high baryonic densities and moderate temperatures by means of heavy ion collisions. Since the electrons are least affected by the QCD strong interactions, the di-electron channel is ideal to probe the dense fireball forming in such collisions. CBM features a Ring Imaging Cherenkov Detector (RICH) to efficiently identify those electrons up to 6 GeV/c with a pion suppression factor in the order of 100.

This talk will focus on recent improvements in the electron identification performance of the CBM RICH, where the machine learning technique used for ring-track matching is improved by changing the MLP to xGBoost. Further, the possibility of using CBM's Transition Radiation Detector (TRD), which is downstream of the RICH, as an intermediate tracker is discussed. Particularly, the use of this tracker to eliminate rings from secondary electrons not stemming from the target region is evaluated.

*Work supported by GSI, BMBF 05P21PXFC1, "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia.

HK 55.4 Wed 18:15 HBR 62: EG 03

In-Medium Vector Meson Spectral Functions from FRG — •Maximilian Wiest[1], Tetyana Galatyuk[1,2,4], Jochen Wambach[1], Lorenz von Smekal[3,4], and Arno Tripolt[3] — [1]TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Justus Liebig University Giessen, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF)

In this talk, we will discuss the FRG treatment of the chiral parity doublet model (PDM) to extract in-medium vector-spectral functions at finite spatial momenta. The PDM incorporates mesons and baryons as effective degrees of freedom including chiral and parity partners. The in-medium rho-meson spectral function is calculated at finite momentum. Our results show strong modifications of the spectral functions with increasing spatial momentum, especially a broadening of the characteristic in-medium N*(1535)->rho+N(939) peak in the mirror baryon assignment. Using a coarse-graining approach, we can extract dilepton spectra from microscopic transport approaches using the obtained vector spectral functions and extract the impact of the mirror-baryon peak on the dilepton spectra. The extraction of finite momentum spectral functions also gives access to the polarization signal of the vector mesons, which we will supplement by including in-medium modifications of the rho-meson pion loop.

Supported by VH-NG-823, DFG CRC-TR 211 and GSI.

HK 55.5 Wed 18:30 HBR 62: EG 03

Development of a ML algorithm for neutral meson and photon reconstruction using PCM in ALICE — •Abhishek Nath for the ALICE Germany-Collaboration — Ruprecht Karl University of Heidelberg, Germany

Direct photon is a great probe for all stages of evolution in high-energy collisions. However, they are present amidst a large background of mostly decay photons. So a precise estimate of decay photons is necessary. The Photon Conversion Method (PCM) is a great tool to identify photons, especially at low transverse momentum as they result in oppositely charged track pairs when they interact with detector materials.

Armed with the current machine learning algorithms, we try to reconstruct photons and their source mesons in heavy ion collision using PCM. The aim is to have an efficient estimate of the mesons along with photon samples with high purity and compare both with the current standardized cuts-based method implemented in the PCM analysis workflow. Our analysis is based on 2018 Pb-Pb data where we aim to explore various algorithms (XGBoost and others) to classify photons on-fly. Based on the analysis, a roadmap for analyzing high luminosity run 3 data is stated at the end.

HK 55.6 Wed 18:45 HBR 62: EG 03

Software trigger in ALICE — •Victor Feuillard for the ALICE Germany-Collaboration — Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany

Since the beginning of Run3, ALICE has been recording data in a trigger less mode. As a consequence an enormous amount of data needs to be stored on disk. To mitigate for this situation, an offline trigger is applied on the data in order to reduce the volume of data stored in the long term. In this presentation, we will introduce the strategy implemented in ALICE to perform this offline filtering, as well as the result of the first two filtering campaigns in pp collisions at $\sqrt{s} = 13$ TeV, regarding the data collected in 2022 and 2023

HK 56: Heavy-Ion Collisions and QCD Phases XIV

Time: Wednesday 17:30–19:15 Location: HBR 62: EG 05

HK 56.1 Wed 17:30 HBR 62: EG 05

Photon reconstruction in the Transition Radiation Detector of ALICE — •Peter Stratmann for the ALICE Germany-Collaboration — Universität Münster

The Transition Radiation Detector (TRD) of the ALICE detector at the Large Hadron Collider has the main purpose of identifying electrons and triggering on electrons and jets. Furthermore, it improves the resolution in track reconstruction at high transverse momenta. The working principle is based on transition radiation, which is produced by charged particles transversing boundaries of material with different dielectric constants.

In a rather new approach, the TRD should be used for measuring the photon production through the detection of conversion electrons. This is facilitated by the large material budget located in front and inside of the TRD. For this purpose, stand-alone tracking independent of the Inner Tracking System and the Time Projection Chamber had already been implemented. So far, this is achieved by a Kalman filter. As a new method, the photons are reconstructed in the TRD using Graph Neural Networks. These have the advantage that they operate well on the high-dimensional and sparse nature presented by the TRD data. In this talk, we will present the principles of the TRD, the direct photon reconstruction in the stand-alone tracking, and first results obtained with the Graph Neural Network.

Supported by BMBF within the ERuM framework, and the DFG as part of the GRK 2149.

HK 56.2 Wed 17:45 HBR 62: EG 05

Measurement of direct photons in Pb-Pb collisions in ALICE at $\sqrt{s_{NN}} = 5$TeV — •Stephan Stiefelmaier — Physikalisches Institut Heidelberg

Direct photons are interesting since they allow to track the evolution of the Quark Gluon Plasma (QGP), the medium which is formed in heavy ion collisions at the LHC. I present the current state of their measurement with photon conversions in the 2018 Pb-Pb data sample using the latest reconstruction and calibration methods. Since eta mesons and neutral pions are responsible for a large part of the experimental background their measurement is also presented.

HK 56.3 Wed 18:00 HBR 62: EG 05

Reconstruction of neutral mesons via photon conversion method in Ag-Ag collisions at 1.58A GeV with HADES* — •Tetiana Povar for the HADES-Collaboration — Bergische Universität Wuppertal,Wuppertal,Germany

Virtual photons and their decays into electron pairs $\left(e^- + e^+\right)$ represent one of the best sources for investigating the properties of nuclear matter under extreme conditions of temperature and density. One of the experiments which focuses on measurements of the dilepton spectrum is the HADES (High Acceptance DiElectron Spectrometer) at GSI in Darmstadt. The precise determination of all contributing sources in the dilepton spectrum is critical to obtaining accurate information about the dense nuclear medium in the early stages of collisions. The major background in the $\left(e^- + e^+\right)$ spectrum at the low invariant mass region is Dalitz-decays of light neutral mesons (π^0, η), so that precise knowledge about neutral meson production is mandatory for the dilepton analyses.

In HADES, these mesons can be reconstructed via their dominant $\gamma\gamma$ decays (BR $\sim 99\%$) using the electromagnetic calorimeter (ECAL) or via double external pair conversion in target or detector material.

In this contribution, main emphasis will be put on determining the efficiency and acceptance corrected π^0 yield applying the conversion method in Ag+Ag collisions at 1.58A GeV, including a detailed discussion of systematic and statistical uncertainties.

* Work supported by BMBF (05P21PXFC1) and GSI.

HK 56.4 Wed 18:15 HBR 62: EG 05

Development of a ML algorithm for neutral meson and photon reconstruction using PCM in ALICE — •Abhishek Nath for the ALICE Germany-Collaboration — Ruprecht Karl University of Heidelberg, Germany

Direct photons are unique probes to study and characterize the quark-gluon plasma (QGP) as they leave the medium unscattered. They are produced throughout all stages of the collision. Thus, they carry information about the space-time evolution and the temperature of the medium. However, they are present amidst a large background of mostly decay photons. So a precise estimate of decay photons is necessary. The Photon Conversion Method (PCM) is a great tool to identify photons, especially at low transverse momentum as they result in oppositely charged track pairs when they interact with detector materials.

Armed with the current machine learning algorithms, we try to reconstruct photons and their source mesons in heavy ion collision using PCM. The aim is to have an efficient estimate of the mesons along with photon samples with high purity and compare both with the current standardized cuts-based method implemented in the PCM analysis workflow. Our analysis is based on 2018 Pb-Pb data where we aim to explore various algorithms (XGBoost and others) to classify photons on-fly. Based on the analysis, a roadmap for analyzing high luminosity run 3 data is stated at the end.

HK 56.5 Wed 18:30 HBR 62: EG 05

Measurement of neutral meson and photon production in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV with the ALICE EMCal — •Marvin Hemmer for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Direct photon production in Pb–Pb collisions can be utilised to study the properties of the QGP and the different stages of the collision. The transverse momenta (p_{T}) of the direct photons carry information on their production time and mechanism; while low p_{T} direct photons are produced in the QPG phase of the collision, photons at high p_{T} are predominately produced during the initial scattering and hence are an ideal probe to study initial conditions of the colliding nuclei.

To disentangle direct photons and photons from hadronic decays, most notably the π^0 and η mesons, a precise measurement of the π^0 and η spectra is needed. In ALICE neutral mesons can be measured using different reconstruction methods. For π^0 and η mesons at high transverse momentum these methods are based on the detection of decay photons with the EMCal calorimeter.

In this talk, the measurement of π^0 and η mesons with the ALICE EMCal in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV is presented. Additionally,the status of the direct photon analysis at high p_{T} will be discussed.

HK 56.6 Wed 18:45 HBR 62: EG 05

Measurement of neutral meson production in small collision systems with ALICE — •Joshua König for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The precise measurement of the neutral meson production in pp collisions can be used to constrain fragmentation functions and parton density functions needed by pQCD calculations. The dependence of the measured neutral meson yield on the event charged-particle multiplicity can give further insight into possible final-state effects in high-multiplicity pp collisions, where other measurements show surprising similarities with results in heavy-ion collisions. Additionally, the measurement of neutral mesons serves as a baseline for direct photon analyses.

The measured neutral meson spectra cover a wide range in p_{T} due to three independent photon reconstruction techniques available in ALICE, including two calorimeters as well as measured e^+e^- pairs from photon conversions in the detector material.

In this talk, the production cross sections of π^0, η and ω mesons as a function of p_{T} in pp and p–Pb collisions measured with ALICE will be presented. For pp collisions at $\sqrt{s} = 13$ TeV, the dependence of the π^0 and η meson production on the charged-particle multiplicity is shown. Additionally, the production of these mesons inside reconstructed jets are used to provide a direct estimate of the fragmentation function.

Supported by BMBF and the Helmholtz Association

HK 56.7 Wed 19:00 HBR 62: EG 05

Performance of photon measurements using PCM with ALICE in Run 3 — •Alica Marie Enderich — Physikalisches Institut, Universität Heidelberg

With the beginning of Run 3 at CERN-LHC and the related upgrades of the detectors used in the ALICE experiment, also the material budget associated with the experimental setup changed. Therefore, a renewal of the knowledge of the material budget is necessary as this is required for the reconstruction of charged particles produced in collisions. This can be achieved by using pions as they make up the biggest fraction of particles created at collisions.

As neutral pions π^0 decay into photons, the latter need to be measured in order to reconstruct them. Photons can be measured in ALICE with electromagnetic calorimeters (EMCal and PHOS) as well as with the photon conversion method (PCM). PCM uses the fact that photons can convert into e^+e^- pairs when traversing material which can then be reconstructed. The reconstructed photons can subsequently be used to probe the detector material. This allows the improvement of Monte Carlo simulations used for charged particle reconstruction. Furthermore, the experimental π^0 mass resolution can be used to examine the momentum resolution and thus the quality of the reconstructed photons.

This talk will present analyses on the PCM performance with ALICE in Run 3 for pp collisions at $\sqrt{s_{\mathrm{NN}}} = 13.6$ TeV. The talk will focus on studies of the material budget as well as the quality of the reconstructed photons. The current status of the analyses will be presented.

HK 57: Hadron Structure and Spectroscopy VII

Time: Wednesday 17:30–19:00 Location: HBR 62: EG 18

Group Report HK 57.1 Wed 17:30 HBR 62: EG 18

High-resolution spectroscopy experiments with WASA-FRS at GSI — •Yoshiki K. Tanaka for the WASA-FRS and Super-FRS Experiment-Collaboration — RIKEN, Wako, Saitama, Japan

The NUSTAR Super-FRS Experiment Collaboration performs high-resolution spectrometer experiments at the border line of atomic, nuclear and hadron physics. The spectroscopic study of exotic hadron-nucleus bound systems is one of the important topics in hadron physics since such systems provide valuable information on hadron properties and interactions in the low-energy region of quantum chromodynamics. In this contribution, we report two pilot experiments recently performed with a newly constructed WASA-FRS setup that integrates the WASA central detector into the fragment separator FRS at GSI.

The first experiment aims at observing η'-meson bound states in carbon nuclei for studying in-medium η'-meson properties. We performed high-resolution missing-mass spectroscopy of the ^{12}C(p,d) reaction near the η'-meson production threshold with the FRS and simultaneously detected particles emitted in the decay of the η'-mesic nuclei with the WASA detector. In the second experiment, we performed invariant-mass spectroscopy of light hypernuclei produced via projectile fragmentation of a 2 GeV/u ^{6}Li beam. The π^- emitted in the mesonic decay was measured with the WASA detector, whereas the residual ion was momentum-analyzed by the FRS. Both experiments were successfully conducted in 2022 in the framework of the FAIR phase-0 program at GSI. In this contribution, the current status of the data analysis as well as the preliminary results will be discussed.

HK 57.2 Wed 18:00 HBR 62: EG 18

The bridge between two-body nucleon-hyperon data and the nuclear equation of state — •Dimitar Mihaylov[1] and Johann Haidenbauer[2] — [1]Technische Universität München, Physics Department, James-Franck-Str., 85748 Garching, Germany — [2]Forschungszentrum Jülich, Institute for Advanced Simulation (IAS-4), 52428 Jülich, Germany

Femtoscopy is a powerful technique for studying final-state interactions between hadrons, employing two- and three-body correlations to analyze the emission source and final-state interactions of particles with low relative momentum. Recent research by the ALICE collaboration has demonstrated the realization of a common baryon-baryon emission source in pp collisions, opening new avenues for studying the properties of the final-state interaction (FSI). In particular, the pΛ system has been measured with unprecedented precision, allowing for a better constraint on existing theoretical models

This talk will present the results of a combined analysis of femtoscopy and scattering involving pΛ, along with the impact on the allowed scattering parameters, the in-medium U_Λ potential as a function of density, and the consequences for the nuclear equation of state, as well as the appearance of hyperons within neutron stars.

This research was funded by the BmBf Verbundforschung (05P21WOCA1 ALICE).

HK 57.3 Wed 18:15 HBR 62: EG 18

The first study of the $\Lambda\pi$ strong interactions with ALICE — •Marcello Di Costanzo for the ALICE Germany-Collaboration — Technical University, Munich, Germany

Due to its non-perturbative nature at low energies, a deep understanding of the strong force still represents a challenge for the physics community. From the theoretical side, the study of low-energy QCD is typically conducted employing effective field theories (EFT) which are based on low-energy constraints to be anchored to the experimental measurements. Understanding the $S = -1$ meson-baryon systems is extremely relevant because they are characterised by a rich coupled-channel structure and feature the emergence of dynamically generated states. At present, EFT calculations have been well constrained by experimental data for energies above the K^-N threshold. At lower energies, there are tensions among models due to the limited amount of measurements. The study of $\Lambda\pi^+$ and $\Lambda\pi^-$ interactions is so relevant because it allows accessing the K^-N sub-threshold energies, leading to new experimental inputs to EFTs. In this contribution, the measurement of the $\Lambda\pi$ scattering parameters is carried out by exploiting correlation function analysis and using ALICE data consisting of high-multiplicity proton-proton collisions at $\sqrt{s} = 13$TeV.

HK 57.4 Wed 18:30 HBR 62: EG 18

Study of p–p–$\pi^\pm$ and p–$\pi^\pm$ femtoscopic correlations with ALICE at the LHC — •Marcel Lesch for the ALICE Germany-Collaboration — TU Munich, Germany

Recent theoretical models propose that the QCD axion might have a crucial impact on the equation of state of dense nuclear matter, consequently affecting the study of neutron stars. While the QCD axion has not been directly observed yet, its properties at finite baryonic densities can be linked to the in-medium properties of pions. Constraining the latter is thus crucial for studying the QCD axion and its impact on the description of neutron stars. In this talk, we present recent results of femtoscopic correlations between pions and protons in high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV measured by ALICE. These small systems produce particles at relative distances of about 1 fm. Therefore, the emission of multiple hadrons can be used to mimic a large-density environment. Firstly, results on p–$\pi^\pm$ are discussed. These two-body correlations play an important role in understanding the lower-order contributions present in the three-body system. Using recently developed three-body femtoscopic techniques, we present the first measurements of p–p–$\pi^{\pm}$ correlations. These results provide new insights on the in-medium properties of pions relevant to the study of the QCD axion.

This research was funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and the BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 57.5 Wed 18:45 HBR 62: EG 18

K^0_S production in p+p interactions measured by NA61/SHINE — •Marjan Cirkovic — Spasovdanska 6, 11032 Belgrade, Serbia

NA61/SHINE (SPS Heavy Ion and Neutrino Experiment) is a fixed-target experiment at the CERN Super Proton Synchrotron. One of its research projects is the systematic measurement of hadron production in proton+proton, proton+nucleus and nucleus+nucleus interactions. These studies are performed in particular to study the predicted signals of the onset of deconfinement and search for the critical point of strongly interacting matter. For this investigation, a two-dimensional scan in beam momentum (13A -150A GeV/c) and nuclear mass number of colliding nuclei was performed.

K^0_S are detected and measured by NA61/SHINE by means of their weak decays into $\pi^+ + \pi^-$ with a branching ratio of 69.2%. This contribution reviews recent NA61/SHINE measurements on the production of K^0_S in p+p interactions. The rapidity and transverse momentum distributions of K^0_S will be presented and compared to transport model predictions. The mean multiplicity of studied K^0_S mesons will be compared with the available data in the range $\sqrt{s_{NN}}$ = 3 - 32 GeV.

HK 58: Hadron Structure and Spectroscopy VIII

Time: Wednesday 17:30–19:00 Location: HBR 62: EG 19

Group Report HK 58.1 Wed 17:30 HBR 62: EG 19

Exploring the 3D structure of baryon resonances with transition Generalized Parton Distributions — •Stefan Diehl for the CLAS-Collaboration — Justus Liebig Universität Gießen and University of Connecticut

The nucleon consists of three quarks bound by the strong interaction, which is the strongest force in nature. If a lepton is scattered on this object, energy is transferred and can lead to an excited system, known as a baryon resonance. Under certain kinematic conditions, a meson or a photon can be emitted during this process and provide us with information on the 3D distribution of the quarks within the resonance, which is encoded in so-called transition Generalized Parton Distributions (GPDs). The knowledge of these objects can help us to better understand the excitation process itself and to study the mechanical properties of resonances and the connection between the angular momentum of resonances and the distribution and motion of the partons. Based on the high-intensity, 10.6 GeV electron beam at JLAB and the CLAS12 detector, it was possible to study the $ep \to e\Delta^{++}\pi^-$ with a large mass of the virtual photon Q^2 and with the pion produced under very forward angles, providing a first measurement sensitive to transition GPDs. The talk will present the results from this study as well as the first results from ongoing measurements of the $N \to N^*$ deeply virtual Compton scattering (DVCS) process ($ep \to e\Delta^+\gamma$) with CLAS12.

*The work is partly supported by Deutsche Forschungsgemeinschaft (Project No. 508107918).

HK 58.2 Wed 18:00 HBR 62: EG 19

Double-Tagged Investigation of $\gamma^*\gamma^* \to \eta'$ at BESIII — •Maurice Anderson, Achim Denig, Christoph Florian Redmer, and Max Lellmann for the BESIII-Collaboration — JGU Mainz

In this presentation, the production of pseudoscalar η' mesons via two virtual spacelike photons is studied ($\gamma^*\gamma^* \to \eta'$). Double-tagged measurements are conducted at the BESIII experiment in Beijing, China, in which both virtual photons possess nonzero momentum transfers Q_1^2 and Q_2^2. The Monte Carlo generator Ekhara 3.0 is used to simulate the expected Q_1^2, Q_2^2 distribution of the signal events. By measuring the double differential cross section at BESIII, the transition form factor (TFF) can be determined for $Q_1^2, Q_2^2 < 2\,\mathrm{GeV}^2$. The TFF of pseudoscalar mesons serves as essential input for calculating the hadronic light-by-light (HLbL) contribution to the theoretical Standard Model prediction of the anomalous magnetic moment of the muon $a_\mu = (g_\mu - 2)/2$.

HK 58.3 Wed 18:15 HBR 62: EG 19

Exploring s quark TMD-s with charged kaon SIDIS with CLAS12 — •Áron Kripkó[1], Stefan Diehl[1,2], and Kai-Thomas Brinkmann[1] for the CLAS-Collaboration — [1]Justus Liebig Universität Gießen, 35390 Gießen, Germany — [2]University of Connecticut, Storrs, CT 06269, USA

A multidimensional study of the structure function ratio $\mathrm{F}_{\mathrm{LU}}^{\sin(\phi)}/\mathrm{F}_{\mathrm{UU}}$ has been performed for $\mathrm{K}^{\pm}$, based on the measurement of beam-spin asymmetries. It uses the high statistics data recorded with the CLAS12 spectrometer at Jefferson Laboratory. The 10.6 GeV longitudinally polarized electron beam interacted with an unpolarized liquid hydrogen target during the experiment. $\mathrm{F}_{\mathrm{LU}}^{\sin(\phi)}$ is a twist-3 quantity that provides information about the quark-gluon-correlations in the proton. The talk will present a simultaneous analysis of two kaon channels (K^+ and K^-) using machine learning improved particle identification, over a large kinematic range with virtualities Q^2 ranging from 1 GeV^2 to 8 GeV^2. The precise multidimensional measurement was performed in a large range of z, $\mathrm{x_B}$, $\mathrm{p_T}$ and Q^2 for the first time in the valence quark region. Based on the precise multidimensional data, a comparison with different TMD based reaction models will be presented for the different kinematic regions.

This work is supported by HFHF and funded by DFG (Project No: 508107918).

HK 58.4 Wed 18:30 HBR 62: EG 19

Measurement of the two photon production of the $f_1(1285)$ in e^+e^- scattering at BESIII — •Jan Muskalla, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Johannes-Gutenberg Universität Mainz, Institut für Kernphysik

The anomalous magnetic moment of the muon a_μ is one of the most precisely measured observables of the Standard Model (SM). Nonetheless, a discrepancy of 5.1σ is observed between SM prediction and experiment. The uncertainties of the SM prediction are currently dominated by hadronic contributions. In particular, axial vector contributions to the hadronic light-by-light (HLbL) scattering need higher precision transition form factor (TFF) measurements as experimental input to theory predictions. The BESIII experiment at the Beijing Electron Positron Collider (BEPCII) is collecting data in the τ-charm energy region and offers large datasets perfectly suited for the study of two-photon interactions. With a data set of up to 40 fb^{-1} in the energy range $\sqrt{s} = (3.77 - 4.6)$ GeV, the reaction $e^+e^- \to e^+e^- f_1(1285)$ is investigated in a single tag configuration to evaluate the momentum dependence of the TFF. This talk will present the current status of the analysis.

HK 58.5 Wed 18:45 HBR 62: EG 19

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

The BGOOD experiment at the ELSA accelerator facility uses an energy tagged bremsstrahlung photon beam to investigate hadronic excitations in meson photoproduction. 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^*-Σ_c interactions. In analogy, in the s-quark sector a peak like structure in $K^0_S\Sigma^0$ photoproduction off the neutron is predicted, associated with a K^*-Σ type configuration.

The reaction $\gamma n \to K^0_S\Sigma^0$ has been measured from threshold to a beam energy of 2600 MeV. Within the available statistics the results appear consistent with the predicted peak like structure. This talk presents updated analysis techniques and improved statistical precision.

Supported by DFG projects 388979758/405882627 and the European Union*s Horizon 2020 programme, grant 824093.

HK 59: Invited Talks II

Time: Thursday 11:00–12:30 Location: HBR 14: HS 1

Invited Talk HK 59.1 Thu 11:00 HBR 14: HS 1
Gamma spectroscopy with AGATA: New insights in nuclear excitations along the nuclear chart — •Peter Reiter — University of Cologne, Institute of Nuclear Physics

The Advanced GAmma Tracking Array AGATA is a next generation high-resolution gamma-ray spectrometer for nuclear structure studies based on the novel principle of gamma-ray tracking. It is built from high-fold segmented germanium detectors that will operate in position-sensitive mode by employing digital electronics and pulse-shape decomposition algorithms. The unique combination of highest detection efficiency and position sensitivity allows studies with radioactive ion beams of lowest intensity. A growing number of AGATA modules was exploited in the leading infrastructures GANIL, GSI and LNL for nuclear structure studies in Europe. The performed experiments give insights into nuclear structure issues which are connected to single particles, collective degrees of freedom, nucleon interactions and symmetries. Most of the investigated nuclei are located outside the stability line and for stable nuclei the investigations concern unexplored configurations. Altogether the obtained results represent advances which could test theory in exclusive way and motivate new theoretical developments. Opportunities for future investigations with the foreseen more advanced phase of AGATA will be presented.

Invited Talk HK 59.2 Thu 11:30 HBR 14: HS 1
Anisotropic flow in heavy-ion collisions at high and low beam energies — •Hannah Elfner — GSI, Darmstadt, Germany — Goethe University, Frankfurt, Germany — FIAS, Frankfurt, Germany

The collective behavior of particles emitted from heavy-ion collisions is sensitive to the properties of the hot and dense medium that is produced. At high beam energies as they are studied at LHC or RHIC detailed measurements of higher order flow coefficients and their correlations are available. Comparing the experimental data for bulk observables with sophisticated dynamical hybrid approaches based on viscous hydrodynamics and hadronic transport allows conclusions about the transport coefficients of QCD matter and their temperature dependence. At lower beam energies as they are reached at GSI and in the future at FAIR the high density regime of QCD is explored. The collective flow measurements are sensitive to the equation of state of nuclear matter and recent progress concerning transport calculations with mean fields will be explained. In both cases, Bayesian multi-parameter analysis are employed to obtain results with quantified uncertainties.

Invited Talk HK 59.3 Thu 12:00 HBR 14: HS 1
Status of ALICE and ALICE 3 — •Alexander Schmah — Gesellschaft fuer Schwerionenforschung, Darmstadt, Germany

ALICE is the dedicated heavy-ion experiment at the Large Hadron Collider at CERN with a focus on studying the quark-gluon plasma created in collisions between lead ions. In the year 2018 the Run 2 data taking period was finished, followed by an upgrade period where, among others, a new inner tracking system was installed and the time projection chamber (TPC) MWPC readout chambers were replaced by GEM based chambers. These upgrades allow a more than ten times higher data taking rate for the TPC, up to 50 kHz for Pb-Pb collisons, and more precise measurements of secondary vertices.

ALICE 3 is under discussion as a successor for the current ALICE experiment with a completely new setup. The ALICE 3 tracking detectors are solely based on silicon-pixel technology. For the most inner layers the ultra-thin MAPS based layers will be bent to cylindrical shapes. This will allow the measurement of charged particles at very low transverse momenta down to a few tens of MeV/c. With the new setup, 20–50 times higher rates can be achieved compared to the Run 3 setup of ALICE.

In this talk I will give an overview of the current ALICE Run 3 results from the pp and Pb-Pb data taking periods and discuss the status of ALICE 3.

HK 60: Focus Session III: Multiquark and Molecular States

Time: Thursday 14:00–15:30 Location: HBR 14: HS 1

Invited Talk HK 60.1 Thu 14:00 HBR 14: HS 1
Theory of multi-quark states — •Christoph Hanhart — IAS-4, Forschungszentrum Jülich

In this talk the different theoretical approaches to multi-quark states in the doubly heavy quark sector will be presented and contrasted. In addition, the implications of different structure assignments - compact tetraquarks, hadronic molecules and hadroquarkonia - for experimental observables will be discussed with special emphasis on what is necessary to get a deeper understanding of the structure of the various multi-quark states found in recent years and thus into the inner workings of QCD.

Invited Talk HK 60.2 Thu 14:30 HBR 14: HS 1
Cross-Experiment Insights into Multiquarks and Molecular States — •Mikhail Mikhasenko — Ruhr Univerity Bochum

This presentation delves into the forefront of hadronic physics, focusing on the intriguing realm of exotic hadrons. I will specifically address two compelling means of matter organization: the genuine Quantum Chromodynamics state, a conventional meson or a baryon, conceptualized as a single 'bag' of quarks, and the hadronic molecule arrangement, where two 'bags' are bound by residual nuclear forces. Central to discussion is the critical role of hadron-hadron rest energy, serving as the reference point for molecular binding.

Recent years have witnessed a proliferation of experimental evidence suggesting a surplus of hadronic states beyond conventional mesons and baryons. Notably, several of these states appear tantalizingly close to the hadron-hadron threshold, suggesting their molecular interpretation and blurring the lines between particle and nuclear physics.

The talk will provide a review of these experimental observations, highlighting their significance in understanding the true nature of multiquark states. I'll aim to shed light on the potential of these exotic states to redefine our understanding of matter organization at a fundamental level.

Invited Talk HK 60.3 Thu 15:00 HBR 14: HS 1
Molecular and bound states searches with femtoscopy — •Valentina Mantovani Sarti — TUM Department of Physics, Garching, Germany

In the last years the correlation measurements at LHC, particularly performed in small colliding systems such as proton-proton collisions, proved to be a powerful complementary experimental tool to access the strong interaction in hadronic systems with strange and charm content. The QCD dynamics driving the underlying interaction in these sectors is characterized by a rich presence of inelastic channels which, depending on the coupling strengths, can give rise to several dynamically generated states. The nature and inner composition of such states strongly depends on the interplay between the different coupled-channels and experimental constraints on their properties are typically obtained from dedicated mass invariant studies widely performed at LHC and as well at electron-positron colliders. In this talk we will discuss how femtoscopy can contribute to the search and understanding of these molecular states. We will present the recent results obtained in the meson-baryon S=-2 sector for the $\Xi(1620)$ and $\Xi(1690)$ states with the measurements of ΛK- correlation. Latest results on the correlation of D mesons with light hadrons will be shown. Finally, future perspectives will also be presented on how to employ femtoscopy to shed light into the composition of heavy multi-quark states with the ALICE 3 dedicated experiment.

HK 61: Instrumentation XIV

Time: Thursday 15:45–17:15 Location: HBR 14: HS 1

Group Report HK 61.1 Thu 15:45 HBR 14: HS 1

LGAD Applications in High Energy, Accelerator and Medical Physics — •Wilhelm Krüger[1], Thomas Bergauer[2], Tetyana Galatyuk[1,3,4], Albert Hirtl[5], Vadym Kedych[1], Yevhen Kozymka[1], Sergey Linev[3], Jan Michel[3], Jerzy Pietraszko[3], Adrian Rost[6], Christian Joachim Schmidt[3], Michael Träger[3], Michael Traxler[3], and Felix Ulrich-Pur[3] — [1]Technische Universität Darmstadt — [2]Austrian Academy of Sciences, Institute of High Energy Physics — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [4]Helmholtz Forschungsakademie Hessen für FAIR — [5]TU Wien, Atominstitut — [6]FAIR Facility for Antiproton and Ion Research in Europe GmbH

Their outstanding timining capabilities, in combination with a high rate capability and high radiation hardness, makes Low Gain Avalanche Diodes (LGADs) excellent candidates for various applications in different fields.

These applications include the in-beam detector for beam monitoring and reaction time reconstruction in high intensity, 4.5 GeV proton beams at HADES, resolving the bunch time-structure at the S-DALINAC for operation in energy recovery mode, and the development of a time-of-flight-based ion computed tomography demonstrator system aimed at improving the treatment planning quality for ion beam therapy in the future.

This group report will present the LGAD calibration procedures, the acquired timing precisions and reached performance of the mentioned applications.

HK 61.2 Thu 16:15 HBR 14: HS 1

Diamond based beam monitoring and T0 systems for the CBM and HADES experiments — •Adrian Rost[1], Tetyana Galatyuk[1,2,3], Vadym Kedych[1], Mladen Kis[1], Yevhen Kozymka[1], Wilhelm Krüger[1], Jerzy Pietraszko[2], and Felix Ulrich-Pur[2] — [1]TU Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR

Experiments with high-intensity heavy ion beams require fast and radiation-hard beam detection systems. For these purposes, chemical vapor deposition (CVD) diamond sensors are widely used. Its radiation hardness and excellent timing characteristics make the diamond material an almost ideal choice for in-beam applications.

A beam detector system (BMON) based on poly-crystal CVD diamond technology has been developed for the CBM experiment at the FAIR accelerator complex. The system will be used for T0 measurements with a time precision of 50 ps and for beam monitoring purposes.

For the upcoming HADES beamtimes at the SIS18 accelerator, a T0 and veto system has been developed and installed, which is based on pcCVD diamond sensors.

This contribution will present the CBM BMON concept and the current status of the project. Furthermore, the HADES T0 and veto system will be introduced, and first insights into its performance will be shown.

HK 61.3 Thu 16:30 HBR 14: HS 1

A beam position detector for the Mainz Microtron MAMI — •Jannik Petersen — Institut für Kernphysik Mainz

The topic of this contribution is the development and construction of a beam position detector designed for MAMI, which can also be used at other accelerator facilities. In contrast to conventional beam telescopes, the detector is to be placed in the beam pipe and can be moved perpendicular to the beam. This makes it possible to measure the beam invasively only when necessary. The aim is to realize a compact and cost-efficient detector in a manageable development time, which determines the position of the beam with a precision of $< 50\,\mu$m in the coordinate system of a respective experiment. Therefore, where possible, it is based on adapted standard components as well as parts and techniques developed for other experiments. The PANDA luminosity detector and the Mu3e experiment have a major influence here. At the heart of the detector are three layers of silicon pixel sensors (HV-MAPS), which can be thinned down to $50\,\mu$m. The concepts and status of cooling, mechanical implementation, and sensor readout will be presented.

HK 61.4 Thu 16:45 HBR 14: HS 1

LISA: LIfe-time measurements with Solid Active targets — •Elisa Maria Gandolfo — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Understanding the nuclear structure and the emergence of collectivity in nuclei is a major open quest in nuclear physics. The collectivity of a nucleus can be evaluated through electromagnetic transition probabilities which can be experimentally accessed through lifetimes of excited states. The latter can be measured in in-beam γ-ray spectroscopy experiments using Doppler-shift techniques. LISA (LIfetime measurement with Solid Active targets) proposes a new approach to measure excited states lifetimes. The main novelty lies in the usage of a multi-layered active target made of single-crystal diamond detectors. Here, each layer serves simultaneously as reaction target and detector. The excellent energy resolution of diamond detectors allows for layer-by-layer Z identification and vertex reconstruction enabling precise Doppler correction despite using thick targets. A first two-layer prototype of LISA has been constructed and its performances has been evaluated with source measurements and in-beam tests at the GSI and HIMAC facilities with beams of ^{238}U and ^{132}Xe. The goal of these tests was to characterize the energy resolution, the influence of the metalization on the performance, the unique Z identification as well as its capabilities as active target. In this contribution, I will present the current status of the project, first results of the experiments, and an outlook to future developments. This project is funded by the European Research Council under ERC-CoG LISA-101001561).

HK 61.5 Thu 17:00 HBR 14: HS 1

Effects of heavy ions irradiation on polycrystalline diamond detectors — •Matteo Alfonsi, Chiara Nociforo, Mladen Kiš, Michael Träger, Joshua Galvis Tarquino, Tobias Blatz, Christos Karagiannis, Martin Winkler, and Haik Simon — GSI Helmholtzzentrum für Schwerionenforschung GmbH Planckstraße 1, 64291 Darmstadt, Germany

The Super Fragment Separator at the FAIR accelerator complex will adopt Chemical Vapor Deposition diamond detectors as radiation-hard, high rate counters. They must monitor and optimize the beam transmission for ions rates up to 10^7 ions/spill, and calibrate the other beam diagnostics devices in duty at higher beam intensities. The target vacuum chamber hosts a 7×7 mm^2 single crystal diamond and a 25×25 mm^2 polycrystalline diamond: they are required to detect crossing particles with high efficiency ($> 98\%$) in case of heavy species (Ar to U), and to survive several years accumulating, due to the target proximity, a dose of few MGy per year. Laboratory measurements and beam test campaigns were arranged in the past years for the validation of the proposed sensors, in particular for the polycrystalline technology. Here we report the outcome of the irradiation of a sensor based on a 20×20 mm^2 polycrystalline diamond produced by Element Six, with high intensity 1 GeV/nucleon Pb and U beams at GSI (Darmstadt). The detector signal shape characteristics and the ion counting efficiency have been monitored by interleaving periods of low ions rates in which we evaluate possible damages or performance degradation, during and after a total bombardment of almost 10^{12} heavy ions.

HK 62: Nuclear Astrophysics V

Time: Thursday 15:45–17:15 Location: HBR 14: HS 4

Group Report HK 62.1 Thu 15:45 HBR 14: HS 4
Fully calibrated lanthanide atomic data for 3D kilonova modeling — •Andreas Flörs[1], Ricardo Fereirra da Silva[2,3], Luke Shingles[1], Christine Collins[1], Jorge Sampaio[2,3], José Manuel Pires Marques[2,3], and Gabriel Martínez-Pinedo[1,4] — [1]GSI, Darmstadt, Germany — [2]LIP, Lisboa, Portugal — [3]Universidade de Lisboa, Lisboa, Portugal — [4]TU Darmstadt, Darmstadt, Germany

With the detection of multiple neutron-star merger events in the last few years, the need for a more comprehensive understanding of nuclear and atomic properties has become increasingly important. Despite our current understanding, there are still large discrepancies in the opacities obtained from different codes and methods. These discrepancies lead to variations in the location and strength or absorption and emission features in radiative transfer models and prevent a firm identification of r-process products. To address this issue, we developed an optimisation technique for energy levels and oscillator strengths consistent with available experimental data. With this novel method, we can increase the accuracy of calculations while reducing the computational cost, finally making it possible to apply the method to all lanthanides instead of focusing on single ions.

In this talk, we will report on converged large-scale atomic structure calculations of all singly and doubly ionised lanthanides with greatly improved transition wavelength accuracy compared to previous works. The impact of our new atomic data set on realistic 3D radiative transfer calculations and prospects of r-process signature identification will be investigated.

HK 62.2 Thu 16:15 HBR 14: HS 4
Mass measurements of neutron-rich nuclides at the N=126 shell closure with the FRS Ion Catcher — •Kriti Mahajan for the S468 experiment-Collaboration — Justus-Liebig-Universität Gießen, Germany — HFHF, Gießen Campus

At GSI Darmstadt experiments with exotic nuclides can be performed, enabling the study of nuclei far from stability. These nuclei can be produced at relativistic energies by projectile fragmentation or fission and separated in the fragment separator FRS.

An experiment was performed in the region "south" of the doubly magic nucleus ^{208}Pb close to the N=126 line, which is of key importance for nuclear structure and nuclear astrophysics studies and can help us to better understand the r-process, in particular the third abundance peak. The experiment aimed to identify new neutron rich isotopes and to measure their production cross sections, masses and half lives. Mean range bunching was used to efficiently stop the beam further in an active stopper for half-life measurements and in the FRS Ion Catcher (FRS-IC) for precise mass measurements.

At FRS-IC, the beam is thermalized inside the cryogenic stopping cell and transmitted to the multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS), which features a high resolving power of up to 1,000,000, short cycle times of a few ten milliseconds and mass accuracies down to a few 1E-8. The preliminary results of these mass measurements will be presented, including the first mass measurements of ^{204}Au, ^{205}Au and ^{200}Ir.

HK 62.3 Thu 16:30 HBR 14: HS 4
γ-ray angular distribution of the ^{3}He$(\alpha,\gamma)^7$Be reaction — •Peter Hempel[1,2], Daniel Bemmerer[1], Axel Boeltzig[1], Till Lossin[1,2], Eliana Masha[1], Konrad Schmidt[1], Steffen Turkat[2], Anup Yadav[1,2], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR) — [2]TU Dresden

The ^{3}He$(\alpha,\gamma)^7$Be reaction plays two roles in astrophysics: It is responsible for ^{7}Li production during Big Bang nucleosynthesis, and it controls the branching between the pp-1 and pp-2 chains in solar hydrogen burning. Here, we report on the final data from a measurement of the γ-ray angular distribution of this reaction in the energy range $E_{\rm CM} = 450$ - 1220 keV. The experiment has been carried out at the Felsenkeller 5MV shallow-underground accelerator lab in Dresden. For the angular study more than 20 HPGe detectors were arranged at angles between $\theta = 25$ - $140\,^\circ$ with respect to the beam direction. – The use of GAMMAPOOL resources is gratefully acknowledged.

HK 62.4 Thu 16:45 HBR 14: HS 4
Results of total and partial cross-section measurements of the ^{87}Rb$(p,\gamma)^{88}$Sr reaction — •Svenja Wilden, Felix Heim, Benedikt Machliner, Martin Müller, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The existence of the p nuclei – a set of stable proton-rich nuclei – cannot be explained by neutron-capture processes [1]. Therefore, another mechanism must come into play, namely photodisintegration reactions, giving rise to the γ process. Since many photodisintegration reactions are not accessible trough experiments, statistical model calculations play a crucial role in predicting reaction rates and cross sections.

To study the ^{87}Rb$(p,\gamma)^{88}$Sr reaction, an in-beam experiment was performed at the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne. The 10 MV FN Tandem accelerator provided proton beams between $E_p = 2$ and 5 MeV. For six proton-beam energies cross-sections values were determined. These first experimental cross-section values for the ^{87}Rb$(p,\gamma)^{88}$Sr reaction help to constrain the nuclear physics input for statistical model calculations.

[1] T. Rauscher *et al.*, Rep. Prog. Phys. **76** (2013) 066201.

Supported by the DFG (ZI 510/8-2).

HK 62.5 Thu 17:00 HBR 14: HS 4
Transition frequency measurements in $^{46-50}$Ti$^+$ of astrophysical interest at COALA — •Julien Spahn, Kristian König, Tim Lellinger, Wilfried Nörtershäuser, and Tim Ratajczyk — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

A long standing question of cosmology is if fundamental physical constants, like the fine structure constant α, are in fact constant or vary with time, as proposed by different theories expanding the standard model [1]. To investigate this behavior, the study of the fine-structure splitting of atomic levels ($\propto \alpha^2$), within the absorption lines caused by gas clouds in the light emitted by quasars, has been proposed [2]. Especially transition metals lighter than Fe and hence produced through fusion, like Ti, are of particular interest, since they are produced in first generation stars and thus give access to the very early state of the universe 12 billion years ago.

Such studies require a precise knowledge of absolute transition frequencies at an accuracy better than 10^{-4} Å, which can be achieved using collinear laser spectroscopy, as demonstrated on numerous stable and short-lived isotopes. Three transitions in $^{46-50}$Ti from the $3d^2(^3\mathrm{F})4s\ ^4\mathrm{F}$ ground state to the $3d^2(^3\mathrm{F})4p\ ^4\mathrm{G}$ state have been investigated at COALA at TU Darmstadt. This contribution will present our latest results obtained using a versatile laser ablation source, which will allow us to investigate other transitions of interest in the future.

This project is supported by BMBF under contract 05P21RDFN1.

[1] J.-P. Uzan, *Reviews of Modern Physics*, vol. 75, 2003.
[2] D. J. Mortlock et al., *Nature*, vol. 474, 2011.

HK 63: Instrumentation XV

Time: Thursday 15:45–17:15 Location: HBR 19: C 1

HK 63.1 Thu 15:45 HBR 19: C 1
Properties of Fast-Lutetium-Gadolinium Oxyorthosilicate Scintillation Material — •Valerii Dormenev, Kai-Thomas Brinkmann, Dzmitry Kazlou, Rainer W. Novotny, and Hans-Georg Zaunick — 2nd Physics Institute Justus-Liebig-University Giessen, Germany

Many modern detector systems based on scintillation materials require high count rates. This involves the use of bright scintillators with fast rise and decay times in combination with modern ultrafast photodetectors such as SiPMs. A possible solution for such kind of applications is a family of Lutetium-Gadolinium oxyorthosilicate ($Lu_{2(1-x)}Gd_{2x}SiO_5$, LGSO). Oxide Corporation (Japan) developed a version of fast-LGSO material with optimized timing characteristics. This work reports on the characterization of properties of fast-LGSO material doped by Ce and their comparison with standard Lutetium-Yttrium Oxyorthosilicates YSO/LYSO/LSO.

This work was carried out in the framework of BMBF Project 05K2019 * UFaCal, the High-D consortium and in line with the Crystal Clear Collaboration. EU regional funding via the EFRE scheme of the State of Hesse is gratefully acknowledged.

HK 63.2 Thu 16:00 HBR 19: C 1

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

The crystal Zero Degree Detector (cZDD) is a proposed 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, that are not covered yet by the already existing detectors at BESIII.

In this presentation the design of the first prototype of the cZDD is discussed and the development of an online feature extraction based on FPGAs is motivated.

HK 63.3 Thu 16:15 HBR 19: C 1

Simulation studies of the Forward Conversion Tracker for ALICE 3 — •Cas van Veen for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

During the Long Shutdown 4 of the Large Hadron Collider, ALICE will upgrade its complete detector to address new physics cases with unprecedented resolution and higher interaction rates, called ALICE 3. The Forward Conversion Tracker (FCT), located in the forward direction, will measure the photon spectrum predicted by Low's theorem in proton-proton collisions at $\sqrt{s} = 14$ TeV.

The focus of this talk will be on the status of the simulation studies of the FCT. The O2 framework of ALICE allows for detailed, full simulations of proton-proton collisions including transportation through the detector setup of ALICE 3. The background bremsstrahlung generated by charged particles passing through material in front of the FCT is a major challenge for this study and strategies to reduce this background will be presented. One of the major strategies is to provide electron particle identification in the region of the FCT, and the other major strategy is to construct a conical beam pipe which comes with its own challenges.

HK 63.4 Thu 16:30 HBR 19: C 1

Progress of the development of the PANDA FAIR Phase-0 electromagnetic calorimeter — Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], Samet Katilmis[1], Frank Maas[1,2,3], Oliver Noll[1,2], David Rodriguez Piñeiro[1], Paul Schöner[1], •Christoph Rosner[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 PANDA experiment will be one of the main pillars of the future FAIR facility in Darmstadt. In the scope of the PANDA FAIR Phase-0 project, the backward electromagnetic calorimeter (EMC) of Panda will be used at the Mainz Microtron (MAMI) accelerator to determine the neutral pion transition form factor, which is a crucial ingredient to reduce the uncertainty of the theoretical calculation of the muon anomalous magnetic moment. Together with an improved experimental uncertainty, this will allow to shed light on the muon g-2 puzzle.

This contribution focusses on the progress of the detector development for the FAIR Phase-0 version of the backward EMC. The calibration of the submodules which the detector comprises will be discussed, as well as a first test assembly of the detector modules in their final configuration. Finally, the plans to install the detector at MAMI will be presented.

HK 63.5 Thu 16:45 HBR 19: C 1

Development of a web based application for the slow control of the PANDA FAIR Phase-0 Calorimeter — Luigi Capozza[1], Jonas Geisbüsch[1], Ravi Gowdru Manjunata[1], •Samet Katilmis[1], Frank Maas[1,2,3], Oliver Noll[1,2], David Rodriguez Piñeiro[1], Paul Schöner[1], Christoph Rosner[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 PANDA FAIR Phase-0 calorimeter consists of 48 submodules. Each submodule houses detector components, such as high voltage distribution boards, charge sensitive preamplifiers, temperature sensors and LEDs. The control values of these components can be set and read. The control of these components is summarised as slow control. The slow control is realised in a web interface to control various sections of the calorimeter. The talk points out the current development status of the web interface.

HK 63.6 Thu 17:00 HBR 19: C 1

Results from the latest Beam Time with the $\overline{\text{P}}$ANDA Cluster-Jet Target at COSY — •Philipp Brand, Daniel Bonaventura, Hanna Eick, Jost Froning, Christian Mannweiler, Sophia Vestrick, Michael Weide, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

The $\overline{\text{P}}$ANDA cluster-jet target will be the Day-1 target for the $\overline{\text{P}}$ANDA experiment within the High Energy Storage Ring (HESR) at FAIR. With this device, a target thickness of more than 10^{15} atoms/cm^2 is achieved at the interaction point more than 2 m below the jet nozzle.

This target was routinely in operation at the COoler SYnchrotron (COSY) over the last years. Special emphasis of the last beam time was on the operation of an MCP system for cluster beam visualization. Therefore, the cluster beam has to be ionized which can be done either by a dedicated electron gun or by the accelerator's ion beam. Using the ion beam has the advantage that then only the vertex region is visualized with the MCP so that this system can work as a vertex zone monitor. Currently, the MCP image intensity dependence on target density, ion beam intensity, and MCP voltages is analyzed which would allow for a rough luminosity monitoring. Furthermore, also studies on the beam target interaction using the HESR stochastic cooling devices were performed. Some results of this last COSY beam time are presented.

This project has received funding from BMBF (05P21PMFP1), GSI FuE (MSKHOU2023) and the EU's Horizon 2020 programme (824093).

HK 64: Instrumentation XVI

Time: Thursday 15:45–17:15 Location: HBR 19: C 2

Group Report HK 64.1 Thu 15:45 HBR 19: C 2

Space-point distortion calibrations for the ALICE TPC in LHC Run 3 — •Matthias Kleiner for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The Time Projection Chamber (TPC) in the ALICE experiment at the CERN LHC provides excellent tracking and particle identification capabilities. In order to cope with the high interaction rates of up to 50 kHz in Pb–Pb collisions during Run 3, the Multi-Wire Proportional Chambers (MWPCs) in the TPC were replaced by stacks of four Gas Electron Multiplier (GEM) foils to allow for continuous data acquisition. Despite the intrinsic ion-blocking properties of the 4-GEM system, a residual amount of ions produced during the electron amplification drifts into the active volume of the TPC, leading to space-charge distortions of the nominal drift field. Various further effects, such as fluctuations in the interaction rate or the decay of the LHC beam, cause time dependent variations of the distortions due to space-charge. Additional detector effects cause static and time dependent space-point distortions. These space-point distortions have to be corrected to preserve the intrinsic tracking precision of the TPC.

In this talk, an overview of observed space-point distortions and time dependent distortions in the ALICE TPC in Run 3 will be presented, along with procedures developed for the calibration of the space-point distortions.

Supported by BMBF and the Helmholtz Association

HK 64.2 Thu 16:15 HBR 19: C 2

Gain Calibration of the ALICE TPC with a Krypton source — •Ankur Yadav, Philip Hauer, and Bernhard Ketzer for the ALICE Germany-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

The ALICE Time Projection Chamber (TPC) was upgraded with a Gas Electron Multiplier (GEM)-based amplification system and continuous readout for Run 3 of the LHC. After the first successful Pb-Pb data taking in 2023, the TPC took several measurements by injecting the meta-stable radioactive isotope Kr-83m into the gas volume in order to calibrate the gain of each pad. In addition to the nominal settings used for physics data taking, several other combinations of electric fields in the quadruple-GEM stack were tested.

The recorded data was used to extract the pad-by-pad gain maps for the calibration of the TPC. In addition, the MC methods provided by the ALICE O^2 toolkit were used to simulate the decays of Kr-83m in the ALICE TPC.

This talk will present the comparison between the results for the different field settings as well as compare the results of the simulation with the data measured by the ALICE TPC.

Supported by BMBF.

HK 64.3 Thu 16:30 HBR 19: C 2

Investigation of gain homogeneity of new GEM tracking detectors for AMBER — •Paul Clemens[1], Jan Paschek[1], Bernhard Ketzer[1], and Karl Flöthner[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]GDD, CERN, Geneva, Switzerland

AMBER is a new fixed-target experiment at CERN's SPS, designed to investigate fundamental properties of hadrons. In the next years, measurement campaigns are planned which aim to measure the proton charge radius, antiproton production cross sections and Drell-Yan processes. In the predecessor experiment, Gas Electron Multiplier (GEM)-based detectors have been used since 2001 for precise tracking close to the beam. The requirements of the new measurements planned for AMBER, free-streaming readout and higher rate capability for strips in the central region, demand an upgrade of the existing COMPASS GEM tracking system. During the commissioning phase of new 30×30 cm^2 triple-GEM tracking detectors, a significantly higher gain was measured at a certain position in the detector, compared to the rest of the active area. This „hot spot“ appeared in all new detectors in the lab and at a test beam at the SPS. Large inhomogeneities in the gain distribution can potentially lead to discharges, threatening stable operation of the detector or even damaging it, or to inefficiencies in lower gain regions. In this talk, I will present systematic investigations towards the cause of this effect and discuss possible solutions.

HK 64.4 Thu 16:45 HBR 19: C 2

A Stabilized Voltage Divider for HV-Supply of GEM Detectors — •Jakob Krauss[1], Philip Hauer[1], Christian Honisch[1], Karl Flöthner[1,2], Matiss Wolter[1], and Bernhard Ketzer[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]CERN, Geneva, Switzerland

Gas Electron Multipliers (GEMs) are a common amplification stage in gaseous detectors. A high electric field is created inside micro-patterned holes to produce charge amplification. When used in high-rate environments, such as AMBER, the charges produced inside the detector lead to non-negligible currents between the electrodes. This imposes more stringent requirements on the stability of the high-voltage supply, as the gain is highly sensitive to the applied potentials.

The commonly used Passive Voltage Divider (PVD), is a cascade of resistors to set the potentials and limit the currents. With this design, any significant current will inevitably cause a change of potential. In contrast, the newly developed Stabilized Voltage Divider (SVD) employs a common-drain circuit, that provides currents with minimal voltage drop. The SVD also provides active current limiters for all GEM electrodes, effectively mitigating continuous discharges.

The talk will cover the principle of the SVD and a comparison with the PVD in simulation and in a detector setup under strong irradiation.

HK 64.5 Thu 17:00 HBR 19: C 2

Photon Reconstruction with ALICE's TPC in Run 3 — •Felix Schlepper for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg

In the upcoming ALICE Run 3 at CERN's LHC, the reconstruction of photons faces significant hurdles due to unconstrained tracks within the Time Projection Chamber (TPC) in continuous readout-mode. Due to their unconstrained nature these tracks produce large combinatorics, which is computationally very challenging. This talk delves into the challenges and solutions to reduce these combinatorics in the secondary vertexing and allow ALICE to reconstruct the vast majority of Photons.

HK 65: Structure and Dynamics of Nuclei XII

Time: Thursday 15:45–17:15 Location: HBR 19: C 5a

Group Report HK 65.1 Thu 15:45 HBR 19: C 5a

Precision ab initio nuclear structure and implications for fundamental physics — •Matthias Heinz[1,2,3], Kai Hebeler[1,2,3], Jan Hoppe[1,2], Takayuki Miyagi[1,2,3], Achim Schwenk[1,2,3], S. Ragnar Stroberg[4], and Alexander Tichai[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]Department of Physics and Astronomy, University of Notre Dame

Ab initio nuclear structure theory aims to predict the structure of atomic nuclei from "first principles," employing systematically improvable approximations in the determination of nuclear forces and in the solution of the many-body Schrödinger equation. Over the past two decades, this ab initio paradigm has been successfully established as a consistent, precise framework for predicting the structure of medium-mass nuclei (closed- and open-shell) and can now also reach heavy systems. Recent developments have extended ab initio calculations on two frontiers: towards higher precision and towards heavier nuclei. I discuss improvements in the treatment of three-body forces to allow converged calculations of ^{208}Pb and high-precision calculations improving the description of calcium isotopes. The precise many-body treatment will be important to understand nuclear structure effects in new physics searches in nuclei.

* Funded by ERC Grant Agreement No. 101020842

HK 65.2 Thu 16:15 HBR 19: C 5a

Evolution of the quadrupole moment of Cd and Sn nuclei — •Pawan Kumar[1,2], Gabriel Martinez-Pinedo[2,1], and Paul-Gerhard Reinhard[3] — [1]Institut für Kernphysik (Theoriezentrum), Fachbereich Physik, Technische Universität Darmstadt, Darmstadt 64298, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt 64291, Germany — [3]Institut für Theoretische Physik II, Universität Erlangen, Erlangen 91058, Germany

The nuclear quadrupole moment is one of the important properties of nuclei. It is taken as a measure of the deviation of nuclear shape from sphericity. While extensive studies by both theorists and experimentalists have been conducted on the nuclear quadrupole moment over the years, its understanding at one aspect has remained elusive: why does the value of the quadrupole moment change in an isotopic chain while the number of protons remains constant? To address this question, we have conducted a theoretical investigation based on the shell model and nuclear density functional theory. Applying these complementary models to the $11/2^-$ and $3/2^+$ states of neutron-rich Cd and Sn nuclei, our investigation reveals that the evolution of the nuclear quadrupole moment in these isotopic chains is a consequence of neutron-induced polarization, which varies with neutron number.

This research is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Project number 448588010.

HK 65.3 Thu 16:30 HBR 19: C 5a

Probing the doubly magic shell closure at ^{132}Sn by Coulomb

excitation of neutron-rich ^{130}Sn — •Maximilian Droste[1], Peter Reiter[1], and Thorsten Kröll[2] for the MINIBALL IS702-Collaboration — [1]IKP, Universität zu Köln, Germany — [2]IKP, Technische Universität Darmstadt, Germany

Excited states of ^{130}Sn, the even-even neighbour of the doubly-magic nucleus ^{132}Sn, were populated via safe Coulomb excitation employing the recently commissioned, highly efficient MINIBALL array. The ^{130}Sn ions were accelerated by the HIE-ISOLDE accelerator to an energy of 4.4 MeV/u and impinged onto a ^{206}Pb target. Deexciting γ rays have been recorded in coincidence with scattered particles. Besides γ rays from the first 2^+ state, deexcitation from higher-lying states was observed. The latter is caused by an isomeric $^{130}\mathrm{Sn}_{7-}$ beam component. Reduced transition strengths for the $0^+_{g.s.} \rightarrow 2^+_1$ ^{130}Sn will illucidate the evolution of collectivity and nuclear structure around the magic shell closure at N=82, Z=50 tin isotopes. Advanced shell model calculations predict enhanced collectivity in the neighbouring isotopes of ^{132}Sn [1]. Moreover, a puzzling discrepancy between previous measurements in ^{130}Sn and latest theoretical results [2] awaits to be resolved.

[1] D. Rosiak et al. Phys. Rev. Lett. 121, 252501 (2018)
[2] T. Togashi et al. Phys. Rev. Lett. 121, 062501 (2018)

Supported by the German BMBF 05P21PKFN9, 05P21RDCI2 and European Union's Horizon Europe Framework research and innovation programme under grant agreement No. 101057511.

HK 65.4 Thu 16:45 HBR 19: C 5a

Two-body currents at finite momentum transfer — •Catharina Brase[1,2,3], Takayuki Miyagi[1,2,3], Javier Menéndez[4,5], 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]Departament de Física Quántica i Astrofísica, Universitat de Barcelona, 08028 Barcelona, Spain — [5]Institut de Ciències del Cosmos, Universitat de Barcelona, 08028 Barcelona, Spain

Two-body currents (2BCs) at zero momentum transfer are essential for understanding observables of electroweak interactions with nuclei, such as helping to solve the long-standing quenching problem. For other processes, e.g., weakly-interacting massive particles scattering off nuclei, 2BCs need to be evaluated at finite momentum transfer and are currently only approximately included. We derived a multipole decomposition of 2BCs to include 2BCs at finite momentum transfer in calculations for processes with medium-mass nuclei, without approximating the 2BCs. To validate the derived multipole decomposition of the 2BCs we compare matrix elements of 2BCs from chiral effective field theory in a harmonic oscillator basis evaluated with the multipole decomposition and with brute force, i.e., Monte Carlo integration to numerically evaluate the diagrams.

* Funded by the ERC Grant Agreement No. 101020842.

HK 65.5 Thu 17:00 HBR 19: C 5a

Shell model investigations along the $N = 31$ and $Z = 28$ chains — •Ramona Burggraf, Peter Reiter, Konrad Arnswald, Andrey Blazhev, Maximilian Droste, Christoph Fransen, and Hannah Kleis — IKP, Universität zu Köln

Lifetime measurements of excited states along the $N = 31$ chain were performed in order to investigate the $N = 32$ sub-shell closure at higher masses near proton magic number $Z = 28$. Precise lifetime values for excited states were determined in ^{59}Ni and ^{57}Fe, which were populated in ^{51}V(^{12}C, $p3n$) and ^{51}V(^{12}C, $pn\alpha$) fusion-evaporation reactions at a beam energy of 55 MeV at the FN tandem accelerator of the University of Cologne. The Cologne plunger device, surrounded by an efficient γ-ray detector array was used to determine lifetimes with the recoil-distance Doppler-shift method. The newly determined values differ significantly from previous experimental results. New shell-model calculations employing the GXPF1A interaction were performed for nuclei along the $N = 31$ and $Z = 28$ chains. The evaluated previous experimental B(E2; $9/2^- \rightarrow 5/2^-$) values for the $N = 31$ isotone chain do not show reduced lower values at the $Z = 28$ shell closure which is in contrast to the results of the shell model calculations. However, the newly determined lifetime values are consistent with the latest theoretical findings.

HK 66: Structure and Dynamics of Nuclei XIII

Time: Thursday 15:45–17:15 Location: HBR 19: C 5b

HK 66.1 Thu 15:45 HBR 19: C 5b

Towards electron-induced fission at the S-DALINAC — •G. Steinhilber[1], N. Pietralla[1], M. Arnold[1], J. Birkhan[1], M. Block[2], M.L. Cortès[1], J. Isaak[1], T. Galatyuk[1], T. Ramaker[1], and M. Spall[1] — [1]IKP, Technische Universität Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

The origin of heavy elements like rare-earth metals is a fundamental question for which direct evidence was found by observation of the gravitational-wave signal GW170817 and its associated kilonova electromagnetic transient. This established the r-process in binary neutron-star merger events for fast synthesis of heavy elements [1]. Mass accumulation due to neutron captures and associated fast beta-decays terminates in the actinide region when fission reactions start to compete. Fission fragments then form the new seed nuclei for the r-process. Detailed models of the r-process require reliable fission models. However, experimental data on nuclear fission as a function of excitation energy is scarce. To increase our understanding of the impact of fission to the r-process, a new setup for electron-induced fission is under development at the S-DALINAC at TU Darmstadt. Combining the large acceptance QCLAM spectrometer with fission fragment detectors allows for a coincident measurement of excitation energy and masses of both fragments. In this contribution, the development of the experimental setup and future physics cases will be discussed.

This work is supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID No. 500/10.006).

[1] J. J. Cowan et al., Rev. Mod. Phys. 93, 015002 (2021).

HK 66.2 Thu 16:00 HBR 19: C 5b

Measurement of masses of fission products and isotopic yields from a ^{252}Cf spontaneous fission source at the FRS Ion Catcher — •Meetika Narang for the FRS Ion Catcher-Collaboration — University of Groningen, Netherlands — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany.

The knowledge of independent isotopic fission yields (IIFYs) and their masses is crucial for understanding the astrophysical r-process of nucleosynthesis, nuclear structure and reactions, and nuclear reactor safety.

At the FRS Ion Catcher (FRS-IC) at GSI, fission fragments are produced by spontaneous fission (SF) from a ^{252}Cf source mounted inside a Cryogenic Stopping Cell (CSC), thermalized and stopped within the CSC. Their masses and IIFYs are measured using a Multiple-Reflection Time-Of-Flight Mass-Spectrometer (MR-TOF-MS). Incorporating several novel and unique concepts, the MR-TOF-MS resolves isobars, even with limited statistics. Its broadband nature ensures minimal relative systematic uncertainties among fission products. Extracting IIFYs includes isotope-dependent efficiency corrections for all the components of FRS-IC.

In this talk, I will present our results of the high-accuracy mass measurements, as they include the first direct mass measurement at the N=90 and Z=56-62 region, and our IIFYs results, which cover several tens of fission products in the less-accessible high-mass peak down to fission yields at the level of 10^{-5}. Future experiments will extend our results to wider Z and N ranges, lower fission yields, and other spontaneously-fissioning actinides.

HK 66.3 Thu 16:15 HBR 19: C 5b

Search for the double-alpha decay of radium isotopes — •Makar Simonov for the Double Alpha-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany

Double-alpha decay is a predicted nuclear decay mode where the nucleus emits two α-particles simultaneously. This process was first considered in the 1980s as a sequence of ^{8}Be-cluster emission followed by its disintegration. According to a recent study (Mercier *et al.*, PRL 127, 012501 (2021)), immediate double-alpha decay is more likely to occur than ^{8}Be-like cluster decay by more than 9 orders of magnitude, and it might be detected as a back-to-back emission of two α-particles.

To verify the prediction, two complementary experiments were conducted: an offline one at the FRS Ion Catcher (GSI, 4 months, 2022) and an online one at the ISOLDE (CERN, 1 week, 2023). At the FRS Ion Catcher, a ^{228}Th source was used to produce recoil nuclei of ^{224}Ra. The filtered beam was implanted on a foil, and two double-sided silicon strip detectors (DSSDs) located around the foil registered the energy, time, and spatial position of α-particles observed by the detectors. At ISOLDE, beams of ^{222}Ra and ^{220}Ra were generated by impinging a proton beam on a uranium target. The setup included four DSSDs triggered by coincidence events only. The expected number of detected double-alpha decays for both experiments is about 100.

In this talk, we will focus on data analysis for the FRS Ion Catcher experiment. We will examine key factors of DSSD calibration: detector geometry, energy and time resolution, and the use of Monte Carlo simulation as a tool to estimate the background.

HK 66.4 Thu 16:30 HBR 19: C 5b

Realistic Coalescence model for deuteron formation — •Maximilian Horst and Laura Fabbietti — Technische Universität München

Coalescence is one of the main models to describe the formation of light nuclei in high-energy collisions. It assumes that protons and neutrons are formed at chemical freeze-out, and bind together if they are close in phase-space. In the past, simplistic models, such as the spherical approximation and box-coalescence, have been used to describe this process. However, all of these models fail to describe the measured results without fitting free parameters. As such, they lack predictive power in regimes where nuclear production yields are not yet measured. This is problematic since one of the most intriguing applications of coalescence is looking for signatures of dark matter in cosmic ray antinuclei. This application requires extrapolation from the current high energy measurement at LHC energies at the TeV scale to the astrophysically relevant collision energies of ∼20 GeV. A promising advanced coalescence model is one that employs the Wigner function formalism to predict deuteron yields without free parameters as long as the size of the emission source and the nucleon momentum distributions are measured. However, the source size has never been measured in small systems outside the LHC energies. In this talk, we present a newly developed Toy Monte Carlo model called ToMCCA, which we use to fit the source size and predict deuteron yields for arbitrary energies. This work is funded by BMBF Verbundforschung (05P21WOCA1 ALICE) and DFG SFB1258

HK 66.5 Thu 16:45 HBR 19: C 5b

Measurement of ^{3}H and ^{3}He production in pp collisions at $\sqrt{s} = 13$ TeV with ALICE at the LHC — •Matthias Herzer for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt, Germany

The production of (anti)nuclei in pp collisions at the LHC has become a major topic in the high-energy physics community. In fact, there is a huge overlap between different research directions, from astrophysics, particle and nuclear physics. For instance, the observation of antinuclei in space is considered as possible signature for dark matter, since they would originate from collisions of potential dark matter candidates among each other. We show the study of the production of ^{3}H and ^{3}He in pp collisions at 13 TeV in two data sets that were taken in LHC Run 2, i.e. in high-multiplicity events and one from a dedicated online trigger on nuclei. Furthermore, we will show the measurement of the ratio of these nuclei. This is an important test of isospin symmetry, which is expected to hold at LHC energies, but can not be tested directly since neutrons are not accessible experimentally.

HK 66.6 Thu 17:00 HBR 19: C 5b

Fission Isomer Studies at IGISOL and at the FRS — •Nazarena Tortorelli for the I290 Collaboration-Collaboration — LMU Munich, Germany

A century from the discovery of nuclear isomers, amongst them strongly deformed fission isomers in the actinides, they are still under high scientific interest. So far 35 fission isomers with lifetimes between 5 ps and 14 ms have been observed. The longest-lived fission isomer known so far, with a half-life of 14 ms, was found in ^{242}Am populated via the $^{242}Pu(d,2n)$ reaction, while for ^{240f}Am, populated via the $^{240}Pu(d,2n)^{240}Am$ reaction, a 0.9 ms half-life was predicted. Recently, at IGISOL an experiment was performed investigating the fission isomer states in $^{240,242}Am$. The isomeric states have been populated via deuteron induced fusion-evaporation reactions on a ^{242}Pu target and the decay time and the kinetic energy of the fission isomers have been measured. Moreover, at the FRS, a new isomer population scheme was investigated: projectile fragmentation (i.e., the collision of a heavy relativistic beam of $1GeV/u$ ^{238}U on a light Be target). This scheme offers rapid production, hence access to isomers with short half-lives, and most importantly, highly pure fragmented beams and event-by-event identification. In this talk the recent experiment at IGISOL will be presented together with a preliminary overview of the experiment performed at the FRS showing the status of the fission isomers studies and the possibilities for future investigations. Supported by GSI F&E (LMTHI2023).

HK 67: Fundamental Symmetries I

Time: Thursday 15:45–17:15 Location: HBR 19: C 103

Group Report HK 67.1 Thu 15:45 HBR 19: C 103

Improved measurement of the anomalous magnetic moment of the muon with 200ppb precision — •René Reimann, Mohammad Ubaidullah Hassan Qureshi, and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Cluster of Excellence PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The magnetic moment anomaly of the muon, that relates the cyclotron and spin precession frequency, provides one of the most stringent tests of the Standard Model of Particle Physics since it is measured and theoretically predicted to very high precision. In August 2023, the Fermilab Muon g-2 experiment reported its result from measurement campaigns 2 and 3 with an increased precision of now 200 ppb, which is both due to increased statistics and reduced systematics. This milestone puts the Muon g-2 experiment well on its way towards its design precision of 140 ppb with final statistics. In this talk we review the key improvements that lead to the reduction of uncertainty on Muon g-2 by a factor of about two and put the measurement in the context of the current theoretical understanding.

Group Report HK 67.2 Thu 16:15 HBR 19: C 103

Status report on the P2 experiment — Sebastian Baunack[1], Maarten Boonekamp[4], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,2,3], Moran Neher[1], Tobias Rimke[1], David Rodriguez Pineiro[2], 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.

HK 67.3 Thu 16:45 HBR 19: C 103

Search for Charged Lepton Flavor Violation with the Mu2e experiment at Fermilab — •Anna Ferrari, Stefan E. Müller, Oliver Knodel, and Reuven Rachamin — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently under construction at the Fermi National Accelerator Laboratory (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 by a rigorous control of all backgrounds that could mimic the monoenergetic conversion electrons, together with an accurate normalization of the signal events.

At the ELBE facility of the Helmholtz-Zentrum Dresden-Rossendorf the pulsed Bremsstrahlung photon beam played a key role to study the performance of the detector system that will monitor the rate of the stopped muons in the aluminum target. In addition, ELBE photon and neutron secondary beams allowed radiation hardness studies of the electronic components that will equip the Mu2e electromagnetic calorimeter.

The design and current status of the Mu2e experiment will be presented, together with a summary of the ELBE results.

HK 67.4 Thu 17:00 HBR 19: C 103

Towards axion searches with polarized hadron beams and targets at the GSI/FAIR storage rings — •Daoning Gu for the JEDI-Collaboration — Institut für Kernphysik, FZ Jülich, Germany — III. Physikalisches Institut B, RWTH Aachen University, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Polarized hadron beams can be used to explore interactions that are not observable with unpolarized beams. In particular, polarized beams are more advantageous for testing symmetry violations. They also offer the opportunity to search for new physics beyond the Standard Model (SM).

Axions are leading particle candidates for dark matter. They were originally introduced to solve the strong CP problem and have also appeared in various extensions to the SM. The axion/axion-like-particle (ALP) field has an effect on the spin motion of the particles in storage rings, which leads to an oscillating electric dipole moment (oEDM).

In this talk, results obtained at the Cooler Synchrotron COSY and possible future experiments that can be performed with existing accelerators at GSI/FAIR in Darmstadt with polarized hadron beams and targets will be discussed. The working principle of axion searches in storage rings will be explained and the preliminary results of simulations will be shown.

HK 68: Heavy-Ion Collisions and QCD Phases XV

Time: Thursday 15:45–17:15 Location: HBR 62: EG 03

Group Report HK 68.1 Thu 15:45 HBR 62: EG 03

QCD Phase Diagram from Strong Coupling Lattice QCD — •Wolfgag Unger[1], Pratitee Pattanaik[1], and Jangho Kim[2] — [1]Fakultät für Physik, Universität Bielefeld — [2]Institute for Advanced Simulation (IAS-4), Forschungszentrum Jülich

We review recent results based on the strong coupling expansion for lattice QCD with staggered fermions at finite temperature and density. The representation of the lattice partition function is in terms of so-called dual variables that allow to circumvent the finite density sign problem. It can be efficiently sampled via Monte Carlo, and is also suitable for Quantum Computing.

We summarize results of the phase diagram at finite baryon density and also address the extension of the strong coupling phase diagram to finite isopin density.

HK 68.2 Thu 16:15 HBR 62: EG 03

A Stability Analysis of Inhomogeneous Phases in QCD. — •Theo Motta[1,2], Julian Bernhardt[1], Michael Buballa[2], and Christian Fischer[1] — [1]JLU Gießen — [2]TU Darmstadt

Understanding the phase structure of Quantum Chromodynamics (QCD) is of paramount importance for nuclear and particle physics. At large densities and low temperatures, many complex phases are expected to appear. This is where the lattice sign problem is unavoidable and extrapolation methods such as Taylor expansions are out-of-bounds. Alongside colour-superconductivity, quarkyonic matter, and so on, the possibility of a crystalline phase has been studied for over twenty years. In simplified models of QCD such as NJL or quark-meson models, these phases are present. However, no unambiguous determination exists that they appear in QCD. In this talk, I will discuss our efforts to develop a method of stability analysis that is compatible with full QCD via Dyson-Schwinger Equations.

HK 68.3 Thu 16:30 HBR 62: EG 03

Quark diffusion coefficients in the phase structure of QCD — •Jonas Wessely[1], Jan M Pawlowski[1,2], and Nicolas Wink[3] — [1]Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Germany — [2]ExtreMe Matter Institute EMMI, GSI, Planckstr. 1, 64291 Darmstadt, Germany — [3]Institut für Kernphysik, Technisch Universität Darmstadt, Schloessgartenstraße 2, 64289 Darmstadt, Germany

I present result on the quark diffusion coefficient for different (light) flavours at finite temperature and density. The diffusion coefficients are obtained via the Kubo relation from non-perturbative realtime diagrams which depend on single particle spectral functions of quarks and gluons. The latter are computed with a combination of spectral reconstructions and recently developed spectral functional techniques for the quark propagator spectral functions at finite T and μ_B.

HK 68.4 Thu 16:45 HBR 62: EG 03

Searching for inhomogeneous phases in the quark-meson model beyond mean field — •Lennart Kurth — TU Darmstadt, Germany

Mean field studies of effective models for QCD have revealed the possibility of the preferred condensate being spatially modulated in certain regions of the phase diagram, i.e., inhomogeneous phases. We extend these studies beyond mean field using the functional renormalization group to include pion fluctuations in a simple truncation of the quark-meson model. In this context, we perform a systematic scan of all UV parameters and investigate their effect on the phase diagram, including inhomogeneous phases. The presence of these is determined via stability analysis. As a result, we find that there is a region in parameter space in which an inhomogeneous phase exists, as is the case in mean field.

HK 68.5 Thu 17:00 HBR 62: EG 03

QCD Anderson transition with overlap valence quarks on a twisted-mass sea — •Robin Kehr[1], Dominik Smith[1,2], and Lorenz von Smekal[1,3] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, Heinrich-Buff-Ring 16, 35392 Giessen, Germany — [2]Facility for Antiproton and Ion Research in Europe GmbH (FAIR GmbH), 64291 Darmstadt, Germany — [3]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen

In this work we probe the QCD Anderson transition by studying spectral distributions of the massless overlap operator on gauge configurations created by the *twisted mass at finite temperature collaboration* (tmfT) with 2+1+1 flavors of dynamical quarks and the Iwasaki gauge action. We assess finite-size and discretization effects by considering two different lattice spacings and several physical volumes, and mimic the approach to the continuum limit through stereographic projection. Fitting the inflection points of the participation ratios of the overlap Dirac eigenmodes, we obtain estimates of the temperature dependence of the mobility edge, below which quark modes are localized. We observe that it is well-described by a quadratic polynomial and systematically vanishes at temperatures below the pseudo-critical one of the chiral transition. In fact, our best estimates within errors overlap with that of the chiral phase transition temperature of QCD in the chiral limit.

HK 69: Heavy-Ion Collisions and QCD Phases XVI

Time: Thursday 15:45–17:15 Location: HBR 62: EG 05

HK 69.1 Thu 15:45 HBR 62: EG 05

Measurement of p-d and Λ-d correlations in Pb–Pb and pp collisions — •Michael Jung for the ALICE Germany-Collaboration — Goethe-Universität Frankfurt

The correlation functions of p–d and Λ–d measured with ALICE in three different source sizes will be presented. The measurements were performed in pp collisions at $\sqrt{s} = 13$ TeV as well as in semi-central and central Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV. The particle identification and the procedure to obtain the correlation function will be shown. The results are then compared to theoretical predictions calculated using the Lednický-Lyuboshitz approach. For these calculations measured scattering lengths are taken. This measurement enables the possibility to study three particle interactions as well as the formation mechanism of light (hyper-)nuclei in particle collisions at LHC energies.

HK 69.2 Thu 16:00 HBR 62: EG 05

Ξ-baryon reconstruction with ALICE in LHC Run 3 data — •Tim Weinreich for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

The precise reconstruction of strange baryons like the Ξ is crucial to study charm baryons via their decay to strange baryons.
In order to extract a signal even in high charged particle multiplicity environments and low transverse momentum regions with high combinatorial background a precise reconstruction of the decay topology is invaluable for obtaining high invariant mass resolutions and reducing background for longer decay chains.
The Kalman Filter Particle (KFParticle) package is a complete reconstruction algorithm for complex decay topologies, fully taking into account the uncertainties of the daughter tracks.
In this work, the KFParticle package is used to reconstruct the cascade-like decay structure of the Ξ-baryon in simulated Run 3 proton-proton data at a centre of mass energy of $\sqrt{s} = 13.6$ TeV.
The reconstruction performance is compared to a reconstruction algorithm used for ALICE Run 3 data analysis, which is based on the minimisation of the distance of closest approach between daughter tracks. A comparison of the two reconstruction methods regarding secondary vertex, transverse momentum and invariant mass resolutions is presented.

HK 69.3 Thu 16:15 HBR 62: EG 05

Sexaquark Search with ALICE — •Andres Borquez — Physikalisches Institut, Germany

For many years, WIMPs have been the most popular dark matter candidate. However, despite extensive experimental research, no WIMP signal has yet been detected, leading to the search for more exotic candidates. In 2017, G. Farrar proposed the sexaquark as a new baryonic candidate for dark matter, which is a neutral, compact, six-quark state with the quark content *uuddss*. This particle is consistent with our current understanding of quantum chromodynamics (QCD) and the relic abundance of dark matter. In the ALICE experiment at the Large Hadron Collider (LHC), we plan to search for this exotic particle via its interaction with detector material after being produced in heavy ion collisions.

In this talk, we will discuss the challenges and prospects of this search, as well as an analysis of the simulations needed to carry it out.

HK 69.4 Thu 16:30 HBR 62: EG 05

Dynamic light Nuclei Production in SMASH — •Martha Ege[2,3], Justin Mohs[2,3], and Hannah Elfner[1,2,3] — [1]Gesellschaft für Schwerionenforschung — [2]Frankfurt Institute for Advanced Studies — [3]Goethe Universität Frankfurt am Main

The study of the QCD phase diagram and in particular the search for the critical endpoint and the first-order phase transition between the QGP and the hadronic phase at high μ_B is one of the main goals of heavy-ion physics. Since for the first order phase transition large fluctuations of the net baryon density are expected, we can assume that the production of light nuclei is sensitive to the critical endpoint and the phase transition. Therefore it is of major interest to get a better understanding about how light nuclei are formed in heavy-ion collisions.

In this work we investigate the production of light nuclei such as deuteron, triton, helium, and hypertriton in Au-Au collisions at different energies from the RHIC beam energy scan. We study the afterburner calculations for the light nuclei production in the framework of the hadronic transport approach SMASH (Simulating Many Accelerated Strongly-interacting Hadrons). The nuclei are produced via pion and nucleon catalysis reactions. In this approach a stochastic collision criterion is implemented to realize both $2 \leftrightarrow 3$ and $2 \leftrightarrow 4$ reactions. In this work spectra and multiplicities of light nuclei will be presented. We will investigate the production time and the origin of the light nuclei in detail. The results are compared to recent experimental data from the STAR collaboration.

HK 69.5 Thu 16:45 HBR 62: EG 05

Measurement of inclusive jet suppression in Pb–Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV with a novel mixed-event approach — •Nadine Alice Grünwald — Physikalisches Institut Universität Heidelberg

QCD matter is studied at very high temperatures and densities utilizing heavy-ion collisions. The ALICE experiment is dedicated to measure heavy-ion collisions at the LHC. The Quark-Gluon Plasma (QGP) is produced in those collisions where quarks and gluons are deconfined and new physics phenomena emerge. The QGP can be studied using jets, which are produced in the early stage of the collisions. Depending on the structure of the QGP, the jets lose energy mainly due to collisional and radiative energy loss. A major difficulty in heavy-ion jet measurements is the huge amount of uncorrelated particles from the underlying event. Those bulk particles smear out the jet measurement itself and are responsible for fake jets. In order to perform low p_T jet measurements, a novel mixed-event technique is exploited. In this talk the mixed events as a new approach to describe the uncorrelated background in heavy-ion jet measurements at ALICE are presented. The description of the uncorrelated background by mixed events enables the inclusive charged-particle jet measurement down to $p_T = 13.5$ GeV/c at collision energies of $\sqrt{s_{NN}} = 5.02$ TeV. We can compare for the first time the jet yield suppression due to quenching at RHIC and the LHC in the same kinematic range. In addition, the results are compared to various model predictions.

HK 69.6 Thu 17:00 HBR 62: EG 05

Role of initial transverse momentum in a hybrid approach — •Niklas Götz[1,2], Lucas Constantin[1], and Hannah Elfner[3,1,2,4] — [1]Goethe University Frankfurt, Department of Physics, Institute for Theoretical Physics, Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, Max-von-Laue-Straße 12, 60438 Frankfurt am Main, Germany

This work studies the effect of exchanging initial condition models in the modular hybrid approach SMASH-vHLLE, composed of the hadronic transport approach SMASH and the (3+1)d viscous hydrodynamic code vHLLE. The initial condition models investigated are SMASH IC, Trento and IP-Glasma. Correlations are calculated on an event-by-event basis between the eccentricities and momentum anisotropies of the initial state as well as the momentum anisotropies in the final state. This work demonstrates that substantial differences exist both in the distributions of eccentricities, the correlations amongst the initial state properties as well as in the correlations between initial state and final state properties. Inclusion of radial flow in the linear fit improves the prediction of final state flow from initial state properties. The presence of momentum in the initial state has an effect on the emergence of flow and is therefore a relevant part of initial state models, challenging the common understanding of a linear response.

HK 70: Hadron Structure and Spectroscopy IX

Time: Thursday 15:45–17:15 Location: HBR 62: EG 18

Group Report HK 70.1 Thu 15:45 HBR 62: EG 18

Proton charge radius measurement at AMBER — •Martin Hoffmann[1] and the GSI PRM group[2] for the AMBER-Collaboration — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The AMBER collaboration plans to perform a new precision measurement of the proton electric form factor at low squared four-momentum transfers (Q^2) 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 (TPC) 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 the TPC and a magnetic spectrometer. In this way, the measurement is over-constrained to cleanly select elastic scattering events.

In 2021, the core setup was studied under realistic beam conditions in a pilot run utilizing a prototype TPC and silicon strip detectors. Prototypes of the required tracking detectors and a free-running data acquisition were tested in 2022 and 2023. This talk will present ongoing analyses and an overview of further developments towards the main experiment.

Supported by EU.

HK 70.2 Thu 16:15 HBR 62: EG 18

The Silicon Tracking System of the E16 experiment at J-PARC: commissioning and results from the test beam — •Dairon Rodriguez Garces, Maksym Teklishyn, Adrian Rodriguez Rodriguez, Alberica Toia, Joerg Lehnert, Kazuya Aoki, Rento Yamada, Shuta Ochiai, and Kyoichiro Ozawa for the CBM-Collaboration — GSI. Darmstadt, Germany

The J-PARC E16 experiment has the goal to search for signatures of the spontaneously broken chiral symmetry and its (partial) restoration, through the study in-medium modification of the vector mesons, particularly the phi meson, decaying via di-electron channel, with a high intensity 30 GeV proton beam interacting with C and Cu targets at rates up to 10 MHz. For this purpose, the experiment will use modules constructed using the same technology and procedures as the modules of the Silicon Tracking System (STS) of the CBM experiment.

A total of 10 modules were assembled, tested, characterized and then installed in the E16 detector setup. The detector was commissioned in a beam test experiment at Tsukuba, where the detector modules could be exposed to a 3 GeV electron beam. In preparation for the beam test the modules were characterized and performance studies accomplished to assess the quality of the setup. In the beamtime 3 modules were operated and illuminated in two planes by the electron beam.

This work will show the results of commissioning and operation of the E16 modules, as well as the status of the data analysis and the insights that we have gained from it, in view of the upcoming series production of STS modules for the CBM experiment.

HK 70.3 Thu 16:30 HBR 62: EG 18

Design of a luminosity monitor for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Boonekamp[2,4], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,2,3], Moran Neher[1], •Tobias Rimke[1], David Rodriguez Pineiro[2], and Malte Wilfert[1] for the P2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz — [4]IRFU, CEA, Université 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 0.14% 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 in this talk. Furthermore, I show the current prototype design with results from promising tests run with the electron beam of the MAMI accelerator and detailed simulation studies with the prototype.

HK 70.4 Thu 16:45 HBR 62: EG 18

Scintillating Fiber Hodoscopes for the Proton Radius Measurement at AMBER — Christian Dreisbach[1], •Karl Eichhorn[1], Jan Friedrich[1], Igor Konorov[1], Martin J. Losekamm[1], Stephan Paul[1], and Thomas Poeschl[1,2] for the AMBER-Collaboration — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN

The AMBER collaboration aims to measure the electric-charge radius of the proton by elastic scattering of high-energy muons on an active hydrogen target at the M2 beamline at CERN's Super Proton Synchrotron. For muon tracking, novel Unified Tracking Stations equipped with silicon pixel detectors in combination with Scintillating Fiber Hodoscopes (SFH) will be used. The SFH consists of 500-μm scintillating-plastic fibers read out with silicon photomultipliers (SiPMs), covering an active area of (9x9) cm^2. We present ongoing studies and results from a test beam experiment performed in 2023 with a detector prototype.

HK 70.5 Thu 17:00 HBR 62: EG 18

A feasibility study for the dark photon search at the BGOOD experiment — •Vlera Hajdini for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

Investigating the potential feeble interaction between particles in the Standard Model (SM) and the Dark Matter (DM) sector is a significant frontier in particle physics. One possible manifestation of this feeble interaction is the dark photon, theorized as a vector gauge mediator that interacts very weakly with SM fermions.

The BGOOD photoproduction experiment combines a central electromagnetic calorimeter with a forward spectrometer for charged particle detection. This configuration enables the complete detection of reaction final states such as $\pi^0 p$, ηp, and $2\pi^0 p$. These are well-suited channels for the study of the mass resolution with regard to the dark photon search. The missing mass of the photons from η and π^0 decays were used to determine the mass resolution of the detector. Kinematic fitting techniques are also used to enhance the mass resolution, a critical element for accurate particle identification in high-energy experiments.

HK 71: Hadron Structure and Spectroscopy X

Time: Thursday 15:45–17:15 Location: HBR 62: EG 19

HK 71.1 Thu 15:45 HBR 62: EG 19

Measurement of mass A=4 hypernuclei in LHC Run 3 with ALICE — •Michael Hartung for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt, Germany

Hypernuclei are bound states that contain ordinary nucleons as well as hyperons (e.g. Λ). Their investigation allows the study of the hyperon-nucleon interaction, which can only be studied to limited extend by scattering experiments.

The most prominent example is the (anti)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon. It has been measured by the ALICE Collaboration in Run 1 and Run 2 of the Large Hadron Collider at CERN. The production of hypernuclei with mass A=4 is strongly suppressed compared to the (anti)hypertriton,

thus an exact measurement of their properties has been impossible so far. Due to the high-interaction rate and the continuous readout of the ALICE detectors in RUN 3, a precise measurement of two mass A=4 hypernuclei, namely hyperhydrogen-4 and hyperhelium-4, will be possible for the first time. We will present the latest results of the production measurement of both hypernuclei in Run 3 Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.36$ TeV.

HK 71.2 Thu 16:00 HBR 62: EG 19

Luminosity Determination and Proton-Proton Elastic Scattering Analysis with the Upgraded HADES Spectrometer — •Gabriela Perez-Andrade[1], James Ritman[1,2,3], and Peter Wintz[3] for the HADES-Collaboration — [1]Ruhr Universität Bochum — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Forschungszentrum Jülich

In 2022, an experiment focused on hyperon production was carried out with the upgraded HADES spectrometer. The upgrade includes a new Forward Detector system (FD), which consists of two PANDA-type Straw Tracking Stations and an RPC. The measurements were performed with a proton beam of T = 4.5 GeV impinging onto a LH_2 target.
Proton-proton elastic scattering events with low 4-momentum transfer were selected by demanding that one proton was detected in the FD ($\theta_{FD} < 6°$), and the other proton was measured in the main HADES acceptance ($70° < \theta_H < 79°$). The event selection based on kinematic observables will be explained in this talk. The number of elastic events, corrected for acceptance and reconstruction efficiency, is used to determine the time-integrated luminosity recorded during this experiment. The measured differential cross-section $d\sigma$ as a function of the square of the 4-momentum transfer t is well described by a function of the form $d\sigma/dt = Ae^{-B|t|}$, from which the optical point $A = d\sigma/dt\big|_{t=0}$ and the nuclear slope parameter B are obtained. Preliminary results of A and B are compared with existing data from other experiments.

HK 71.3 Thu 16:15 HBR 62: EG 19

Common femtoscopic hadron-emission source in pp collisions at the LHC — •Maximilian Korwieser for the ALICE Germany-Collaboration — Technische Universität München

The ALICE Collaboration recently published a plethora of results on the interaction between many exotic combinations of particles, most notably p−Ω, obtained from femtoscopic measurements in pp collisions at the LHC. Previous studies of the source in pp collisions at $\sqrt{s} =$ 13 TeV have been performed by analysing p−p and p−Λ correlations. The source was constructed using a Gaussian core for the primordial particles and introducing exponential deformations due to the decay of short-lived strongly decaying resonances. The conclusion was that the primordial sources for hadrons share a common m_{T} scaling. The goal of this work is to ascertain whether the primordial sources for mesons also exhibit the same m_{T} scaling, for example in the case of same charge π–π (or K^+–p), for which by far the largest contribution from resonances is expected. A differential study of the spatial extension of the source function as a function of transverse mass (m_{T}) and multiplicity is presented. The results are based on minimum-bias and high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV recorded with the ALICE detector. An mT scaling behaviour of the source is observed and found to be compatible with previous results in the baryonic sector. This measurement gives confidence for a common source for hadrons in small systems, allowing to employ the same model to constrain the source for meson−baryon and meson−meson pairs. This research was funded by BmBf Verbundforschung (05P21WOCA1 ALICE).

HK 71.4 Thu 16:30 HBR 62: EG 19

p-d femtoscopy and p-p source size measurement in PbPb collisions with ALICE at the LHC — •Dongfang Wang for the ALICE Germany-Collaboration — Fudan university, Shanghai, China

The ALICE Collaboration recently published a measurement of p-d correlation function in pp collisions at 13TeV. In order to describe the data a three-body analysis was needed. The small source size (of 1 fm) makes the measurement sensitive to the interaction of the proton with the compositions of the deuteron. However we do not know the sensitivity in Pb-Pb which has about 5-10 fm of the typical distances depending on the centralities. In general, these studies depend on a precise measurement of the effective particle emitting source. In small systems extensive studies performed by ALICE showed that the source exhibits an m_T-scaling behavior. Currently, relevant for proton-deuteron studies measurements of proton mt scaling are absent in Pb-Pb 5.02TeV. In this contribution, we extend proton-deuteron study from pp to Pb-Pb collisions and the p-p correlation function analysis differentially in m_T and centrality has to be performed. The obtained correlation functions are fitted and the source size is extracted. Next the detailed information about the source dependence on mT are used as an input to state-of-the-art of source prediction of correlation function. This control of source is necessary for investigation of the sensitivity of 3-body effects present in the p-d correlation function in Pb-Pb.

HK 71.5 Thu 16:45 HBR 62: EG 19

Properties of Heavy-Flavour Four-Quark states from Functional Methods — •Joshua Hoffer[1,2], Gernot Eichmann[3], and Christian S. Fischer[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität Gießen, 35392 Gießen, Germany — [2]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSIHelmholtzzentrum für Schwerionenforschung, Campus Gießen, 35392 Gießen, Germany — [3]Institute of Physics, University of Graz, Universitätsplatz 5, 8010 Graz, Austria

Since the experimental discovery of the first tetraquarks in 2003, there has been a lot of excitement around this topic from the theoretical as well as the experimental side. We employ hadronic bound state equations, i.e., Bethe-Salpeter equations, to study the properties of these four-quark states. In this talk we will present a comprehensive overview of the mass spectra for hidden- and open-flavour four-quark states in the charmonium and bottomonium sector, as well as their internal structure.

HK 71.6 Thu 17:00 HBR 62: EG 19

Studying the interaction between charm and light-flavor mesons — •Daniel Battistini for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

In the last years, several exotic states have been observed in the charm sector. Such particles cannot be interpreted as regular baryons or mesons and are thought to be either quark bags or molecular states. To unveil their nature, it is crucial to experimentally constrain the strong force that governs the interaction between the charm hadrons and other hadrons. The knowledge of the strong interaction in the charm sector is also essential for the study of ultrarelativistic heavy–ion collisions. In fact, during the hadronic phase of the system expansion, the charm hadrons interact with the hadron gas produced in the collisions. Such interactions modify the heavy-ion observables, and, to disentangle this effect from the signatures of the quark-gluon plasma formation, the scattering parameters of the charm hadrons with light-flavor hadrons are required. The available experimental knowledge on the charm-hadron interactions is, however, very poor. In this contribution, the first measurement of the strong final-state interaction between open-charm and light-flavor meson systems is presented. The measurement is performed using the femtoscopy technique and high-multiplicity proton-proton collisions at $\sqrt{s} = 13$ TeV collected by the ALICE Collaboration. Funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72: Poster

Time: Thursday 17:15–18:45 Location: HBR 14: Foyer

HK 72.1 Thu 17:15 HBR 14: Foyer

Deep-learning for 3D Photon Interaction Position Reconstruction in Monolithic Scintillation Detectors — •Beatrice Villata, Maria Kawula, and Peter G. Thirolf — Department of Medical Physics, Ludwig-Maximilians-Universität München, Germany

Accurate spatial localization of the photons is important for high-resolution medical imaging in PET systems or prompt-gamma Compton cameras. Monolithic scintillation $LaBr_3$ or $CeBr_3$ detectors offer excellent energy and time resolution and can register the light distribution when read out with position-sensitive photosensors. This work presents a supervised deep-learning algorithm to reconstruct the 2D irradiation position on a monolithic crystal, by stacking convolutional layers and creating a CNN. The training dataset includes images of the light patterns acquired by irradiating the detector with a collimated photon source. Addressing the challenge of the depth of interaction (DOI), an additional unsupervised deep-learning algorithm is presented. This architecture combines the data-driven approach of deep learning with the mathematical modeling of the setup, implemented by parameterizing the signal's evolution in the detector. The unsupervised approach is convenient because the current dataset does not contain information about the ground truth along the third dimension. This architecture would allow the reconstruction without the need to perform a Monte Carlo simulation or an additional irradiation of the setup to obtain a training dataset. Combining these approaches offers a promising approach to achieving precise 3D interaction position information in monolithic crystals.

HK 72.2 Thu 17:15 HBR 14: Foyer

Investigation of the Scissors Mode of ^{76}Ge — •M. Heumüller, V. Werner, S. Bassauer, T. Beck, M. Berger, M. Beuschlein, I. Brandherm, K. E. Ide, J. Isaak, R. Kern, J. Kleemann, O. Papst, N. Pietralla, P. Ries, G. Steinhilber, M. Stoyanova, and R. Zidarova — IKP, TU Darmstadt

^{76}Ge is the baseline isotope for experiments searching for neutrinoless double-beta decay. Nuclear structure input is needed to constrain $0\nu\beta\beta$-matrix elements calculated from nuclear theory. We aim for constraining in particular isovector degrees of freedom by the observation of the nuclear scissors mode, following previous experiments employing the method of nuclear resonance fluorescence (NRF) [1,2]. A bremsstrahlung measurement with an endpoint energy of 5.5 MeV was performed for minimizing systematic uncertainties, like the feeding effect, for cross section measurements below 5 MeV, the energy region of the low lying scissors mode. The photons were provided by the superconducting electron accelerator S-DALINAC, impinging on the enriched target in the Darmstadt High Intensity Photon Setup (DHIPS) surrounded by three HPGe detectors for γ-ray detection. A comparison of the experimentally determined collective transition strength of the scissors mode to its systematics [3] will be shown.

This work was supported by the DFG under grant numbers SFB 1245, Project-ID 279384907, and GRK 2891, Project-ID 499256822.

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[2]R. Schwengner *et al.*, Phys. Rev. C **105**, 024303 (2022)
[3]N. Pietralla *et al.*, Phys. Rev. C **58**, 184 (1998)

HK 72.3 Thu 17:15 HBR 14: Foyer

HPGe-BGO Pair Spectrometer for ELI-NP — •Ilja Homm — Technische Universität Darmstadt, Germany

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

The 8 HPGe CLOVER detectors of ELIADE are important instruments for the γ-spectroscopic study of photonuclear reactions. We investigate the possibility to operate an advanced version of an anti-Compton shield (AC shield) as escape γ-rays pair spectrometer for one of the ELIADE CLOVERS. This should improve the performance at high energies where the pair production process dominates. The BGO shield operated as a stand-alone device can also be used as γ-beam intensity monitor and to investigate the cross section for pair production near the threshold. A prototype pair spectrometer, consisting of 64 BGO crystals with SiPM (silicon photomultiplier) readout, has been designed and built. Two test measurements with high energy photons have been performed at the University of Cologne and at the ILL in Grenoble. Results are going to be presented.

This work is supported by the German BMBF (05P15RDENA, 05P21RDFN2) and the LOEWE-Forschungsschwerpunkt "Nukleare Photonik".

HK 72.4 Thu 17:15 HBR 14: Foyer

Study of the dipole response of ^{242}Pu with 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], M. Singer[1], T. Stetz[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt, Germany — [2]HZDR, Dresden, Germany — [3]FRIB, East Lansing, MI, USA

Nuclear structure data of transuranium actinides play an important role in understanding the stellar nucleosynthesis. However, available information on photonuclear reactions is sparse. A first nuclear resonance fluorescence (NRF) experiment on the nucleus ^{242}Pu was conducted under various safety precautions at the Darmstadt High-Intensity Photon Setup to probe its low-energy dipole response. The superconducting linear electron accelerator S-DALINAC at TU Darmstadt produced bremsstrahlung up to 3.7 MeV to irradiate a sample of PuO_2 with a total mass of about 1 g. Measured NRF γ rays reveal evidence for dipole-excited states with intrinsic projection quantum numbers $K = 0$ and $K = 1$. The latter indicates a potential fragment of the scissors mode, a collective low-energy $M1$ excitation of deformed nuclei. The isotope ^{242}Pu is now the heaviest nuclide for which NRF information is available. Details of the experiment, γ-ray spectra, and preliminary results will be presented.

This work is supported by the LOEWE project 'Nukleare Photonik' by the State of Hesse and by the DFG under grant No. GRK 2891.

HK 72.5 Thu 17:15 HBR 14: Foyer

Investigation of the low-lying dipole strength of ^{62}Ni via real photon scattering — •Tanja Schüttler[1], Florian Kluwig[1], Miriam Müscher[1], Ronald Schwengner[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Since photons transfer only small angular momenta, (γ,γ') experiments are an established method to investigate the properties of the low-lying dipole strength of atomic nuclei [1]. To improve the understanding of the underlying dipole excitation modes, systematic studies of isotonic and isotopic chains are crucial. The nickel (Z = 28) isotopic chain is well suited for this purpose as it consists of four stable even-even isotopes covering a large range of N/Z ratios. Since ^{58,60,64}Ni have already been measured in (γ,γ') experiments, the dipole response of ^{62}Ni is one missing link to complete the systematics [2-5]. Thus, a (γ,γ') experiment using energetically-continuous bremsstrahlung with a maximal photon energy of $E_{\max} = 8.7$ MeV was performed at the γELBE facility at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) [6]. First results of this experiment will be presented.

This work is supported by the BMBF (05P21PKEN9).

[1] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903.
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[5] M. Müscher, submitted to Phys. Rev. C.
[6] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211.

HK 72.6 Thu 17:15 HBR 14: Foyer

Activation experiment for cross-section measurements of proton-induced reactions around A=110 — •Benedikt Machliner, Felix Heim, Martin Müller, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

Understanding the nucleosynthesis of stable isotopes on the proton-rich side of the valley of stability, the so called p-nuclei, is still subject of current reasearch. Most reactions relevant for the p-process take place far away from the valley of stability, hence theoretical calculations for cross sections and reaction rates are crucial. To adjust and verify theoretical models a wide database of experimental results is needed [1]. In the context of p-nuclei the region around A=110 is particularly interesting as it contains seven p-nuclei (^{102}Pd, ^{106}Cd, ^{108}Cd, ^{113}In, ^{112}Sn, ^{114}Sn and ^{115}Sn). In order to extend the experimental database in this mass region the activation method is well suited. Using the University of Cologne's 10 MV FN Tandem accelerator and the Cologne Clover Counting setup [2] proton-induced reactions on four cadmium isotopes, on ^{102}Pd, and ^{116}Sn were performed at astrophysically relevant energies, respectively. The cross section results will be presented and a method of analyzing reactions applicable to nuclei hindered by long-lasting metastable states in the reaction product will be introduced.

Supported by the DFG (ZI 510/8-2)

[1] M. Arnould and S. Goriely, *Phys. Rep.* **384**, 1 (2003).
[2] F. Heim *et al.*, Nucl. Instrum. Methods A **966** (2020) 163854.

HK 72.7 Thu 17:15 HBR 14: Foyer

Investigation of dipole excitations in ^{50}Ti by using the (d,pγ) reaction — •Jonathan Braumann, Markus Müllenmeister, Michael Weinert, and Andreas Zilges — University of

Cologne, Institute for Nuclear Physics, Germany

The electric dipole strength around and below the neutron separation energy is known as Pygmy Dipole Resonance (PDR). Its exact emergence is still a part of research [1]. In recent years, there has been an increasing focus on investigating the PDR. Neutron transfer experiments have been established as a tool to investigate the single-particle nature of the PDR [2,3]. ^{50}Ti served as an initial start for studying the titanium isotope series, via using the $(d, p\gamma)$ reaction on ^{49}Ti. ^{50}Ti may provide further insights of the emergence of the PDR in lighter nuclei. A total of 61 states were successfully identified. Through the integration of Nuclear Resonance Fluorescence (NRF) experiments, spin and parity assignments were possible for 28 states. By comparing the excitation strength one gathered information about the single particle character of the identified $J = 1$ states. Furthermore, the experiment indicated the observation of spin-flip resonances at higher energies. Supported by the DFG (ZI 510/10-1).

[1] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360
[2] M. Spieker *et al.*, Phys. Rev. Lett. **108** (2023) 014311
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021) 242501

HK 72.8 Thu 17:15 HBR 14: Foyer

Development of a Compton camera prototype using monolithic and pixelated scintillators with segmented SiPM readout for medical imaging — •Sultan Alzahrani[1,2], Beatrice Villata[1], and Peter Thirolf[1] — [1]Department of Medical Physics, Ludwig-Maximilians-Universitat München, Germany — [2]Department of Physics and Astronomy, KSU, Riyadh, Saudi Arabia

The growing interest in particle beam therapy for cancer treatment is driven by the ability to provide high-precision dose delivery. However, this benefit demands a high accuracy of the determination of the well-localized dose deposition (Bragg peak), which has to be located within the tumour volume. Different methods of beam range monitoring are assessed globally. The Compton camera is a promising γ-ray detector that operates in a wide energy range. Compton scattering kinematics, utilized to determine the energy and origin of γ-rays from the irradiated volume without the need for a mechanical collimator, is the basis of Compton imaging. The objective of our project is to develop and implement an imaging system that uses a Compton camera, consisting of monolithic (CeBr3) and pixelated (GAGG or CeBr3) scintillators as scatterer and absorber, read out by segmented SiPM arrays. In order to facilitate the system to be used for clinical application, the signal readout and processing complexity could be reduced by a scalable DAQ electronics. The status of this project including different detector and readout configurations of a Compton camera prototype, associated imaging algorithms, improvement scopes, and their prospective features will be presented.

HK 72.9 Thu 17:15 HBR 14: Foyer

Characterization of Graphenic Carbon (GC) foils for heavy ion accelerator applications — •Konstantina Botsiou[1,3], Timo Dickel[1,2], Joachim Enders[1,3], Emma Haettner[1], Sivaji Purushothaman[1], Christoph Scheidenberger[1,2], and Marilena Tomut[1,4] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Justus-Liebig-Universität, Gießen, Germany — [3]Institute for Nuclear Physics, Technische Universität Darmstadt, Darmstadt, Germany — [4]Institut for Materialphysik, University of Münster, Münster, Germany

Vacuum windows, essential in high-intensity electron accelerators, separate different vacuum areas or the beam vacuum from the atmosphere. GC, with its low atomic number and excellent thermo-mechanical properties, is ideal for such windows and stripper foils in ion beams. The general goal is to balance different material properties: windows and strippers need to withstand a high thermal load and intense radiation damage. A low material budget is desirable (to minimize energy losses and longituninal and transverse emittance growth) and long lifetimes are required. In addition, accurate knowledge of the area density of the GC material is essential for its application. Ketek GmbH, Munich, has developed GC windows with diameter of 7.5 mm and thickness of 1 μm, which can withstand 2 bar of pressure. These windows used as vacuum windows for X-ray detectors and tested for heavy ion applications. We use GC foils as test material for heavy ion applications. Using high-resolution alpha spectroscopy and theorical models we estimate the area density.

HK 72.10 Thu 17:15 HBR 14: Foyer

Development of Low-Budget and Compact Radition Monitoring Systems for Integration into Satellites and Stratospheric Balloons — •Nico Krug, Roman Bergert, Luisa Wennemann, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physics Institute Justus-Liebig-University Giessen

A cost-effective microdosimeter concept designed for integration into AmbaSat Ltd's open-community femto-satellite platform and its incorporation into the ongoing development of a stratospheric balloon experiment will be presented, aligning with the principles of NewSpace.

The microdosimeter and the Strato project, a row of stratospheric balloon experiments, rely on commercial off-the-shelf components. The Strato project features a custom Printed Circuit Board (PCB) based on a Raspberry Pi Zero readout, additionally including the MuonPi detector developed in-house along with commercial environmental sensors communicating over a generic I2C interface. The board is being developed for integration into the CubeSat-project "StratoSat". The concept design will be showcased with communication pathways based on LoRaWAN.

The poster will delve into the performance of this integrated system within the challenging conditions of free space. Rigorous stress tests have been conducted, offering a comprehensive performance mapping of various components in terms of their physical and electrical properties.

HK 72.11 Thu 17:15 HBR 14: Foyer

Test of a Novel Neutron Detector Prototype Using ^{10}B enriched BNNT — •Kim Tabea Giebenhain, Kai-Thomas Brinkmann, and Hans-Georg Zaunick — Justus-Liebig-Universität, Gießen, Germany

BNNT (Boron Nitride Nanotubes) is a material with excellent mechanical and thermal qualities. Enriched with the isotope ^{10}B, which has a high neutron cross section for thermal neutrons, it makes for a versatile and promising material for neutron detection. An enriched BNNT mat coupled to an inorganic GaGG scintillator, read out by a SiPM array or a PMT respectively, supplemented by a plastic scintillator-based detector prototype for fast neutrons, have been tested at the Marburg Ion beam therapy facility (MIT) and the COSY facility in Jülich for their neutron detection abilites.

HK 72.12 Thu 17:15 HBR 14: Foyer

Recent Progress of Front-End and Readout Electronics Assembly and Prototype Tests for the PANDA Barrel EMC* — •Aniko Tim Falk, Kai-Thomas Brinkmann, and Hans-Georg Zaunick for the PANDA-Collaboration — II. Physics Institute, Justus-Liebig-University, Gießen

The barrel part of the electromagnetic calorimeter EMC in the PANDA experiment at the future FAIR accelerator facility will provide an excellent photon energy resolution over a wide dynamic range. In order to achieve this, the individual parts of the calorimeter, in particular the readout and front-end electronics, have to run with operating and calibration parameters of utmost precision. This fact makes a vast variety of functional tests and calibration runs for determining the optimal setup indispensable. The currently running prototype setup as well as the results of beamtimes and laboratory tests over the last two years will be presented in this contribution. *supported by the BMBF, GSI and HFHF.

HK 72.13 Thu 17:15 HBR 14: Foyer

Readout Electronics for the Micro Vertex Detector of the PANDA Experiment — •Marvin Peter[1], Nils Tröll[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Daniela Calvo[2], Fabio Cossio[2], Giovanni Mazza[2], Francesca Lenta[2], Michele Caselle[3], Tobias Stockmanns[4], Lukáš Tomášek[5], and Pavel Staněk[5] for the PANDA-Collaboration — [1]2. Physik, JLU Gießen — [2]INFN Torino — [3]KIT Karlsruhe — [4]FZ Jülich — [5]CTU Prague

The Micro Vertex Detector (MVD) is the tracking detector in the center of the PANDA experiment, closest to the interaction point. To read out the strip sensors of the MVD, the Torino Amplifier for silicon Strip detectors (ToASt) was developed by INFN in Turin. The ToASt ASIC is a self-triggering amplifier and time-over-threshold (ToT) digitizer. It meets the requirements imposed by the PANDA experiment where a free-running detector system is one of the key features. The Module Data Concentrator (MDC), which is planned to communicate with multiple ToASt chips, is currently under development at KIT. This poster shows an overview of the features and current status of the readout electronics for the MVD. *Funded by BMBF.

HK 72.14 Thu 17:15 HBR 14: Foyer

Prefilter methods in dielectron measurements in pp collisions at $\sqrt{s} = 13.6$ TeV at ALICE in Run 3 — •Davud Sokolovic — Goethe Universität Frankfurt

Thermal radiation in form of e^+e^- pairs carry undistorted information about the properties of the quark-gluon plasma (QGP) produced in heavy-ion collisions. However, the separation of dielectrons emitted by the QGP and the other sources is a highly non-trivial task. Therefore dielectron measurements in pp collisions, where no medium effects are expected in first order, serve as reference. Here, the main sources of e^+e^- pairs at low invariant mass are light- and heavy-flavour hadron decays, as well as background from real photon conversions in the detector material. In particular, electrons from π^0-Dalitz decays and real photon conversions contribute to the combinatorial background up to a relatively large mass and reduce the signal-to-background ratio and significance of the measurements.
In this poster, we will explain how the contribution from electrons from π^0-Dalitz decays and real photon conversion can be suppressed in the electron candidate sample with prefilter methods. Such techniques will be applied and optimised in the analysis of the ALICE pp data at 13.6 TeV recorded in 2022. The improvement will be quantified in terms of significance and signal-to-background ratio.

HK 72.15 Thu 17:15 HBR 14: Foyer

Development of a Tracking Detector for Charged Particles Based on Scintillating Fibers — •Lara Dippel, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physikalisches Institut, Justus-Liebig-Universität Giessen

The primary motivation of this work was to develop a detector which produces a fast and precise time signal for time-of-flight measurements performed at the Marburger Ion Beam Therapy Center (MIT), where the beam intensity can reach up to 1.9×10^9 particles/s. For a first prototype, eight plastic scintillating fibers with a diameter of 1 mm were chosen as the detection material and individually read out by SiPMs. Different fiber coatings were tested and compared to maximize the light yield of the fibers. After a first in-beam test at the MIT, a new mechanical setup and signal-processing chain were developed and tested again at the MIT and the Cooler Synchrotron (COSY) in Juelich. The latest setup consists of two layers with 16 fibers each and was employed as a fast trigger and veto detector for neutron detection and particle identification, as well as a two-dimensional tracking detector. For the next iteration of this detector system, the readout chain will be improved to primarily enhance the spatial resolution which will be compared with the tracking detectors currently in use at the MIT facility. Supported by BMBF via the High-D consortium.

HK 72.16 Thu 17:15 HBR 14: Foyer

Onboard Particle Trigger and Data Compression for the AFIS Satellite Mission — •Peter Hinderberger[1], Liesa Eckert[1], Martin J. Losekamm[1], Luise Meyer-Hetling[1], Stephan Paul[1], Thomas Pöschl[2], and Sebastian Rückerl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN, Geneva, Switzerland — [3]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany

The Earth's magnetic field traps charged particles in the Van Allen radiation belts. To measure their antiproton flux at energies between 25 and 100+ MeV, we currently develop AFIS (Antiproton Flux in Space) using scintillating plastic fibers and silicon photomultipliers (SiPMs). The compact satellite platform that we intend to employ poses restrictions with respect to power, volume, and transmission bandwidth. In addition, a low signal-to-background ratio and the expected high event rates make data processing challenging. We are developing a hardware and software framework based on a pure field-programmable gate array (FPGA) that can acquire sensor data efficiently and implements a multi-stage particle trigger, exploiting the FPGA's advantages in low-power parallel computation. A compression stage in addition reduces the amount of data that needs to be transmitted to ground significantly. We present the current state of development, compression approaches, and future plans of this framework. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 72.17 Thu 17:15 HBR 14: Foyer

Experimental setup for the investigation of the internal conversion lifetime of ^{229m}Th in a solid state environment using VUV sensitive SiPMs — •Daniel Moritz[1], Lilli Löbell[1], Georg Holthoff[1], Mahmood Hussain[1], Tamila Rozibakieva[1], Kevin Scharl[1], Benedict Seiferle[1], Markus Wiesinger[1], Lars von der Wense[2], and Peter G. Thirolf[1] — [1]Ludwig Maximilians Universität München — [2]Johannes Gutenberg Universität Mainz

With its exceptionally low energy of the isomeric first excited nuclear state (8.334±0.024 eV), ^{229m}Th is in the focus of current research as the presently only suitable candidate to be used as the basis for building a nuclear clock. One of the isomer's properties investigated is the lifetime of neutral ^{229m}Th atoms for which the decay from the isomer to the ground state is dominated by the internal conversion (IC) decay channel. So far, the internal conversion lifetime has only been measured on metallic surfaces and first hints on its dependence on the electronic environment of ^{229m}Th have been obtained. Given that their entrance window dead layer is thin enough, VUV sensitive silicon photo multipliers (VUV SiPMs) provide the opportunity of implanting ^{229m}Th atoms into their depletion region where IC electrons can be detected, thus offering a possible way to investigate the IC lifetime within a solid state environment. To assure sufficient thickness, the dead layers of the VUV SiPMs need to be further reduced by etching. This poster presents the experimental setup at LMU as well as the corresponding etching treatments. This work was supported by the ERC Synergy Grant "ThoriumNuclearClock".

HK 72.18 Thu 17:15 HBR 14: Foyer

An input-output study with diffractive-production pseudodata for testing of a partial-wave analysis program — •David Spülbeck, Sumin Alff-Kim, Max Hariegel, Henri Pekeler, Mathias Wagner, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik Universität Bonn

Studying the excitation spectra of hadrons is crutial for gaining a better understanding of the strong interaction in the non-perturbative regime. In order to extract the quantum numbers, resonance parameters, and couplings of bound states formed in a reaction from the angular distributions of the decay products in the final state, a partial-wave analysis is usually performed.

It is important to test the implementation of the complex algorithm. One possible way is an input-output study, which proceeds in the following way: (i) generate pseudo-data from a physics model for a given reaction; (ii) perform a partial-wave analysis on the pseuda-data and compare the result to the input parameters. In the case presented in the poster, we apply this procedure to COMPASS-like diffractive reactions of the kind $\pi^- + p \to X^-(\to \pi^-\pi^+\pi^-\eta) + p$, with X^- as intermediate resonances. The study helps to debug the implementation, but also allows for further systematic studies by changing the fit model, including background processes, etc.

Supported by BMBF.

HK 72.19 Thu 17:15 HBR 14: Foyer

Implementation of a new ASIC-based data acquisition setup for the C-REX detector array — •Steffen Meyer[1], Corinna Henrich[1], Thorsten Kröll[1], Han-Bum Rhee[1], Roman Gernhäuser[2], and Sergei Golenev[2] — [1]TU Darmstadt — [2]TU Munich

The C-/T-REX Si detector array used for Coulomb excitation and transfer reaction experiments at the HIE-ISOLDE facility (CERN) faces limitations due to noise caused by cabling and grounding. To overcome these problems, a new data acquisition is tested. It is based on a new data acquisition that has been developed for the new HI-TREX transfer setup [1]. The HI-TREX setup uses a FPGA-based GEAR platform to read out data from SKIROC2 ASICs. These ASICs make it possible to minimize and eliminate sources of noise, as they are able to pre-amplify, shape and digitize the data on-chip. In order to use this new data acquisition with the existing Si detectors of C-REX, the system was adapted and new components were designed.

The current state of implementation is presented.

This work is supported by the German BMBF under contract 05P21RDCI2.

[1] C. Berner et al., Nuclear Inst. and Methods in Physics Research, A 987 (2021) 164827

HK 72.20 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,2,3], David R. Pineiro[2], Tobias Rimke[1], and Malte Wilfert[1] — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Helmholtz Institute Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. 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 to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain and a long measurement time are needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.21 Thu 17:15 HBR 14: Foyer

Determining the reaction volume with CBM — •Beatriz Artur for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The main goal of the Compressed Baryonic Matter (CBM) Experiment at FAIR is to probe the QCD phase diagram at high net-baryon densities and moderate temperatures with nucleus-nucleus collisions, in order to locate the possible first order phase transition from hadronic to partonic matter and its critical end point (CEP). The higher moments (cumulants) of conserved quantities, such as baryon number, strangeness and electrical charge, are suggested to be sensitive to the proximity of the CEP. In order to assess the behavior of these cumulants, it is crucial to determine the reaction volume. Different procedures for centrality selection, based on participant multiplicity with the STS detector or on spectator multiplicity with the new FSD detector, allow us to study reaction volume fluctuations and their impact on net-baryon cumulants. In this work, we explore these different procedures using different hadronic transport models, such as SMASH and PHQMD.

This work has been supported by DFG-grant BL 982/4-1.

HK 72.22 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Université Paris-Saclay, Saclay, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

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The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.23 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. 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 to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.24 Thu 17:15 HBR 14: Foyer

Collective flow measurements with HADES in Ag+Ag collisions at 1.58 AGeV — •Christopher Grimm — Goethe-Universität, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron, hadron and light nuclei production in heavy-ion collisions with unprecedented precision. High statistics measurements of flow coefficients for protons and light nuclei, including ^{3}He and tritons in Ag+Ag collisions at 1.58 AGeV are presented here. The directed (v_1) and elliptic (v_2) flow components are investigated. All flow coefficients are studied multi-differentially for different centrality classes over a large region of phase space, i.e. as a function of transverse momentum p_t and rapidity. We will discuss the scaling properties of the various flow harmonics, which possibly provides information on the production processes of light nuclei, e.g. via coalescence, and puts constraints on the properties of dense matter, such as its viscosity and equation-of-state (EOS).

HK 72.25 Thu 17:15 HBR 14: Foyer

The motorised orifice system for the $\overline{\text{P}}$ANDA Beam Dump: programming and implementation of a control software in a local EPICS Slow Control System — •Liridon Deda, Daniel Bonaventura, Philipp Brand, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

The planned $\overline{\text{P}}$ANDA experiment at the future HESR ring will be vital for investigating the mysteries of hadron physics at FAIR in Darmstadt. A high target thickness of more than 10^{15} atoms/cm^2 will be crucial for the $\bar{\text{p}} - \text{p}$ interation studies at $\overline{\text{P}}$ANDA. The cluster-jet target system for the $\overline{\text{P}}$ANDA experiment, already achieved these required target thickness in $\overline{\text{P}}$ANDA geometry, i.e. in a distance of more than 2 m from the jet nozzle. Providing such a target thickness at the interaction point, requires to effectively remove the target beam after the interaction point via a beam dump. In order to mitigate any gas backflow, a multi-stage beam dump system with differential pumping has been implemented. Each stage comprises adjustable orifices, allowing for modification of the orifice width and position, in one direction. Additionally, the orifice control system and its implementation into the local EPICS slow control system is presented. Furthermore, the orifices are equipped with two motors each, controlled through a robust CAN-Bus communication system ensuring resistance against electrical disturbances and electromagnetic interference. The setup and its performance will be presented and discussed.

This project has received funding from BMBF (05P21PMFP1).

HK 72.26 Thu 17:15 HBR 14: Foyer

Quasi-real-time range Monitoring in hadron therapy using positron emitters of carbon and oxygen — •Sivaji Purushothaman for the BARB- and Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

A fast and reliable range monitoring method is required to fully exploit the high linear energy transfer (LET) provided by therapeutic ion beams such as carbon and oxygen while minimizing damage to healthy tissue due to range uncertainties. Quasi-real-time range monitoring, utilizing in-beam positron emission tomography (PET) with therapeutic beams of positron-emitters of carbon and oxygen, proves to be a promising approach. An experimental comparative study of therapeutically relevant positron emitters of carbon and oxygen within this context was performed at the fragment-separator facility (FRS) as part of the BARB (Biomedical Applications of Radioactive Beams) project at GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany. The experimental results and the figure of merit metric developed for the qualitative comparison of the studied isotopes will be presented.

This work is supported by European Research Council (ERC) Advanced Grant 883425 (BARB) to Marco Durante. The measurements were performed within the Super-FRS Experiment Collaboration (Experiment No. S533 by S. Purushothaman et al.) at GSI in the framework of the FAIR Phase-0 experimental program.

HK 72.27 Thu 17:15 HBR 14: Foyer

In-flight production and separation of positron emitters for hadron therapy — •Emma Haettner for the BARB- and Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The European project on Biomedical Applications of Radioactive Beams, BARB, was launched at GSI in 2021. It aims at pre-clinical validation of in-vivo beam visualization and ion-beam therapy with positron-emitting isotopes of carbon and oxygen. The positron emitters were produced, separated and identified with the Fragment separator FRS at GSI in a joint experimental effort of the the FRS and the biophysics groups at the GSI and Department of physics at LMU. In the first experiments different hadron therapy relevant positron emitters were investigated in terms of intensity, purity, energy, and energy spread. One branch of the FRS is connected to the bio-medical cave of the GSI. Here, we present the new ion-optical mode and commissioning results of the FRS-Cave M branch where positron emitting 15O-ions were provided to the medical cave for first time and also imaging results from experiments at the main branch of the FRS.

This work is supported by ERC Advanced Grant 883425 (BARB) to M. Durante. The measurements were performed within the Super-FRS Experiment Collaboration (Exp. No. S533 by S. Purushothaman et al.) in the framework of the FAIR Phase-0 experimental program.

HK 72.28 Thu 17:15 HBR 14: Foyer

Cooling of silicon photomultipliers for collinear laser spectroscopy using Peltier elements — •Aaron Flaig, Bernhard Maass, Wilfried Nörtershäuser, Julian Palmes, and Laura Renth — Institut für Kernphysik, TU Darmstadt, Germany

Collinear laser spectroscopy requires single photon detection with high efficiencies. Typically, photomultiplier tubes (PMTs) are used for this purpose. Compared to this classical approach, silicon photomultipliers (SiPMs) offer many benefits. Due to their small size and square layout they can be tiled closely together into a desired shape and they can be operated directly in a vacuum and in strong magnetic fields. At room temperature, SiPMs have a dark count rate which is too high for single photon detection, however, this can be overcome by cooling the SiPMs to very low (< -40 °C) temperatures.

In order to reach such temperatures, the possibility of cooling SiPMs using Peltier elements in combination with a liquid cooling system is investigated. The performance of the new detection system for collinear laser spectroscopy is tested by performing spectroscopy on stable Strontium ions at the KOALA beamline at TU Darmstadt. The results are compared to measurements simultaneously performed with PMTs. Funded by BMBF, contract 05P21RDFN1.

HK 72.29 Thu 17:15 HBR 14: Foyer

Stimulated recovery for PWO-based electromagnetic calorimetry — •Pavel Orsich, Valery Dormenev, Hans-Georg Zaunick, and Kai-Thomas Brinkmann for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

Lead tungstate based calorimeters under ionizing radiation exhibit a degradation of optical transmittance and, as the result, deterioration of the energy resolution. Notably, this effect is more pronounced in calorimeters operating at low temperatures.

One technique to minimize the effect of radiation-induced damage of PWO crystals involves stimulated recovery. Stimulated recovery is achieved by illuminating the crystal with optical light of a specific wavelength. This approach enables rapid and effective in-situ restoration of the crystal's optical transmittance. Implementation occurs either during periods when the beam is inactive, using blue light, or in real-time during data acquisition using near-infrared light. Employing stimulated recovery has the potential to significantly prolong the operational period of PWO-based calorimeters, particularly those operating at low temperatures, by controlling radiation damage within acceptable levels.

This project is supported by BMBF and HFHF.

HK 72.30 Thu 17:15 HBR 14: Foyer

Towards a test of D3h symmetry in ^{12}C — •I. Jurosevic, J. Birkhan, I. Brandherm, B. Hessbacher, J. Isaak, N. Pietralla, T. Ramaker, M. Spall, and G. Steinhilber — Institut für Kernphysik, Technische Universität Darmstadt

Due to the pronounced cluster structure of ^{12}C it has been proposed that some of its excited states can be classified according to the D3h symmetry [1]. In particular, the electric ground state excitation strengths of different multipole orders should be related. We have contributed a precision measurement for the $E2$ strength of the 2_1^+ state by electron scattering at the S-DALINAC at low momentum transfer [2]. We aim, now, at a similar measurement of the form factors of the 3_1^- and 4_1^+ states of ^{12}C at low momentum transfer (0.3 fm$^{-1} \leq q \leq 0.8$ fm^{-1}). The plans for our experiment will be presented.

*Project is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under grant No. SFB 1245 - Project-ID 279384907.

[1] R. Bijker and F. Iachello, Prog. Part. Nucl. Phys. 110, 103735 (2020).
[2] A. D'Alessio *et al.*, Phys. Rev. C 102, 011302(R) (2020).

HK 72.31 Thu 17:15 HBR 14: Foyer

A simulation-based feasibility study of the measurement of K_L^0 in ALICE — •Laura Gans-Bartl for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment is designed to study the characteristics of hot and dense nuclear matter created in heavy-ion collisions. The measurement of a large variety of identified particles can help to better understand the underlying physics processes at play, while particle production in proton proton (pp) collisions serves as a baseline for these measurements. The production of one of the eigenstates of the neutral Kaon, K_S^0, has been measured several times in pp collisions by the ALICE collaboration[1]. The K_L^0 has not been measured so far, as the measurement is more challenging due to its long flight time.
In this contribution, a simulation-based feasibility study of $K_L^0 \to \pi^+\pi^-\pi^0, \pi^0 \to \gamma\gamma$ in pp collisions with ALICE is presented. Charged pions can be measured with the main tracking detectors of the experiment, while neutral pions can be reconstructed from decay photons measured with eletromagnetic calorimeters. Based on a PYTHIA simulation, the influence of the efficiency and acceptence of the ALICE experiment is studied, and possibilities and limits of the measurement of K_L^0 are discussed.
Supported by BMBF and the Helmholtz Association.
[1] e.g. *Eur. Phys. J. C 81 (2021) 256*

HK 72.32 Thu 17:15 HBR 14: Foyer

Large-Scale XYZ Digital Microscope — •Konstantin Münning[1], Philip Hauer[1,2], Jan Paschek[1,2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Forschungs- und Technologie-Zentrum Detektorphysik, Universität Bonn, Germany

Modern particle physics experiments widely use Micro Pattern Gas Detectors (MPGDs) for particle tracking and identification. The new Research and Technology Center for Detector Physics (FTD) in Bonn has recently commissioned infrastructure for production of micropatterned structures like Gas Electron Multipliers (GEMs). The performance of the MPGDs strongly depends on the physical properties of these structures. Therefore a rigorous Quality Assurance (QA) is imperative. Besides other in-house QA, a precise optical survey of the structures is performed. Recent large-scale MPGDs require large-size micropatterned structures that are not covered by commercially available digital microscopes. A new digital microscope with precise large-scale XYZ-positioning for cleanroom operation using standard technologies was developed to fill this gap and allow manual and automatic QA procedures.

The poster presents the specifications, the design and the present setup.

HK 72.33 Thu 17:15 HBR 14: Foyer

Lifetime measurements of excited states in ^{69}As — •Sven Wagner, Maximilian Droste, and Peter Reiter — Institut für Kernphysik, Universität zu Köln

Lifetime measurements in ^{69}As were motivated by the expected evolution of the shape of this nucleus, from oblate at low spin to triaxial prolate at intermediate spin [1]. Lifetimes and transition strengths values of excited states in ^{69}As are not well known yet and independent evaluated results are contradictory. Excited states were populated via the fusion evaporation reaction ^{40}Ca(^{32}S,3p)^{69}As at 100 MeV at the FN tandem accelerator at the University of Cologne. The Cologne plunger device, surrounded by an efficient γ-ray detector array comprising 18 HPGe detectors was employed to determine lifetimes with the recoil-distance Doppler-shift method using the differential decay-curve method in coincidence mode. First lifetime values, which deviate from previous results, will be presented.

[1] A. M. Bruce et al., Phys. Rev. C. 62, 027303 (2000)

HK 72.34 Thu 17:15 HBR 14: Foyer

Influence of the pixel mask on the EPICAL-2 calorimeter performance — •Dani Ateyeh — IKF Goethe Universität Frankfurt

The EPICAL-2 detector, a prototype for a digital pixel calorimeter, has been developed within the context of the proposed ALICE-FoCal detector. It consists of alternating layers of tungsten absorbers and silicon pixel sensors utilising the ALPIDE chip, designed for the ALICE-ITS upgrade, with two ALPIDE chips in each EPICAL-2 layer. Each ALPIDE chip consists of 1024×512 pixels with a size of approximately 30×30 μm^2. The measurement of the energy of electromagnetic showers E with EPICAL-2 is based on counting charged shower particles via the number of pixel hits N_{hit} contrary to the direct measurement of deposited energy in conventional calorimeters.

Some pixels in the ALPIDE chips employed in the EPICAL-2 may be malfunctioning, either noisy or dead. To identify malfunctioning chips in the detector, criteria for a pixel masking procedure have been developed using experimental data acquired in test-beam measurements at DESY and at CERN-SPS. These pixels have been excluded from the analyses.

To investigate the influence of the malfunctioning pixels on the calorimeter performance, different scenarios of the amount of malfunctioning pixels have been investigated. In this poster, we present the influence of different masking schemes on the calorimeter performance with focus on the energy response and energy resolution.

Supported by BMBF and the Helmholtz Association

HK 72.35 Thu 17:15 HBR 14: Foyer

^{234}U($\vec{\gamma}$,f) photon-induced fission — •Vincent Wende[1], Dimiter Balabanski[2], Joachim Enders[1], Sean W. Finch[3], Alf Göök[4], Calvin R. Howell[3], Annabel Ibel[1], Ronald C. Malone[5], Maximilian Meier[1], Andreas Oberstedt[2], Stephan Oberstedt[6], Marius Peck[1], Norbert Pietralla[1], Jack A. Silano[5], Gerhart Steinhilber[1], Forrest Q. L. Friesen[3], Anthony P. D. Ramirez[5], Anton P. Tonchev[5], and Werner Tornow[3] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]ELI-NP, IFIN-HH, Magurele, Romania — [3]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [4]Uppsala Universitet, Uppsala, Sweden — [5]Lawrence Livermore National Laboratory, Livermore, CA, USA — [6]EC-JRC Geel, Belgium

High-precision data from photon-induced fission experiments provides strong motivation for developing a thorough description of the nuclear fission process. Mass, total kinetic energy and polar as well as azimuthal angular distributions of fission fragments can be simultaneously measured using a position-sensitive twin Frisch-grid ionization chamber. This contribution presents the current status of data analysis of a ^{234}U($\vec{\gamma}$,f) experimental run conducted at the High-Intensity γ-Ray Source (HIγS) facility using several quasi-monochromatic and nearly 100 % linearly polarized photon beams between 6.2 and 13 MeV.

*Supported by DFG (GRK 2891, project ID 499256822)

HK 72.36 Thu 17:15 HBR 14: Foyer

^{83m}Kr N-line spectrum measurement at KATRIN — •Jaroslav Storek[1], Moritz Machatschek[1], and Matthias Böttcher[2] for the KATRIN-Collaboration — [1]Institute for Astroparticle Physics, Karlsruhe Institute of Technology — [2]Institute of Nuclear Physics, University of Münster

The ^{83m}Kr conversion electrons are used for calibration purposes of different (astro-)particle physics experiments due to the narrow ^{83m}Kr line widths and short ^{83m}Kr half-life. In the KArlsruhe TRItium Neutrino experiment (KATRIN), that currently provides the best neutrino mass upper limit of 0.8 eV/c^2 (90% C. L.) in the field of direct neutrino-mass measurements, several systematic uncertainties are studied by a shape distortion of the quasi monoenergetic ^{83m}Kr spectrum. This creates high demands on precise knowledge of the undistorted spectrum.

In KATRIN we use the 32 keV N-lines lying in the high energy region of the spectrum including the weaker N_1 line. This poster summarizes the results of a dedicated measurement of the ^{83m}Kr electron N-spectrum with emphasis on N_1 line conducted at KATRIN experiment.

This work is supported by the Helmholtz Association, by the Ministry for Education and Research BMBF (05A23PMA, 05A23PX2, 05A23VK2, and 05A23WO6) and the Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology (KSETA)" through the GSSP program of the German Academic Exchange Service (DAAD).

HK 72.37 Thu 17:15 HBR 14: Foyer

First measurement of proton-deuteron and lambda-deuteron correlation function with data taken by ALICE in Run 3 — •Anton Riedel for the ALICE Germany-Collaboration — Technische Universität München, Garching, Deutschland

Femtoscopy is a powerful tool that uses correlation techniques to explore the details of how hadrons interact. In Run 2 of the LHC, the ALICE collaboration extended its femtoscopic studies to nuclei, investigating the correlation between protons and deuterons (p–d). The measurement hinted at the presence of significant three-body dynamics in the p–d system but was ultimately limited by the available statistics. As we transition into Run 3 of the LHC, where we have access to more data by two orders of magnitude, our goal is to conduct a more in-depth study of the p–d system. Additionally, we aim to take a preliminary look at the lambda-deuteron system (Λ–d). This poster presents the initial measurements of the correlation between protons and deuterons, as well as between lambdas and deuterons, 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 BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.38 Thu 17:15 HBR 14: Foyer

The future of three-body interactions: femtoscopic p-p-p and p-p-Λ correlations in ALICE Run 3 — •Laura Serksnyte for the ALICE Germany-Collaboration — TUM

A satisfactory description of many-body systems, such as (hyper)nuclei or the core of neutron stars, demands a comprehensive understanding of two-body and three-body interactions. The latter are usually studied in traditional proton-deuteron scattering experiments or by measuring properties of (hyper)nuclei. The ALICE Collaboration recently proposed a novel way to access interactions in three-hadron systems by measuring the femtoscopic correlation functions in momentum space. Such an experimental approach provides a unique opportunity to study a 3→3 scattering process, including previously inaccessible systems, for example, three unbound protons (p-p-p) or a triplet including a Lambda hyperon (p-p-Λ). Such measurements performed in Run 2 by ALICE motivated the theorists to develop a framework calculating correlation functions with state-of-the-art description of the interactions. However, the available statistical sample in Run 2 is limited, and more data is needed to challenge theoretical models and to perform precision studies. In this poster, we present the preliminary measurements of p-p-p and p-p-Λ correlation functions in pp collisions at $\sqrt{s} = 13.6$ TeV measured by ALICE in the Run 3 data taking campaign which allowed for a sevenfold increase in statistics.

This research was funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and the BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.39 Thu 17:15 HBR 14: Foyer

Methods for three-particle correlation function analyses: from cumulants to full-fledged three-body calculations — •Raffaele Del Grande for the ALICE Germany-Collaboration — Technical University of Munich, Garching, Germany

In recent years the femtoscopy technique has been used by the ALICE Collaboration at the Large Hadron Collider (LHC) to perform new studies of the hadronic interactions. In pp and p–Pb collisions at the LHC particles are emitted at relative distances of about 1 fm and the final state interactions of the produced hadrons can be explored by measuring their correlation in the momentum space. The high statistics collected by ALICE during the LHC Run 2 data campaign allowed measuring for the first time the free scattering of three unbound hadrons, such as p–p–p, p–p–Λ, p–p–K$^+$ and p–p–K$^-$, providing new experimental information on the hadron dynamics in these three-body systems. The sensitivity to genuine three-body effects in the measured correlation functions has been studied using the cumulant analysis. This approach was used to show that in p–p–K$^+$ and p–p–K$^-$ systems only pairwise interactions are present in the systems without strong evidence of genuine three-body effects. In the case of three-baryons, such as p–p–p and p–p–Λ, full-fledged three-body calculations are necessary to interpret the measurements. In this contribution, an overview of the results obtained by ALICE from the analysis of the LHC Run 2 data acquired in pp collisions at 13 TeV will be presented. Future plans will be also discussed. This research was funded by DFG SFB1258 and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.40 Thu 17:15 HBR 14: Foyer

Conversion electron spectrometer with stacked Si pad detectors and Mini-Orange — •Han-Bum Rhee, Steffen Meyer, Corinna Henrich, Ilja Homm, Martin von Tresckow, and Thorsten Kröll — TU Darmstadt, Darmstadt, Germany

Spectroscopy of conversion electrons, in particular from E0 transitions, requires thick Si detectors. Often this is achieved by the use of Si(Li) detectors for which several mm thickness are available. We investigate the use of stacks of Si pad detectors of 1-1.5 mm thickness which are more convenient to operate. The Si detectors are read out by a digital DAQ.

We intend to use these stacks to refurbish an electron spectrometer including a Mini-Orange (MO) magnetic transport system [1]. The MO consists of a set of 6 orange-slide shaped permanent magnets. The provided magnetic field focuses the electrons on the detector surface. Our setup also allows to cool the silicon detector to further increase its resolution.

Potential experiments will address e.g. E0 transitions between shape coexisting nuclear states.

The status and preliminary results with a ^{207}Bi radioactive source are presented.

[1] D. Gassmann, Dissertation, LMU München, 2003

HK 72.41 Thu 17:15 HBR 14: Foyer

p-p-Λ correlation studies using scattering theory — •Dmytro Melnichenko — TUM Munich

Scattering theory is a primary tool used in quantum theory to determine cross-sections and asymptotic wave function behavior. In the case of three interacting hadrons, local three-body potentials can be treated perturbatively in the generalized Born series. In our work, first order Born approximation was used to treat available p-p-Λ interaction potentials and to calculate the corresponding three-body correlation function. We discuss our findings by inspecting the validity region of this approach and comparing it with numerical methods. Results are compared to the p-p-Λ correlation function measured by ALICE in pp collisions at 13 TeV. This research was funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.42 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. 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 to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.43 Thu 17:15 HBR 14: Foyer

Source Size Measurement in Jets — •Lars Jörgensen, Laura Fabbietti, and Maximilian Horst for the ALICE Germany-Collaboration — Technische Universität München

Antinuclei in cosmic rays could be an indicator for dark matter decay. In order to correctly interpret any future measurement of the flux of antinuclei in our galaxy, the formation mechanism of antinuclei must be understood. The coalescence model aims to describe the formation process on a microscopic level, assuming that nucleons close in phase space are likely to bind together. A powerful tool to test coalescence is the study of nuclear production in jets since their emission is highly collimated and therefore the coalescence condition is likely to be fulfilled. One key parameter in the coalescence model is the baryon emitting source size, which has never been measured in jets to date. The source size is extracted from the momentum correlation function of particle pairs using femtoscopy. In this contribution, perspectives on measurements of the source size in jets performing a femtoscopic analysis on p-p correlations using LHC Run 2 data are shown.

This work is funded by BMBF Verbundforschung (05P21WOCA1 ALICE) and DFG SFB1258.

HK 72.44 Thu 17:15 HBR 14: Foyer

Investigations of the readout electronics of the P2 experiment — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,3,4], •Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1] und Malte Wilfert[1] für die P2-Kollaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The superconducting electron accelerator MESA is currently being built in Mainz. At this facility, the P2 collaboration aims for a high-precision measurement of the weak mixing angle at low momentum transfer, serving as a test of the Standard Model with a sensitivity for new physics up to a mass scale of 50 TeV. In the experiment, spin-polarized electrons with changing helicity are scattered on a hydrogen target. The parity-violating asymmetry due to the weak interaction of the scattered electrons is measured using a Cherenkov detector ring.

The readout electronics is developed in collaboration with the University of Manitoba and needs to be understood and characterized. In this poster, the P2 experiment is introduced, test setups will be described, and the first results will be presented.

HK 72.45 Thu 17:15 HBR 14: Foyer

Indication of a p-ϕ bound state from a correlation function analysis — •Emma Chizzali — TUM, Munich, Germany

The existence of a nucleon-ϕ (N-ϕ) bound state has been subject of theoretical and experimental investigations for decades, as the interaction is poorly understood and only spin-averaged information is available. Studying the interaction among the constituents, which is characterized by the two spin channels 1/2 and 3/2, can give hints on the possible existence of such a state. Therefore, analyzing the two-particle correlation function between protons and ϕ mesons measured by ALICE provides an alternative approach to invariant mass spectra. By constraining the spin 3/2 p-ϕ interaction using newly available lattice calculations by the HAL QCD collaboration it is possible to infer on the interaction in the spin 1/2 for the first time, which is found to be sufficiently strong, to support a p-ϕ bound state. Funded by IMPRS EPP.

HK 72.46 Thu 17:15 HBR 14: Foyer

Status of the Fierz term analysis with PERKEO III — •Anna Schubert for the PERKEO III-Collaboration — Technical University of Munich, Garching, Germany

Measurements of the free neutron decay enable a variety of tests of the Standard Model of particle physics. Observables of the decay are, among others, the beta asymmetry A and the Fierz interference term b. From precision measurements of A the CKM matrix element V_{ud} may be determined, while a non-zero Fierz term b would signal the existence of scalar and tensor interactions beyond the Standard Model.

Determinations of these neutron decay parameters were pursued by the PERKEO III experiment by measurements of the electron and/or proton energy spectrum, during multiple runs at the ILL PF1b facility. For these measurements, we used a pulsed beam of cold neutrons to control major systematic effects. This beam is guided into the 2 m long decay volume of the experiment, in which some of the neutrons decay. The charged particles from the decay are guided by a magnetic field towards one of two scintillation detectors with PMT readout. With this measurement technique, PERKEO III delivers the currently most precise values for A and b with a polarized neutron beam.

We present experimental details of the 2019/2020 campaign to measure the electron spectrum from unpolarized neutrons to extract an improved limit for the Fierz interference term and the ongoing analysis, where we currently focus on the characterization of the readout electronics.

HK 72.47 Thu 17:15 HBR 14: Foyer

Lifetime measurement of neutron rich Xe isotopes applying Fast-Timing method — •Andi Messingschlager[1], Martin von Tresckow[1], Thorsten Kröll[1], Matthias Rudigier[1], Andrey Blazhev[2], Julia Fischer[2], Sorin Pascu[3], and Jonathan N. Wilson[4] for the nu-Ball2 N-SI-120-Collaboration — [1]TU Darmstadt — [2]U Cologne — [3]U Surrey — [4]IJCLab Orsay

^{140,142}Xe are neutron rich isotopes which lie in a region of emerging quadrupole collectivity [1,2]. The lifetimes of the excited states of ^{140,142}Xe are in the range of a few tens of picoseconds, making the Fast-Timing method suitable so that the resulting transition strength can be compared to predictions by theory. The isotopes of interest are produced through a fission reaction ^{238}U(n,f) during the nu-Ball2 campaign. The nu-Ball2 spectrometer comprises a detector array consisting of 24 HPGe Clover detectors and 20 $LaBr_3$(Ce) detectors from FATIMA, offering excellent energy and time resolution, respectively. The campaign was performed 2022 at IJCLab in Orsay, France. Preliminary results will be presented. Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21RDFN1 and ARIEL grant 847594.

[1] S. Ilieva et al., PRC 94, 034302 (2016).
[2] C. Henrich, Dissertation TU Darmstadt (2020)

HK 72.48 Thu 17:15 HBR 14: Foyer

Implementation of a MagneTOF detector into the COALA Beamline — •Leo Reissler, Kristian König, Wilfried Nörtershäuser, Patrick Müller, Julian Palmes, Julien Spahn, and Emily Burbach — TU Darmstadt

The COALA beamline at the institute for nuclear physics of TU Darmstadt is a facility for high precision collinear laser spectroscopy. Measurements are performed on singly and multiply charged ions produced in an electron beam ion source or a Penning ion source. In order to optimize the ion beam production, knowledge of the ion beam composition is crucial. This characterization of an unknown ion beam was achieved by a time of flight measurement. We therefore implemented a MagneTOF detector into the beamline which allows for high time resolution (<1 ns FWHM pulse width) and ion detection efficiency of up to 80%. Details on the technical integration in the beamline and first results will be presented.

This project is funded by BMBF under contract 05P21RDFN1.

HK 72.49 Thu 17:15 HBR 14: Foyer

Development of Machine Learning Algorithms to Optimise the Detection of Low-mass Dileptons — •Saket Sahu[1], Johan Messchendorp[2], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum, Bochum, Germany — [2]GSI Helmholtzzentrumfür Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Jülich, Jülich, Germany

Radiative transitions and decays of hadrons provide valuable information on their electromagnetic structure. Particular, the usage of virtual photon (dileptons) is promising since it allows to extract observables, such as spin-density matrix elements (SDMEs), that are not accessible using real photons. The experimental challenges lie in the identification of (mostly) low-mass dilepton pairs and separating the physics channels of interest from bremsstrahlung and external conversion processes. The **H**igh **A**cceptance **D**i- **E**lectron **S**pectrometer (HADES) at GSI Darmstadt is designed for an excellent e^+/e^- reconstruction in hadronic reactions. The current reconstruction algorithm fails to efficiently identify dilepton pairs with very small opening angles. Convolutional Neural Networks (CNN) are known to show great performance in image analysis and thus can be used for ring reconstruction. This poster outlines the analysis strategy for the SDME extraction based on recently taken data in proton-proton collisions with HADES, with an outlook on the implementation of the CNN for the ring reconstruction.

HK 72.50 Thu 17:15 HBR 14: Foyer

Inelastic cross section of antinuclei in Run 3 with ALICE — •Rafael Manhart for the ALICE Germany-Collaboration — Technische Universität München

Low-energy cosmic-ray antinuclei are a promising probe for indirect detection of dark matter. Theoretical predictions foresee dark matter flux to be orders of magnitude higher than the background due to interactions of cosmic rays with the interstellar medium, at low kinetic energies ($E_{kin} \sim 1$ GeV). In order to interpret any future measurements correctly, it is important to study the inelastic cross section of antinuclei. Such inelastic cross section measurements have been carried out in the past using fixed target experiments. ALICE, thanks to its outstanding tracking and particle identification capabilities, has contributed to the measurements of the inelastic cross section of light antinuclei, namely of antideuterons, antitritons and anti^{3}He. In this contribution, results of the measurements carried out during the LHC Run 2 of the inelastic cross section of antimatter will be shown, together with prospects on similar measurements carried out with the improved statistics of the LHC Run 3 campaign.

Fundedf by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.51 Thu 17:15 HBR 14: Foyer

Exploring deuteron production with pion-deuteron femtoscopy — •Bhawani Singh — Technical University of Munich, James-Franck-Straße 1, 85748 Garching bei München

The ALICE Collaboration presents a new experimental approach to explore the interactions in three-hadron systems by analyzing femtoscopic correlation functions of deuteron-hadron pairs produced in high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV at the LHC. These measurements provide unique information on the aspects of strongly-coupled systems, such as the genuine three-particle interaction, the formation of light nuclei, and the search for exotic bound states. A microscopic understanding of (anti)nuclei production in hadron-hadron collisions is the subject of discussion for experimental and theoretical efforts in nuclear physics. This topic is also very relevant for astrophysics since the rare production of antinuclei in our Universe could be a doorway to discover new physics. The results presented in this poster are obtained by measuring the pion-deuteron (π–d) femtoscopic correlations. The observed π–d correlations are compared with theoretical predictions, employing scattering parameters from conventional experiments for $\pi^{\pm}$–d systems. A noticeable discrepancy arises when calculations only consider the strong interaction between the pion and deuteron. The signal due to the presence of strongly decaying resonances in $\pi^{\pm}$–d systems indicates a delayed (anti)deuteron formation compared to hadrons in hadron-hadron collisions. This research was funded by BmBf Verbundforschung (05P21WOCA1 ALICE)

HK 72.52 Thu 17:15 HBR 14: Foyer

First differential measurement of the femtoscopic source with data taken by ALICE in Run 3 — •Georgios Mantzaridis and Jaime Gonzalez Gonzalez for the ALICE Germany-Collaboration — TUM, Garching, Germany

Femtoscopy has proven itself as a precise tool to constrain the strong interaction between hadrons in previously inaccessible sectors. When the source of particles in a collision is known, it is possible to probe the interaction potential between two particles. Already during the Run2 datasample, a universal emitting source of hadrons in pp collisions has been identified and benchmarked by studying the correlations of the produced proton-proton (p-p) and proton-lambda (p-Λ) pairs. With this result as a foundation it was possible to probe the strong force between many different exotic pairs of hadrons like p-Ω, p-ϕ, and many more. With the newly available data from the LHC Run 3 and the upgraded ALICE detector, femtoscopic studies can now be performed with an even greater precision and even more exotic interactions can be experimentally constrained for the first time. In this poster, we present the measurement of the p-p and p-Λ correlation functions as well as the femtoscopy source differentially in mT and multiplicity in pp collisions at 13.6 TeV at the ALICE experiment at the LHC. This will be the starting point for the femtoscopy campaign with ALICE in Run 3.

This project has been funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.53 Thu 17:15 HBR 14: Foyer

Theoretical investigation of light transmittance in PWO crystals under radiation damage — •Ather Ahmad[1], Pavel Orsich[1], Hans-Georg Zaunick[1], Kai-Thomas Brinkmann[1], and Simone Sanna[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Gießen, Germany — [2]Institut für Theoretische Physik, Gießen, Germany

Fast response, high density and radiation hardness make lead tungstate ($PbWO_4$ or PWO) a well suited scintillator for calorimetry of electromagnetic radiation. Lead tungstate crystals are already used as working material in various experiments, e.g. CMS at LHC in CERN. Next-generation crystals (PWO-II) with improved properties were developed for the PANDA experiment at FAIR in Darmstadt. To reduce absorption of the scintillation light within the crystals, the lead tungstate is doped with Lanthanum and Yttrium. This results in a change of the electronic and optical properties. In order to assess the functionality of the calorimeter, we first need to analyse these electronic and optical properties of lead tungstate

Experimental measurements of light transmittance in PWO-II after irradiation with a Co-60 source were done in our working group. In this work we do theoretical calculations in the framework of density functional theory (DFT) to calculate the light transmittance in PWO-II with different defects implemented. These results can be compared to the experiment to obtain a better understanding of radiation induced damage.

This project is supported by HFHF and HGS-hire

HK 72.54 Thu 17:15 HBR 14: Foyer

Basic GEANT4 examples for the FRS Ion Catcher and SARAF — •Frederik Uhlemann[1], Heinrich Wilsenach[3,1], Timo Dickel[1,2], Israel Mardor[4,3], Erez Cohen[5], Wolfgang Plass[1,2], and Christoph Scheidenberger[1,2,6] — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany, — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]School of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel — [4]Soreq Nuclear Research Center, Yavne, Israel — [5]Physics department, Beer-Sheva, Israel — [6]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center for Heavy Ion Research, Gießen, Germany

Due to the complex geometries and physical processes of particles travelling through matter, scientists created a general simulation toolkit called Geant4. This project aims to show three basic Geant4 examples. A simple simulation of a Passivated Implanted Planar Silicon detector was created, like it is used as a diagnostics tool for the FRS-IC. A beginner-friendly guide was also written and is provided on the project website. The second experiment shows how Geant4 can combine nuclear reaction cross-sections and interaction kinematics to calculate neutron induced reaction rates and escape probabilities from a thin foil at the SARONA instrument in SARAF [1]. The last example shows how to read complex tabulated data into Geant4 from other simulation programs. This poster will provide beginners a starting point in the program through the three example projects.

[1] I. Mador et al., Frontiers in Physics, 11, 2296-424X (2023)

HK 72.55 Thu 17:15 HBR 14: Foyer

Test of a spatially-resolving fluorescence detection region for collinear laser spectroscopy — •Pascal Gabel, Bernhard Maass, Patrick Müller, Laura Renth, and Wilfried Nörtershäuser — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

Collinear laser spectroscopy is a well-established method to determine nuclear properties such as nuclear charge radii and nuclear electromagnetic moments. For the extraction of these properties from fluorescence spectra, effects that change the shape of the spectrum, such as photon recoils or optical population transfer between hyperfine structure states, need to be well understood.

We present a fluorescence detection region (FDR) comissioned at the collinear apparatus for laser spectroscopy and applied physics (COALA) at TU Darmstadt that allows us to probe the fluorescence spectrum at different positions inside the FDR. For this, measurements of the $5s\,^2S_{1/2} \rightarrow 5p\,^2P_{1/2}$ electronic transition in Sr^+ ions were performed. The spatial resolution of the FDR was tested in a separate offline test station. First results will be presented.

This work has been supported by BMBF under contract # 05P21RDFN1.

HK 72.56 Thu 17:15 HBR 14: Foyer

Implementing a low-cost THGEM detector for science outreach and education — •Oguz Alp Duran, Leonardo Bugia, and Berkin Ulukutlu — Technische Universität München, Munich, Germany

In the last fifty years, particle and nuclear physics have made significant progress due to advancements in detection technologies. Modern experiments use cutting-edge tools like MAPS or MPGD devices alongside traditional methods such as cloud chambers, which remain valuable in science education. A new cost-effective particle detector using PCB ThickGEMs is being developed, employing accessible components like Arduino and Raspberry Pi to track low-rate charged particles, such as those from cosmic sources. This contribution details the creation of a specialized readout board that interfaces the detector with an Arduino system. The board enables the measurement of a 10x10 cm2 area using 64 channels equipped with low-noise preamplifiers. It also discusses important design considerations for the detector chamber's mechanical structure, highlights performance limitations faced in this setup, and explores educational possibilities for the new detector. The research was funded by the DFG Sachmittel FA 898/5-1.

HK 72.57 Thu 17:15 HBR 14: Foyer

βPlast, a plastic scintillator for fast timing and decay spectroscopy — •Carole Chatel for the DESPEC-Collaboration — IKP, TU Darmstadt, Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — HFHF

Decay SPECtroscopy (DESPEC) setup investigates the properties of exotic nuclei at the FRagment Separator (FRS) at GSI and in the future at the Super-FRS at FAIR. It is composed of state-of-the-art detectors allowing fast-timing, high-precision or high-efficiency measurements. The core of the DESPEC setup comprises a stack of implantation detectors within a "snout", wherein exotic ions are implanted. It typically comprises one or more highly-segmented AIDA double-sided silicon strip detectors sandwiched by two β-plastique scintillators.

The βPlast detectors are of primary importance to provide excellent timing resolution for β particles emitted by the exotic ions of interest to enable gamma-gamma timing-measurements. They comprise rectangular monolithic plastic sheets with 1-dimensional arrays of Silicon PhotoMultipliers optically-coupled to the edges. The fast-timing characteristics of the detectors are exploited thanks to the use of TAMEX multi-channel TDCs developed in-house at GSI. The βPlast detectors have been operated during FAIR Phase-0 experiments in recent years in several configurations. This contribution provides information regarding technical details and detector characterisation, as well as recent work to improve detector performance and an outlook for future development work.

HK 72.58 Thu 17:15 HBR 14: Foyer

Properties of the Polyethylene Naphthalate (PEN) Organic Scintillation Material — •Valerii Dormenev[1], Kai-Thomas Brinkmann[1], Karl Eichhorn[2], Jan Friedrich[2], Dzmitry Kazlou[1], Martin J. Losekamm[2], and Hans-Georg Zaunick[1] — [1]2nd Physics Institute, Justus Liebig University, Giessen, Germany — [2]School of Natural Sciences, Technical University of Munich, Garching, Germany

Development of new or optimization of already widely used scintillation materials for high-energy physics applications has become a very important research activity during the last decade. There are presently several detector concepts in consideration that are based on organic scintillator material for fast timing of charged particles or sampling calorimeters. In recent years, the widely used organic material polyethylene naphthalate (poly(ethylene 2,6-naphthalate) or PEN) was discovered and intensively studied as a potential cost-effective plastic scintillator. We tested a set of PEN samples produced by injection molding in the framework of R&D towards the LEGEND project for the search of neutrinoless double beta decay. The material was evaluated through the measurement of changes of the optical transmittance under irradiation with ^{60}Co photons, light yield and scintillation kinetics parameters at different temperatures. The paper will report on the obtained results.

We acknowledge support by BMBF via the High-D consortium.

HK 72.59 Thu 17:15 HBR 14: Foyer

Significance of the number space $\mathbb{Q}$ and the coordinate system for energy ratios of elementary particles — •Helmut Christian Schmidt — LMU München

For energy relations, as in the GR, a system of 3 objects, each with

3 spatial coordinates (φ,r,θ) and the common time, is sufficient. The quantum information from these 10 independent parameters results in a polynomial $P(2)$. Each measurement consists of coincidences of revolutions $q\pi$ $q \in \mathbb{Q}$. A transformation into $P(2\pi)$ provides the energy ratios. $P(2\pi)$ is compatible with quantum theory and GR.

E.g. neutron:
$E_p = (2\pi)^4 + (2\pi)^3 + (2\pi)^2$
$E_e = -((2\pi)^1 + (2\pi)^0 + (2\pi)^{-1})$
$E_{measuring-device} = 2(2\pi)^{-2} + 2(2\pi)^{-4} - 2(2\pi)^{-6}$
Christoffel-Symbol
$E_{time} = 6(2\pi)^{-8}$
$m_{neutron}/m_e = E_p + E_e + E_{measurement} + E_{time} = 1838.6836611$
$measured : 1838.68366173(89)m_e$
Neutrinos correspond to $\nu_\tau = \pi$, $\nu_\mu = 1$, $\nu_e = \pi^{-1}$.
$hG_N c^5 s^8/m^{10}\sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} = 0,999991$

A photon is made up of neutrinos and can be viewed as two entangled electrons e^- and e^+. The charge results in an energy ratio E_C.
$E_C = -\pi^1 + 2\pi^{-1} + \pi^{-3} - 2\pi^{-5} + \pi^{-7} - \pi^{-9} + \pi^{-12}$
$m_{proton} = m_{neutron} + E_C m_e = 1836.15267363\ m_e$

An approach to an algorithm for calculating the muon and tauon mass is presented.

HK 72.60 Thu 17:15 HBR 14: Foyer

Recent measurements and developments at ISOLTRAP — •Paul Florian Giesel for the ISOLTRAP-Collaboration — Universität Greifswald, Institute of Physics, 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. The experiment employs multi-reflection time-of-flight and Penning-trap mass spectrometry for absolute and relative mass measurements. By using Einstein's famous formula $E = mc^2$, a measured mass can be translated into a binding energy. This binding energy reflects all underlying interactions in the nucleus and allows the study of nuclear structure and nuclear astrophysics, the weak interaction and other fundamental physics applications. The current status of the experimental setup and recent technical developments will be presented as well as the results of the most recent beamtime periods. These include the neutron deficient ^{97,98}Cd ground states in the vicinity of the doubly-magic ^{100}Sn and the ^{97m}Cd isomeric state, as well as the first mass measurements of the neutron-rich ^{209,210}Hg. A measurement of the ^{79*}Zn isomer resolved the state ordering of the 1/2+ and 5/2+ states and solidifies previous evidence of shape coexistence [2].

[1] Lunney, D. *et al.*, *J. Phys. G: Nucl. Part. Phys.* **44**, 064008 (2017) [2] Nies *et al.*, PRL. In print (2023), *arXiv:2310.16915

HK 72.61 Thu 17:15 HBR 14: Foyer

Systematic studies with a laser ablation carbon cluster ion source at the FRS Ion Catcher — •Leonard Welde[1], Jiajun Yu[2], and Christine Hornung[1,2] for the FRS Ion Catcher-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

A laser ablation carbon cluster ion source (LACCI) was commissioned at the FRS Ion Catcher at GSI Darmstadt, Germany. The LACCI will be used in future experiments with exotic nuclei to provide calibrant ions from different carbon and metal targets in the mass range of interest up to about 300 u. ^{13}C-enriched Fullerene targets allow calibrant ions with nearly every mass number in the medium mass range. These ions can be mixed with the ions of interest using a radio frequency quadrupole (RFQ) switchyard. Afterwards, the ions are sent to a RFQ mass filter and further to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).
First measurements targeting rate stability and long term stability were taken with a variety of different targets, such as carbon targets (Sigradur®, Fullerene) and different metal targets. Influence of the energy and repetition rate of the laser on the mass range of the produced carbon cluster ions was investigated. In addition, first results merging ions from LACCI and ions from a thermal ^{133}Cs ion source inside the FRS Ion Catcher were achieved. The results of this first measurements and studies will be reported in this contribution.

HK 72.62 Thu 17:15 HBR 14: Foyer

Arduino Readout Electronics — •Markus Köhli[1], Jannis Weimar[1], Simon Schmidt[1], Fabian Schmidt[2], Jochen Kaminski[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Heidelberg University, Germany — [2]Physikalisches Institut, University of Bonn, Germany

Open Hardware-based microcontrollers, especially the Arduino platform, have become a comparably easy-to-use tool for rapid prototyping and implementing creative solutions. Such devices in combination with dedicated frontend electronics can offer low cost alternatives for student projects and independently operating small scale instrumentation. The capabilities can be extended to data taking and signal analysis at decent rates. We present two projects, covering the readout of proportional counter tubes and of scintillators or wavelength shifting fibers with Silicon Photomultipliers. With the SiPMTrigger we have realized a small-scale design for SiPMs as a trigger or veto detector. It consists of a custom mixed signal frontend board featuring signal amplification, discrimination and a coincidence unit for rates up to 200 kHz. The nCatcher board transforms an Arduino Nano to a proportional counter readout with pulse analysis - time over threshold measurement and a 10-bit analog-to-digital converter for pulse heights. The device is therefore suitable for low to medium rate environments, where a good signal to noise ratio is crucial - in case presented here to monitor thermal neutrons.

HK 73: Members' Assembly

Time: Thursday 19:00–20:30 Location: HBR 14: HS 1

HK 74: Invited Talks III

Time: Friday 9:45–10:45 Location: HBR 14: HS 1

Invited Talk HK 74.1 Fri 9:45 HBR 14: HS 1

Strange hadron spectroscopy at GlueX and beyond — •Peter Hurck — University of Glasgow, UK

Hadron spectroscopy has been successfully employed as a tool to study Quantum Chromodynamics for many years. While much progress has been made in the past in the study of states with the light up and down quarks and the heavy charm and bottom quarks, there has been little progress regarding states with strange quarks. For the baryon sector, a recent review on "Λ and Σ Resonances" in the PDG states that the "field is starved for data" [1]. The situation is similar for mesons. Several experimental campaigns are ongoing or in the planning stages to address this shortcoming and provide high quality data on hyperons and mesons with strange quarks.

The GlueX experiment, located at Jefferson Lab, studies the spectrum of hadrons using photoproduction on a LH2 target. With its detector system capable of measuring neutral and charged final state particles GlueX can measure many different hadrons containing strangeness. A linearly polarized photon beam allows the measurement of polarization observables, which contain information about the production mechanisms.

In this talk, the GlueX experiment is introduced, and recent progress of its strangeness program will be presented. In addition, prospects for strangeness measurements at other facilities, such as the KLong Facility at Jefferson Lab or AMBER at CERN, will be discussed.

[1] R.L. Workman et al. (Particle Data Group), Prog. Theor. Exp. Phys. 2022, 083C01 (2022) and 2023 update, Chapter 82.

Invited Talk HK 74.2 Fri 10:15 HBR 14: HS 1

Overview of LUNA project at LNGS — •Denise Piatti — University of Padua, Italy — INFN, division of Padua, Italy

Nuclear reactions shape the life and death of stars and they produce most of the chemical elements in the Universe. The cross section, at the energy of the Gamow peak, is a crucial ingredient to improve our knowledge on stellar and Universe chemical evolution. Its low value at stellar energies prevent direct measurements in earth-based laboratories. In recent years low energy data significantly improved thanks to underground facilities, pioneered by the Laboratory for Underground Nuclear Astrophysycs (LUNA).

LUNA started its activity in 1991 with a 50 kV electrostatic accelerator installed under Gran Sasso, which is a natural shield against cosmic rays ensuring a ultra low background environment. LUNA early activity was dedicated to reactions relevant to the Sun, and then, thanks to the installation of a new accelerator (LUNA400), it focused on the study of the Big Bang Nucleosynthesis (BBN) and of the CNO, NeNa and MgAl cycles.

LUNA is now facing the next steps, helium and carbon burning, thanks to the new 3.5MV accelerator, which has just started its activity at the Bellotti Facility of LNGS. The accelerator provides hydrogen, helium and carbon beams, allowing to study the reactions that shape both the evolution of massive stars to their final fate and the synthesis of most of the elements in the Universe.

In the talk I will provide an introduction to underground nuclear astrophysics, LUNA recent results, ongoing and future measurements.

HK 75: Invited Talks IV

Time: Friday 11:00–12:30 Location: HBR 14: HS 1

Invited Talk HK 75.1 Fri 11:00 HBR 14: HS 1
Precision theory for charge radii of light nuclei — •Arseniy Filin[1], Vadim Baru[1], Evgeny Epelbaum[1], Christopher Körber[1], Hermann Krebs[1], Daniel Möller[1], Andreas Nogga[2], and Patrick Reinert[1] — [1]Institut für Theoretische Physik II, Ruhr-Universität Bochum, Bochum, Germany — [2]IAS-4, IKP-3, JHCP, and CASA Forschungszentrum Jülich, Juilich, Germany

Charge radii of light nuclei characterize the distribution of electric charge inside the corresponding nuclei and are a perfect tool to test modern high-precision nuclear forces. Experimentally, these radii can be extracted from electron scattering and the laser spectroscopy of normal and muonic atoms with the sub-percent level of accuracy. Theoretical description with a similar accuracy level requires a very good understanding of two- and three-body forces, two-body electromagnetic currents, and various relativistic effects. We present a high-accuracy calculation of the nuclear structure for A=2,3,4 nuclei using the latest two- and three-nucleon forces and charge density operators derived up through the fifth order in the chiral effective field theory. We predict the structure radii of the deuteron, the alpha-particle and the isoscalar combination of ^{3}H and ^{3}He and perform a comprehensive analysis of various sources of uncertainties. Using the predicted values of the ^{2}H and ^{4}He structure radii combined with the spectroscopic measurements of the deuteron-proton charge radius difference and ^{4}He charge radius we extract the neutron and proton charge radii.

Invited Talk HK 75.2 Fri 11:30 HBR 14: HS 1
Investigating dense nuclear matter - recent results from HADES — •Behruz Kardan for the HADES-Collaboration — Goethe-Universität, Frankfurt am Main

The study of strongly interacting matter under extreme conditions is one of the most important topics in the exploration of Quantum Chromodynamics (QCD).

In this talk, we highlight new measurements by HADES, the *High-Acceptance Dielectron Spectrometer* located at the SIS18 at GSI in Darmstadt, which is currently the only experimental setup with the unique ability to measure rare and penetrating probes at the high-μ_B frontier of the QCD phase diagram. The possibility of performing measurements with the same apparatus in a variety of reaction systems, such as elementary exclusive channels, in cold nuclear matter, and in its dense and excited state, provides a broad and complementary way of exploring the properties of strongly interacting matter. The main objective of the physics program is to investigate the *emissivity of resonance matter*, the role of *baryonic resonances* in these reactions, and the mechanism of *strangeness* and *light nuclei production*.

We discuss recent high statistics results on spectra, collective flow phenomena and correlations of hadrons, light nuclei, and dileptons. The data provide essential constraints for theoretical transport models utilised in the determination of the properties of dense baryonic matter, such as its *emissivity* and *equation-of-state* (EOS).

Supported by the Helmholtz Forschungsakademie HFHF and the BMBF grant 05P21RFFC3.

Invited Talk HK 75.3 Fri 12:00 HBR 14: HS 1
High-precision mass measurements of light ion species — •Sangeetha Sasidharan[1,2], Olesia Bezrodnova[1], Wolfgang Quint[2], Sven Sturm[1], and Klaus Blaum[1] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany

The properties of simple atomic nuclei, like the proton, deuteron, helion, and alpha particle, along with the electron, are cornerstones in understanding fundamental physics. These light ion systems allow precise atomic structure calculations, thus enabling tests of fundamental theories such as QED. Accurate calculation of the predictions requires precise values of fundamental physical constants, which are often connected to the masses of light ions. For example, in hydrogen spectroscopy, the proton's mass impacts the value of the Rydberg constant. The electron's atomic mass could be improved by accurately measuring the bound electron g-factor in ^{4}He$^+$. The highly precise atomic mass of ^{4}He$^+$ is instrumental in achieving this objective. Furthermore, a mass difference measurement of ^{3}He and T will provide a crosscheck of the systematics in the electron anti-neutrino mass determination with the KATRIN experiment. Many world-leading experiments have measured these masses, but inconsistencies are observed among their results, known as the "Light Ion mass puzzle". Improved measurements of the light ion masses will help clarify this puzzle. In this talk, I will present the recent highlights and results of LIONTRAP (Light ION TRAP), a Penning trap setup dedicated to mass measurements of light ions with a relative precision of 10 parts-per-trillion and better.