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

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Overview of Invited Talks and Sessions

(Lecture halls HSZ/0002, HSZ/0103, HSZ/0105, SCH/A251, SCH/A118, SCH/A216, SCH/A316, SCH/A.101, SCH/A117, SCH/A215, SCH/A315, SCH/A419, and SCH/A252; Poster HSZ EG)

Plenary Talk of the Hadronic and Nuclear Physics Division

PV IX	Wed	9:45–10:30	HSZ/AUDI	**The origin of the chemical elements** — •Marialuisa Aliotta

Invited Talks

HK 1.1	Mon	11:00–11:30	HSZ/0002	**Nucleosynthesis of heavy nuclei – moving a supernova into the laboratory** — •Felix Heim
HK 1.2	Mon	11:30–12:00	HSZ/0002	**Exploring the 3D nucleon structure with CLAS and CLAS12 at JLAB** — •Stefan Diehl
HK 1.3	Mon	12:00–12:30	HSZ/0002	**Lattice simulations with chiral effective field theory at N3LO** — •Serdar Elhatisari
HK 12.1	Tue	11:00–11:30	HSZ/0002	**Baryon spectroscopy at ELSA and MAMI** — •Farah Afzal
HK 12.2	Tue	11:30–12:00	HSZ/0002	**ALICE upgrades, status and perspectives for ALICE-3** — •Robert Muenzer
HK 12.3	Tue	12:00–12:30	HSZ/0002	**Nuclear parton distribution functions** — •Michael Klasen
HK 23.1	Wed	11:00–11:30	HSZ/0002	**High-Precision Laser Spectroscopy of C^{4+} for an All-Optical Determination of the Nuclear Charge Radius** — •Phillip Imgram, Kristian König, Bernhard Maass, Patrick Müller, Wilfried Nörtershäuser
HK 23.2	Wed	11:30–12:00	HSZ/0002	**ALICE determines the transparency of our galaxy to the passage of antihelium nuclei** — •Laura Serksnyte
HK 23.3	Wed	12:00–12:30	HSZ/0002	**The world of light and strange mesons: from spectroscopy puzzles to low energy QCD phenomena** — •Stephan Paul
HK 52.1	Thu	11:00–11:30	HSZ/AUDI	**AI Techniques for Event Reconstruction** — •Ivan Kisel
HK 76.1	Fri	11:00–11:30	HSZ/0002	**Thermalization of heavy quarks in the QGP** — •Federica Capellino
HK 76.2	Fri	11:30–12:00	HSZ/0002	**Hadron structure in Lattice QCD** — •Konstantin Ottnad
HK 76.3	Fri	12:00–12:30	HSZ/0002	**LISA: LIfetime measurements with Solid Active targets** — •Kathrin Wimmer

Sessions

HK 1.1–1.3	Mon	11:00–12:30	HSZ/0002	**Invited Talks I**
HK 2.1–2.5	Mon	16:30–18:00	SCH/A251	**Instrumentation I**
HK 3.1–3.5	Mon	16:30–18:00	SCH/A.101	**Instrumentation II**
HK 4.1–4.5	Mon	16:30–18:00	SCH/A117	**Instrumentation III**
HK 5.1–5.6	Mon	16:30–18:00	SCH/A216	**Heavy-Ion Collisions and QCD Phases I**
HK 6.1–6.5	Mon	16:30–18:00	SCH/A315	**Heavy-Ion Collisions and QCD Phases II**
HK 7.1–7.5	Mon	16:30–18:00	SCH/A316	**Hadron Structure and Spectroscopy I**
HK 8.1–8.5	Mon	16:30–18:00	SCH/A419	**Nuclear Astrophysics I**
HK 9.1–9.5	Mon	16:30–18:00	SCH/A118	**Structure and Dynamics of Nuclei I**

HK 10.1–10.5	Mon	16:30–18:00	SCH/A215	**Structure and Dynamics of Nuclei II**
HK 11.1–11.6	Mon	16:30–18:00	HSZ/0204	**Outreach Public/Teilchenwelt (joint session T/HK)**
HK 12.1–12.3	Tue	11:00–12:30	HSZ/0002	**Invited Talks II**
HK 13.1–13.5	Tue	17:00–18:15	SCH/A251	**Instrumentation IV**
HK 14.1–14.5	Tue	17:00–18:45	SCH/A.101	**Instrumentation V**
HK 15.1–15.7	Tue	17:00–18:45	SCH/A117	**Instrumentation VI**
HK 16.1–16.5	Tue	17:00–18:30	SCH/A216	**Heavy-Ion Collisions and QCD Phases III**
HK 17.1–17.5	Tue	17:00–18:30	SCH/A315	**Heavy-Ion Collisions and QCD Phases IV**
HK 18.1–18.7	Tue	17:00–19:00	SCH/A316	**Hadron Structure and Spectroscopy II**
HK 19.1–19.5	Tue	17:00–18:30	SCH/A419	**Nuclear Astrophysics II**
HK 20.1–20.5	Tue	17:00–18:45	SCH/A118	**Structure and Dynamics of Nuclei III**
HK 21.1–21.6	Tue	17:00–18:45	SCH/A215	**Structure and Dynamics of Nuclei IV**
HK 22.1–22.7	Tue	17:00–18:45	SCH/A252	**Outreach (joint session HK/T)**
HK 23.1–23.3	Wed	11:00–12:30	HSZ/0002	**Invited Talks III**
HK 24.1–24.5	Wed	14:00–15:30	SCH/A251	**Instrumentation VII**
HK 25.1–25.6	Wed	14:00–15:30	SCH/A.101	**Instrumentation VIII**
HK 26.1–26.5	Wed	14:00–15:30	SCH/A117	**Instrumentation IX**
HK 27.1–27.5	Wed	14:00–15:30	SCH/A216	**Heavy-Ion Collisions and QCD Phases V**
HK 28.1–28.5	Wed	14:00–15:30	SCH/A315	**Heavy-Ion Collisions and QCD Phases VI**
HK 29.1–29.5	Wed	14:00–15:30	SCH/A316	**Hadron Structure and Spectroscopy III**
HK 30.1–30.5	Wed	14:00–15:30	SCH/A419	**Nuclear Astrophysics III**
HK 31.1–31.4	Wed	14:00–15:30	SCH/A118	**Structure and Dynamics of Nuclei V**
HK 32.1–32.6	Wed	14:00–15:30	SCH/A215	**Structure and Dynamics of Nuclei VI**
HK 33.1–33.4	Wed	14:00–15:30	SCH/A252	**Fundamental Symmetries I**
HK 34.1–34.5	Wed	15:45–17:15	SCH/A251	**Instrumentation X**
HK 35.1–35.3	Wed	15:45–17:00	SCH/A.101	**Instrumentation XI**
HK 36.1–36.6	Wed	15:45–17:15	SCH/A117	**Computing I**
HK 37.1–37.6	Wed	15:45–17:15	SCH/A216	**Heavy-Ion Collisions and QCD Phases VII**
HK 38.1–38.6	Wed	15:45–17:15	SCH/A315	**Heavy-Ion Collisions and QCD Phases VIII**
HK 39.1–39.5	Wed	15:45–17:15	SCH/A316	**Hadron Structure and Spectroscopy IV**
HK 40.1–40.4	Wed	15:45–17:00	SCH/A419	**Nuclear Astrophysics IV**
HK 41.1–41.5	Wed	15:45–17:15	SCH/A118	**Structure and Dynamics of Nuclei VII**
HK 42.1–42.5	Wed	15:45–17:15	SCH/A215	**Structure and Dynamics of Nuclei VIII**
HK 43.1–43.4	Wed	15:45–17:15	SCH/A252	**Fundamental Symmetries II**
HK 44.1–44.5	Wed	17:30–19:00	SCH/A251	**Instrumentation XII**
HK 45.1–45.6	Wed	17:30–19:00	SCH/A.101	**Instrumentation XIII**
HK 46.1–46.5	Wed	17:30–19:00	SCH/A216	**Heavy-Ion Collisions and QCD Phases IX**
HK 47.1–47.5	Wed	17:30–18:45	SCH/A315	**Heavy-Ion Collisions and QCD Phases X**
HK 48.1–48.6	Wed	17:30–19:00	SCH/A316	**Hadron Structure and Spectroscopy V**
HK 49.1–49.6	Wed	17:30–19:00	SCH/A118	**Structure and Dynamics of Nuclei IX**
HK 50.1–50.5	Wed	17:30–19:00	SCH/A215	**Structure and Dynamics of Nuclei X**
HK 51.1–51.4	Wed	17:30–19:15	SCH/A252	**Fundamental Symmetries III**
HK 52.1–52.3	Thu	11:00–12:30	HSZ/AUDI	**AI Topical Day – Invited Talks (joint session AKPIK/HK/ST/T/AKBP)**
HK 53.1–53.6	Thu	14:00–15:30	HSZ/0103	**AI Topical Day – Computing II (joint session HK/AKPIK)**
HK 54.1–54.6	Thu	14:00–15:30	HSZ/0105	**AI Topical Day – Heavy-Ion Collisions and QCD Phases XI (joint session HK/AKPIK)**
HK 55.1–55.5	Thu	14:00–15:30	SCH/A251	**Instrumentation XIV**
HK 56.1–56.5	Thu	14:00–15:30	SCH/A.101	**Instrumentation XV**
HK 57.1–57.5	Thu	14:00–15:30	SCH/A316	**Hadron Structure and Spectroscopy VI**
HK 58.1–58.5	Thu	14:00–15:30	SCH/A419	**Hadron Structure and Spectroscopy VII**
HK 59.1–59.5	Thu	14:00–15:30	SCH/A118	**Structure and Dynamics of Nuclei XI**
HK 60.1–60.6	Thu	14:00–15:30	SCH/A215	**Structure and Dynamics of Nuclei XII**
HK 61.1–61.5	Thu	14:00–15:15	SCH/A117	**Structure and Dynamics of Nuclei XIII**
HK 62.1–62.4	Thu	14:00–15:15	SCH/A252	**Astroparticle Physics I**
HK 63.1–63.4	Thu	15:45–17:00	SCH/A251	**Instrumentation XVI**
HK 64.1–64.3	Thu	15:45–16:45	SCH/A.101	**Instrumentation XVII**
HK 65.1–65.6	Thu	15:45–17:15	SCH/A216	**Heavy-Ion Collisions and QCD Phases XII**
HK 66.1–66.6	Thu	15:45–17:15	SCH/A315	**Heavy-Ion Collisions and QCD Phases XIII**
HK 67.1–67.4	Thu	15:45–17:00	SCH/A316	**Hadron Structure and Spectroscopy VIII**
HK 68.1–68.4	Thu	15:45–17:00	SCH/A419	**Hadron Structure and Spectroscopy IX**

HK 69.1–69.6	Thu	15:45–17:15	SCH/A118	**Structure and Dynamics of Nuclei XIV**
HK 70.1–70.5	Thu	15:45–17:15	SCH/A215	**Structure and Dynamics of Nuclei XV**
HK 71.1–71.5	Thu	15:45–17:15	SCH/A117	**Structure and Dynamics of Nuclei XVI**
HK 72.1–72.5	Thu	15:45–17:00	SCH/A252	**Astroparticle Physics II**
HK 73.1–73.6	Thu	15:50–17:20	HSZ/0204	**Outreach Diverse (joint session T/HK)**
HK 74.1–74.54	Thu	17:30–19:00	HSZ EG	**Poster**
HK 75	Thu	19:00–20:00	HSZ/0002	**Members' Assembly**
HK 76.1–76.3	Fri	11:00–12:30	HSZ/0002	**Invited Talks IV**

Members' Assembly of the Hadronic and Nuclear Physics Division

Thursday 19:00–20:00 HSZ/0002

HK 1: Invited Talks I

Time: Monday 11:00–12:30 Location: HSZ/0002

Invited Talk HK 1.1 Mon 11:00 HSZ/0002
Nucleosynthesis of heavy nuclei – moving a supernova into the laboratory — •Felix Heim — University of Cologne, Institute for Nuclear Physics

Stars do not only produce visible light and energy via nuclear fusion reactions but are also responsible for the creation of heavy elements. Since its birth over 60 years ago, the field of nuclear astrophysics strives to describe the complex nuclear processes and astrophysical conditions that drive elemental nucleosynthesis. While many facets of this topic are well-understood, others do still remain a great puzzle. Many heavy isotopes are produced within explosive stellar scenarios such as supernova explosions or neutron-star merger events. The procedure and the outcome of these events is heavily affected by nuclear reactions and the rates at which they occur. Therefore, it is essential to study the relevant nuclear reactions in the laboratory and mimic the stellar conditions. Furthermore, theoretical models have to be employed in many cases, where no experimental data are yet available. Therefore systematic investigation and testing of the underlying nuclear physics parameters is essential.

This contribution will discuss some experimental techniques to study nuclear reactions under astrophysical conditions using ion beam accelerators. In addition, current experimental results will be put into context of modern theoretical models using statistical methods. Supported by the DFG (ZI 510/8-2).

Invited Talk HK 1.2 Mon 11:30 HSZ/0002
Exploring the 3D nucleon structure with CLAS and CLAS12 at JLAB — •Stefan Diehl for the CLAS-Collaboration — Justus Liebig Universität Gießen and University of Connecticut

Exploring the 3 dimensional structure of the nucleon can help to understand several fundamental questions of nature, such as the origin of the nucleon spin and the charge and density distributions inside the nucleon. In QCD, the 3-dimensional structure of the nucleon is described by Wigner functions. However, experimentally momentum and coordinate space have to be assessed independently. The momentum distribution can be accessed by transverse momentum dependent distribution functions (TMDs) measured in semi-inclusive deep inelastic scattering (SIDIS) or Drell-Yan processes. The distribution in transverse coordinate and longitudinal momentum space is described by generalized parton distributions (GPDs) which can be accessed for example by deeply virtual Compton scattering (DVCS) and hard exclusive meson production (DVMP). Based on the high quality data of CLAS and the recently upgraded CLAS12 detector at Jefferson Laboratory (JLAB), a detailed study of these distribution functions is being performed. With the new CLAS12 data, multidimensional, high precision studies in an extended kinematic range become possible for the first time. The talk will present the results of recent SIDIS, DVCS and DVMP studies with CLAS and CLAS12, as well as perspectives for 3D nucleon structure measurements with PANDA at FAIR and their impact on the understanding of the 3D nucleon structure.

*The work is supported by DFG (project number: 508107918) and BMBF.

Invited Talk HK 1.3 Mon 12:00 HSZ/0002
Lattice simulations with chiral effective field theory at N3LO — •Serdar Elhatisari — Faculty of Natural Sciences and Engineering, Gaziantep Islam Science and Technology University, Gaziantep, Turkey — Helmholtz-Institut fuer Strahlen-und Kernphysik, Universitaet Bonn, Bonn, Germany

In this talk I present a new approach called wave function matching for solving quantum many-body systems and recent results for ab initio calculations of nuclear structure. The method is applied to lattice Monte Carlo simulations of light nuclei, medium-mass nuclei, neutron matter, and nuclear matter. The goal of method is to ensure that the perturbative corrections used in the lattice calculations converge quickly. We use interactions at next-to-next-to-next-to-leading order in the framework of chiral effective field theory and we find that the method is producing good results for the binding energies and charge radii of light and medium mass nuclei as well as the equation of state for pure neutron matter and symmetric nuclear matter saturation. Also, these results are accompanied by new insights on the nuclear interactions that may help to resolve long-standing challenges in accurately reproducing nuclear binding energies, charge radii, and nuclear matter saturation in ab initio calculations.

HK 2: Instrumentation I

Time: Monday 16:30–18:00 Location: SCH/A251

Group Report HK 2.1 Mon 16:30 SCH/A251
Aufbau und Kalibration der Vorwärtsendkappe des elektromagnetischen Kalorimeters des $\overline{\text{P}}$ANDA-Experimentes am COSY in Jülich — •Lukas Linzen für die PANDA-Kollaboration — Ruhr Universität Bochum, Germany

Das $\overline{\text{P}}$ANDA-Experiment wird eines der Schlüsselexperimente an der sich im Bau befindlichen Beschleunigeranlage FAIR. Dort werden Kollisionen von Antiprotonen in einem Impulsbereich zwischen 1,5 GeV/c und 15 GeV/c mit verschiedenen Targets untersucht. Der $\overline{\text{P}}$ANDA-Detektor ist ein vielseitiger Detektor mit präziser Spurrekonstruktion und der Möglichkeit neutrale, sowie geladenen Teilchen zu detektieren.

Das homogene elektromagnetische Kalorimeter (EMC) des Target-Spektrometers besteht aus einem fassförmigen Mittelteil und zwei Endkappen. Es stellt eine zentrale Detektorkomponente für die Bestimmung der Energien von e^-, e^+ und γ dar. Als Szintillator wird Bleiwolframat ($PbWO_4$) unter anderem wegen seiner hohen Strahlenhärte, kurzen Abklingzeit und kurzen Strahlungslänge eingesetzt. Zur Verbesserung der Lichtausbeute wird das EMC auf $-25\,^\circ$C gekühlt.

Es wird ein Überblick über den Aufbau der Vorwärtsendkappe und die Vorbereitung für die am COSY geplante Vorkalibration gegeben. Hierbei wird auf die finalen Detektorkomponenten und die Entwicklung des Datenerfassungssystems näher eingegegangen. Zur Kalibration werden Photonen aus π^0- und η-Zerfällen verwendet, welche in pp- und pn-Kollisionen erzeugt werden. Dazu wird ein Protonenstrahl mit einer Energie von 2,5 GeV und ein PET-Target verwendet.

Gefördert durch das BMBF.

HK 2.2 Mon 17:00 SCH/A251
Performance studies of pixel layers for the ALICE-FoCal detector — •Youssef El Mard Bouziani for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The upgrade of the ALICE experiment at CERN-LHC for LHC-Run 4 includes the expansion of the physics program with a study of small-x gluon distributions via prompt photon production.

To facilitate this study a highly granular Si+W electromagnetic calorimeter combined with a conventional sampling hadronic calorimeter covering pseudorapidities of $3.4 < \eta < 5.8$ has been proposed: the FoCal detector. The FoCal-E subdetector will consist of a Si+W sampling calorimeter hybrid design using two different Si readout technologies, pad layers, and pixel layers based on ALPIDE-chip technology. The pixel layers have been successfully tested within the framework of the EPICAL-2 prototype detector.

In this talk, we report on studies of the shower measurements with the EPICAL- 2 design. Furthermore, simulation studies of performance tests of the implementation of the pixel layers in the FoCal detector setup will be discussed.

Supported by BMBF and the Helmholtz Association.

HK 2.3 Mon 17:15 SCH/A251
Performance of the EPICAL-2 ultra-high granularity electromagnetic calorimeter prototype — •Tim Sebastian Rogoschinski for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Uni 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 $\sim 30 \times 30\,\mu\text{m}^2$. EPICAL-2 has been successfully tested with cosmic muons as well in test-beam campaigns at DESY and CERN-SPS.

We will report on results on calibration from cosmic muons and on the combined energy measurement performance obtained at both DESY and SPS. Furthermore, we will present results on the electromagnetic shower shape description. Both the performance and the shape description can be reproduced by simulation.

Supported by BMBF and the Helmholtz Association.

HK 2.4 Mon 17:30 SCH/A251

Tuning of GFlash for COMPASS calorimeter simulations — •Henri Pekeler, Laney Klipphahn, David Spülbeck, Mathias Wagner, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

Monte-Carlo simulations of detector setups are an essential element of physics analyses. At COMPASS, we use a high-level Monte Carlo program called TGEANT, which is based on GEANT4, to determine the acceptance of the detector system. For final states with photons from π^0 or η decays, the correct response of the electromagnetic calorimeter in the simulations is essential.

Instead of tracking every single particle in a shower, which is computationally very expensive, the GFlash algorithm is used. It models the energy distribution and the extend of the shower, which should change for different calorimeter module types.

The COMPASS calorimeters are a combination of homogeneous and sampling calorimeter modules and it is of great importance to verify that reality is described well enough by GFlash. During this talk, we present how we tuned GFlash in order to match the shower shape of real events in the different COMPASS calorimeter modules and showcase the improved photon reconstruction after the tuning.

Supported by BMBF.

HK 2.5 Mon 17:45 SCH/A251

A Feature Extraction Ansatz for the PANDA Forward-Endcap EMC — •Celina Frenkel — HISKP, Uni Bonn

The forward endcap of the electromagnetic calorimeter of the PANDA experiment consists of 3856 lead tungstate crystals. These are either readout by VPTTs in the high rate regime ($\theta \lesssim 13°$) or by 2 APDs per crystal at larger angles. The signals are then digitized using sampling ADCs.

A feature extraction algorithm implemented on the FPGAs on the SADC boards is used to extract energy and time information from the SADC signals online in real-time. The expected particle rate in forward direction of the experiment reaches ∼500 kHz such that pile-up is a relevant aspect. A signal deconvolution can be used to shorten the pulse in time and reduce the probability of pile-up.

The central topic of this talk is the investigation of an online feature extraction ansatz making use of the Pulse Shape Deconvolution (PSD). With this ansatz it is possible to even remove unwanted properties of the signal shape and provide a clean signal for the following extraction of the signal's features using a peakfinder algorithm.

Finally, the performance of the new PSD ansatz is compared to the less FPGA resource demanding moving window deconvolution based feature extraction, currently implemented.

HK 3: Instrumentation II

Time: Monday 16:30–18:00 Location: SCH/A.101

Group Report HK 3.1 Mon 16:30 SCH/A.101

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) is the main tracking and particle identification detector of the ALICE experiment at the CERN LHC. 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) 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-point distortions of the nominal drift field. Various effects, such as variations in the number of collisions for a given time interval, cause fluctuations of the distortions due to space-charge on very short time scales. Additional effects such as charging up of the GEM frames contribute to the space-point distortions. The average space-point distortions as well as the fluctuations have to be corrected to preserve the intrinsic tracking precision of the TPC.

In this talk, an overview about space-point distortions and distortion fluctuations 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 3.2 Mon 17:00 SCH/A.101

First tests of the time projection chamber and the trigger barrel of the PUMA experiment — Alexandre Obertelli[1,2], •Clara Klink[1,2], Sabrina Zacarias[2], Christina Xanthopoulou[2], Francois Butin[1], Frank Wienholtz[2], and Emmanuel Pollacco[3] — [1]CERN, Genève, Switzerland — [2]TU Darmstadt, Darmstadt, Germany — [3]CEA-IRFU, Paris-Saclay, France

The antiProton Unstable Matter Annihilation (PUMA) experiment plans on using antiprotons as probe for the nucleonic composition in the tail of the nuclear density distribution for stable and exotic nuclei. Antiprotons annihilate with the nucleons on the nucleus' surface: the combined charge of the annihilation products will reveal the neutron-to-proton content at the nuclear surface. This allows to investigate quantum phenomena like Halo nuclei and neutron skins. The products of the annihilation will be detected in a time projection chamber surrounded by a plastic-scintillator trigger barrel. In this talk, the working principle of the PUMA detection system will be explained, as well as the data acquisition system. The results of first tests with the system will be presented.

HK 3.3 Mon 17:15 SCH/A.101

Low Material TPC construction — •David Markus for the MAGIX-Collaboration — Institute of Nuclear Physics, JGU Mainz

The MAinz Gas Injection Target EXperiment MAGIX, currently under construction in Mainz, together with the Mainz Energy-Recovering Superconducting Accelerator MESA, will perform electron scattering measurements on various gases, provided by a gas jet target. With an intended luminosity of 10^{35} cm^{-2} s^{-1} at 105 MeV, MAGIX is capable of servicing a wide variety of phyiscal objectives, including dark sector searches, investigations into few body systems and nuclear astrophysics.

The scattered particles will be measured with two identical high resolution magnetic spectrometers. In their focal plane a short drift GEM-based Time Projection Chamber is placed to serve as tracking detector. The active area of the TPC is 768x192x140mm. The setup of the experiment, from the internal gas jet target to the TPC, is designed to limit the interaction of scattered particles before their detection, such that the only seperator of TPC gas volume and interaction point is single kapton foil entry window. To assure that the desired precision can be achieved, a space saving calibration system using UV-LEDs has been designed. Plastic scintillators mounted after the capton foil exit window serve as a trigger veto system.

The low material TPC contruction and calibration system will be the focus of this talk.

HK 3.4 Mon 17:30 SCH/A.101

The MAGIX StarryNight calibration system — •Daniel Steger for the MAGIX-Collaboration — Institute of Nuclear Physics, JGU Mainz

The MESA accelerator will host the MAGIX experiment, which is based on the scattering of an electron beam on a gas jet target. This enables scattering on gases like hydrogen while minimizing interaction with any other materials allowing us to perform high precision experiments. The measurement of the scattered particles is done by two magnetic spectrometers using a GEM based TPC to track the particles. To achieve the precision desired an independent system to calibrate the TPC is necessary. A prototype of such a system has been designed, utilizing LEDs with a wavelength of 275 nm that are operated in pulses above the cathode of the active volume of the TPC. Furthermore the cathode of the TPC has been replaced with aluminium based photon-electron-converter boards.

In this contribution the setup and development of this calibration system will be presented.

HK 3.5 Mon 17:45 SCH/A.101

Quality Control for the ALICE TPC — •Berkin Ulukutlu for the ALICE Germany-Collaboration — Technische Universität München, Munich, Germany

The ALICE TPC (Time Projection Chamber) detector at the LHC has recently been upgraded to handle higher interaction rates with a continuous readout mode. This upgrade includes a new readout system using GEMs for amplification, custom front-end electronics, and new reconstruction software. To monitor this essentially new detector's performance and assure its reliability under extreme operating conditions, a Quality Control framework has been developed. This framework provides tools for monitoring the TPC in real-time at both the hardware and physics observable levels, such as particle identification performance. The QC systems also include automated checks for alerting detector experts in case of any issues. However, pinpointing the source of issues in such a complex system is not easy. To assist with this, QC tools specifically designed for expert use are being developed, offering a direct and interactive interface to TPC observables in contrast to the predefined histograms and projections used in synchronous monitoring. In this talk, we will provide an overview of the TPC QC project, highlighting the challenges and the tools developed to address them.

HK 4: Instrumentation III

Time: Monday 16:30–18:00 Location: SCH/A117

Group Report HK 4.1 Mon 16:30 SCH/A117

Measurements with fast neutrons nELBE — •Roland Beyer[1], Roberto Capote[2], and Arnd R. Junghans[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Dresden, Germany — [2]International Atomic Energy Agency, Vienna, Austria

The neutron time-of-flight facility nELBE at Helmholtz-Zentrum Dresden-Rossendorf features the first photo-neutron source at a superconducting electron accelerator, which provides a very precise time structure, high repetition rate and favorable background conditions due to the low instantaneous flux and the absence of any moderating materials. The neutron energy spectrum ranges from about 100 keV up to 10 MeV. The resulting very flexible beam properties at nELBE enable a broad range of nuclear physics experiments, e.g. determination of the reaction cross section of elastic and inelastic neutron scattering or neutron induced fission or the determination of the response of detectors for in-situ particle range verification during cancer treatment with proton or ion beams.

As an examples the neutron transmission measurement of thick iron samples will be described in detail. The results of this measurement help to eliminate significant shortcomings in the resolved resonance region of all existing evaluations of iron isotopes that have been identified in leakage neutron measurements to be related to inaccurate elastic cross sections minima between 50 and 700 keV.

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847594 (ARIEL).

HK 4.2 Mon 17:00 SCH/A117

Towards a low-background X-ray setup at Felsenkeller Dresden — •Christoph Seibt, Hans Fritz Rudolf Hoffmann, Marie Pichotta, Steffen Turkat, and Kai Zuber — Institute of nuclear and particle physics, TU Dresden, Germany

Gamma Spectrometry is one of the most commonly used tools in nuclear physics, and it has advanced over the last decades considering efficiency, resolution and background reduction. X-ray spectrometry on the other hand is barely used in the field of nuclear physics despite a wide range of applications in the field of rare nuclear decays. Low-background X-ray spectrometry may enable the investigation of decays with no gamma ray emission and decays with a low Q-value. Therefore, a low-background X-ray spectrometry setup is designed and installed in the Felsenkeller shallow-underground laboratory in Dresden, Germany. The setup consists of a Silicon Drift Detector, encapsulated by a multi-layer passive shielding. This presentation reports on the current status of the setup design, installation and background measurements.

HK 4.3 Mon 17:15 SCH/A117

HPGe-BGO Pair Spectrometer for ELI-NP — •Ilja Homm for the ELI-NP Pair Spectrometer-Collaboration — 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 4.4 Mon 17:30 SCH/A117

Improved Pulse Shape Simulations for Highly Segmented HPGe Detectors — •Rouven Hirsch, Rainer Abels, Jürgen Eberth, Kai Henseler, Herbert Hess, Darius Luyken, and Peter Reiter — Institut für Kernphysik, Universität zu Köln

The Advanced GAmma Tracking Array (AGATA) utilizes the γ-ray tracking method to reconstruct the path of the γ rays through the detector array. Essential for the tracking is the determination of the γ-ray interaction positions with high spatial resolution. This is obtained via pulse-shape analysis (PSA) of the 37 preamplifier signals of the 36-fold segmented high purity germanium detectors. Simulated signal shapes are compared to measured signals to match the interaction positions. Simulated data bases of position dependent signals were generated for a cylindrical 36-fold segmented single ended coaxial HPGe detector employing the AGATA Detector Library [1] and SolidStateDetectors.jl [2]. Systematic deviations at the crystal borders and segmentation lines were identified and investigated by comparing simulated pulse shapes and measured signals for both approaches. The impact of individual parameters on the simulated pulse shapes were identified to improve the overall PSA performance. Supported by BMBF Project 05P18PKFN9 and 05P21PKFN9

[1] B. Bruyneel et al. Eur. Phys. J. A (2016) **52**: 70
[2] I. Abt et al. 2021 JINST **16** P08007

HK 4.5 Mon 17:45 SCH/A117

Revision of the AGATA Triple Cluster detectors — •Rainer Abels, Jürgen Eberth, Kai Henseler, Herbert Hess, Rouven Hirsch, Darius Luyken, Peter Reiter, and Jasper Wehlitz — IKP Universität zu Köln, Cologne, Germany

The Advanced GAmma Tracking Array (AGATA) is a 4π position sensitive γ-ray spectrometer based on the principle of γ-ray tracking. It provides high energy resolution, high efficiency and position resolution for in beam γ-ray spectroscopy. A high reliability of the AGATA Triple Cluster (ATC) detectors is mandatory for continues long term operation without maintenance of ATC detectors. For this purpose the following modifications were implemented. The HPGe crystals are encapsulated in a new reusable aluminum housing using a temperature resistant full-metal elastic seal. To recover the energy resolution of detectors suffering from neutron damage, a reliable annealing procedure was developed. New vacuum feedthroughs are implemented in order to increase the longevity of the ATCs. To improve the vacuum properties the position of getter materials inside the cold part was put close to the capsules. Novel test procedures for cold j-FETs were developed and new cold core preamplifiers replace obsolete electronic components. After the physics campaign at GANIL, France, AGATA was erected with the revised ATCs at LN Legnaro, Italy. Successful commissioning and first experiments were performed with improved performance values. Supported by BMBF Projects 05P18PKFN9, 05P21PKFN9.

HK 5: Heavy-Ion Collisions and QCD Phases I

Time: Monday 16:30–18:00 Location: SCH/A216

HK 5.1 Mon 16:30 SCH/A216

Dilepton anisotropic flow in hadronic transport — •Renan Hirayama[1,2] and Hannah Elfner[1,2,3,4] — [1]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Frankfurt, Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany — [3]Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

We present first calculations of dielectron anisotropic flow in heavy-ion collisions at HADES beam energies from a hadronic transport approach. The collectivity of the electromagnetic radiation produced during the evolution of these collisions has recently been dubbed as a barometer, serving as a probe for the flow velocity of the underlying hadronic matter. In particular, we study the elliptic flow coefficient v_2 of dileptons in different collisions systems, and its relation to the flow of hadrons.

HK 5.2 Mon 16:45 SCH/A216

Probing rapidity structure of A-A events with correlations of particle number ratios — •Igor Altsybeev for the ALICE Germany-Collaboration — Technische Universität München, James-Franck-Straße 1, 85748 Garching bei München

Measurements of fluctuations allow one to study phase transitions and other collective phenomena in systems formed in high-energy hadronic collisions. In this report, we will discuss properties of a recently proposed fluctuation observable, namely, the correlation coefficient between ratios of identified particle yields measured in two angular acceptance windows. With such an observable it is possible, for instance, to study the correlation between relative strangeness yield in separated rapidity intervals, which should be sensitive to the density of the fireball formed in A-A collisions. Such correlations are also sensitive to various short-range effects, in particular, they are affected by spin statistics. We will show first experimental measurements of particle ratio correlations in pp and Pb-Pb data recorded by ALICE, and compare with predictions from several models that include various physics effects. Such comparison allows one to exclude some of the models.

This work is supported by BmBf.

HK 5.3 Mon 17:00 SCH/A216

Elliptic flow of pions, kaons and protons relative to the spectator plane measured with ALICE at the LHC — •Michael Rudolf Ciupek[1,2], Lukas Kreis[1,2], and Ilya Selyuzhenkov[2] for the ALICE Germany-Collaboration — [1]Physikalisches Institut, Heidelberg, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

In relativistic heavy-ion collisions, the shape of the initial energy density in the overlap region of the colliding nuclei is asymmetric and fluctuates. Due to interactions, these fluctuations are transferred to the momentum distribution of particles in the final state which is quantified by the flow coefficients v_n. The thermodynamic expansion of the quark-gluon plasma (QGP) results in a specific particle mass dependence of the v_n coefficients as a function of the transverse momentum. The measurements of the v_n relative to the spectator plane is of special interest, since the spectators decouple very early in the collision. Comparison of the v_n measured relative to the participant and the spectator plane with the corresponding eccentricities allow constraining the initial state models. The particle-type dependence of these differences is sensitive to the viscous effects in the QGP expansion. ALICE measurements of the v_2 for pions, kaons and protons wrt. the spectator plane in Pb-Pb collisions at $\sqrt{s_{\rm NN}} = 2.76$ TeV are presented. The measurement of the particle-type dependent difference between v_2 relative to spectator plane and that of four-particle cumulants extends on previously published results for charged hadrons and allow to separate effects from QGP evolution and initial state fluctuations.

HK 5.4 Mon 17:15 SCH/A216

Equation of motion of the shear stress tensor in the moment approximation — •Timo Füle — FIAS, Frankfurt am Main, Germany

One of the most prominent theories for the evolution of the hot quark gluon plasma is kinetic theory. The common equations of motion (EOM) by Israel and Stewart lack a method for consistently increasing accuracy, namely a power counting scheme. This is due to a truncation of the expansion of the distribution function before deriving the EOM. But in fact the equations of motion can be derived without closing the expansion leaving infinitely many moments of the Boltzmann equation and being able to decide on the order of the approximation afterwards. This work revises the EOM derived by Denicol et al. at the example of the shear stress tensor. The truncation will be done afterwards to arrive at the EOM of the 14-moment approximation with the incorporated power counting scheme in the Knudsen- and inverse Reynolds-number.

HK 5.5 Mon 17:30 SCH/A216

Collective flow at SIS energies within a hadronic transport approach: Influence of light nuclei formation and equation of state — •Justin Mohs[2,3] and Hannah Elfner[1,2,3] — [1]Gesellschaft für Schwerionenforschung — [2]Goethe-Universität Fankfurt — [3]Frankfurt Institute for Advanced Studies

Collective flow observables are known to be a sensitive tool to gain insights on the equation of state of nuclear matter from heavy-ion collision observations. Towards more quantitative constraints one has to carefully assess other influences on the collective behaviour. Since the formation of light nuclei is important in low-energy heavy-ion collisions, two different approaches to take the formation of light nuclei into account are contrasted to each other within the hadronic transport approach SMASH: A clustering algorithm inspired by coalescence and microscopic formation of deuterons via explicit cross-sections. The sensitivity of directed and elliptic flow observables in Au+Au collisions at $E_{\rm lab} = 1.23A$ GeV to the strength of the Skyrme mean field is explored and we find that a stiff equation of state describes the measurement best if no momentum dependence is included in the nuclear potentials. This study establishes the current understanding of collective behaviour within the SMASH approach and lays the ground for future more quantitative constraints on the equation of state of nuclear matter within improved mean field calculations.

HK 5.6 Mon 17:45 SCH/A216

Collective flow measurements with HADES in Au+Au collisions at 1.23 AGeV — •Behruz Kardan for the HADES-Collaboration — 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. The high statistics measurements of flow coefficients for protons, deuterons and tritons in Au+Au collisions at 1.23 AGeV are presented here. In addition to the directed (v_1) and elliptic (v_2) flow components also the higher coefficients v_3, v_4, v_5 and v_6 are investigated for

the first time in this energy regime. The multi-differential analysis in different centrality classes over a large region of phase space, i.e. as a function of transverse momentum p_t and rapidity, will be shown and various scaling properties will be discussed. This provides the possibility to characterise the production process of light nuclei, i.e. via coalescence, and puts strong constraints on the determination of the properties of dense matter, such as its viscosity and equation-of-state (EOS).

Supported by the Helmholtz Forschungsakademie HFHF and HGS-HIRe.

HK 6: Heavy-Ion Collisions and QCD Phases II

Time: Monday 16:30–18:00 Location: SCH/A315

Group Report HK 6.1 Mon 16:30 SCH/A315

Dielectrons with ALICE - Past, Present, Future — •Sebastian Scheid for the ALICE Germany-Collaboration — Goethe University, Frankfurt, Germany

The measurement of dielectrons is a fundamental piece in the understanding of hot and dense matter produced in ultra-relativistic heavy-ion collisions. The dielectron spectra yield information that pierce the veil of final-state hadronic interactions and give direct access to the early phases of the collision. ALICE recently started the LHC Run 3 data taking campaign after a major upgrade of the detector, which will significantly improve the capabilities to measure dileptons.

In this talk, we will give an overview of the dielectron measurements achieved so far with ALICE in different collision systems. Furthermore, the status of the Run 3 analyses together with the prospects for the Runs 3 and 4 will be presented. In particular, the impact of the detector upgrades installed during the long shut down will be explained. Finally, ultimate precision dielectron measurements in the 2030s with ALICE 3, a next-generation heavy-ion experiment at the LHC, will be discussed.

HK 6.2 Mon 17:00 SCH/A315

Thermal dileptons as a multi-messenger probe of the fireball — •Florian Seck[1], T. Galatyuk[1,2], R. Rapp[3], N. Schwarz[1], J. Steinheimer[4,5], J. Stroth[4,2], and M. Wiest[1] — [1]Technische Universität Darmstadt — [2]GSI, Darmstadt — [3]Texas A&M University, College Station, USA — [4]Universität Frankfurt — [5]FIAS, Frankfurt

As dileptons are radiated from the extreme states of matter created in heavy-ion collisions with negligible final-state interactions, they retain the information imprinted on them at the time of their creation. Multi-differential measurements of dilepton invariant mass, momentum, and angular distributions can therefore serve as a multi-messenger tool to characterize the properties of matter in the interior of the hot and dense fireball. To compute thermal dilepton spectra, we integrate in-medium dilepton rates over the space-time evolution of the collision described by a coarse-graining method of hadronic transport or hydrodynamic simulations. While the general shape of the dilepton invariant mass spectrum probes the baryon density, the slope at moderate masses measures the average temperature reached during the collision. The yield in the low-mass range is related to the fireball lifetime and is enhanced if a significant fraction of the fireball volume crosses a possible first-order phase transition. The analysis of the collective flow and polarization of dileptons can provide additional insights into the space-time evolution of the fireball in the QCD phase diagram and possible changes in the composition of the emitting source.

This work has been supported by: VH-NG-823, Helmholtz Alliance HA216/EMMI, GSI, HFHF, and the DFG through grant CRC-TR 211.

HK 6.3 Mon 17:15 SCH/A315

Dielectron Analysis for the CBM Experiment — •Adrian Meyer-Ahrens for the CBM-Collaboration — Institut für Kernphysik WWU Münster, Münster, Deutschland

The Compressed Baryonic Matter (CBM) experiment is a fixed-target heavy-ion experiment currently under construction at FAIR in Darmstadt which will explore the QCD phase diagram at high net-baryon densities. Dielectrons serve as versatile probes for the properties of the hot and dense medium created in the collisions since they do not interact strongly and escape the fireball undisturbed. Dielectron physics relies on the efficient reduction of combinatorial background, dominated by misidentified hadrons as well as electrons from photon conversions in the target or detector material.

In this talk, simulation results concerning dielectron invariant mass spectra at CBM will be presented, focussing on background rejection using conventional cut-based selections as well as machine learning methods. This work is supported by BMBF grant 05P21PMFC1.

HK 6.4 Mon 17:30 SCH/A315

Real-time methods for spectral functions — Johannes Roth[1], •Leon Sieke[1], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, 35392 Giessen, Germany

We compare different real-time methods to calculate spectral functions in dissipative open systems based on generalized Langevin equations. These are classical-statistical lattice simulations, a quasiclassical approximation and a Gaussian state approximation (GSA) which is the main focus of this talk. Results from exact diagonalization of the quartic anharmonic oscillator with damping serve as benchmark which can be seen as a (0+1)-dimensional toy theory for self-interacting scalar fields at finite temperature. Inspired by the well-known Caldeira-Leggett model, we extend the classical Langevin dynamics for the coupling to an external heat bath to the corresponding Heisenberg-Langevin dynamics in the GSA [1]. We furthermore use the latter to compute spectral functions in a self-interacting scalar field theory in (2+1) and (3+1) dimensional spacetime. To achieve this we employ two different methods to compute the spectral functions which work particularly well in complementary temperature regimes.

[1] J. V. Roth, D. Schweitzer, L. J. Sieke and L. von Smekal, Phys. Rev. D 105 (2022) 116017.

HK 6.5 Mon 17:45 SCH/A315

Momentum dependence of thermal dilepton invariant mass spectra combining transport models and an FRG spectral function — •Maximilian Wiest[1], Tetyana Galatyuk[1,2,4], Ralf-Arno Tripolt[3], Lorenz von Smekal[3,4], and Jochen Wambach[1] — [1]Technical University of Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Justus Liebig University Giessen, Germany — [4]Helmholtz Research Academy Hesse for FAIR (HFHF)

Dileptons provide a unique way to access the properties of the fireball in heavy ion-collisions. While the bulk of the detected particles stemming from heavy ion collisions are hadrons, particles heavily influenced by final state interactions, dileptons do not suffer from this disadvantage and can leave the fireball undisturbed, probing the hot and dense matter before it freezes out. We use the microscopic transport model UrQMD to simulate heavy-ion collisions at SIS18 energies in different centrality classes. Employing a Coarse Graining approach, we are able to combine the simulated microscopic dynamics with in-medium spectral functions obtained from FRG methods at finite momenta. This allows to study the impact of finite momentum effects of the spectral function on the dilepton spectra invariant mass spectra measured at SIS18 energies.

Supported by VH-NG-823, DFG CRC-TR 211 and GSI.

HK 7: Hadron Structure and Spectroscopy I

Time: Monday 16:30–18:00 Location: SCH/A316

Group Report HK 7.1 Mon 16:30 SCH/A316

A coupled channel analysis of e^+e^- annihilation in the bottomonium region — •Nils Hüsken[1,2], Ryan Mitchell[2], and Eric Swanson[3] — [1]Johannes Gutenberg-Universität Mainz — [2]Indiana University Bloomington — [3]University of Pittsburgh

In recent years, a large number of exotic hadron candidates have been discovered in the charmonium and bottomonium regions. Electron positron annihilation in experiments like BaBar, BESIII, Belle(II) and CLEO has played an important role in the discoveries of many of these charmonium- and bottomonium-like states, in particular of vector-states directly produced in the collision. Thus far, new resonances have regularly been studied using fits of simplified models to the cross sections of e^+e^- annihilation to exclusive final states, leading to large model dependencies. Here, we will present the first global and unitary analysis of $e^+e^- \to b\bar{b}$ cross sections including exclusive cross sections in the $B\bar{B}$, $B^*\bar{B}(+c.c.)$, $B^*\bar{B}^*$, $B_s^*\bar{B}_s^*$, $\Upsilon(nS)\pi^+\pi^-$ and $h_b(nP)\pi^+\pi^-$ channels as well as the total inclusive cross section for $b\bar{b}$ production. Pole positions and residues are determined for four vector-bottomonium states, which we associate with the $\Upsilon(4S)$, $\Upsilon(10750)$, $\Upsilon(10860)$ and $\Upsilon(11020)$. Strong evidence is found for the new $\Upsilon(10750)$ recently claimed by Belle, although with parameters not well constrained by the data. Results presented here cast doubt on the validity of branching ratios reported earlier using Breit-Wigner parametrizations or ratios of cross sections. * This work received funding from the European Union Horizon 2020 research and innovation program under Marie Skłodowska-Curie Grant Agreement No. 894790

HK 7.2 Mon 17:00 SCH/A316

Continuity Constraints for Partial-Wave Analyses* — •Florian Kaspar[1,2] and Jakob Knollmüller[1,2] for the COMPASS-Collaboration — [1]Technische Universität München, James-Franck-Straße 1, 85748 Garching — [2]Exzellenzcluster ORIGINS, Boltzmannstr. 2, 85748 Garching

The COMPASS experiment studies the light-meson spectrum in the three-pion final state. The conventional way of extracting resonance parameters, e.g. mass and width, is performing a partial-wave analysis in two steps. First, the individual partial-waves are extracted in bins of the three-pion mass, then a model fit is performed to the results of the first stage. The method reaches its limits for large numbers of partial-waves as the finite amount of data in the individual bins in combination with many free parameters leads to noisy results in this first analysis step. By combining the two analysis steps into one, we are able to apply our knowledge of continuity of the physical signal to the fits. The continuity constraints are implemented via Gaussian Processes. This stabilizes the fits while keeping the extraction effectively model-independent. We use the NIFTy framework for numerical information field theory to implement the continuous model and demonstrate the feasibility of the new method for the three-pion final state. We also outline the way towards the direct extraction of resonance parameters in a single fit to the data.

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

HK 7.3 Mon 17:15 SCH/A316

Understanding the Ambiguities in the Partial-Wave Decomposition of the $K_s^0K^-$ Final State* — •Julien Beckers for the COMPASS-Collaboration — Technical University of Munich

COMPASS is a multi-purpose fixed-target experiment at the CERN SPS. One of its main goals is to probe the excitation spectrum of light mesons in diffractive scattering reactions. This requires decomposing the data into partial-wave amplitudes with well-defined quantum numbers and searching for resonances in these amplitudes. Using this method, decays of light mesons into various final states are studied at COMPASS. In the case of final states with two spinless particles, mathematical ambiguities appear in the partial-wave decomposition, meaning that several sets of values for the amplitudes lead to the same measured intensity distribution, i.e. are indistinguishable by the data.

In this talk, we will present a new investigation of these ambiguities in the $K_s^0K^-$ final state, which allows us to study a_J- and π_J-like resonances with spin J with high precision and which complements the $\eta\pi^-$, $\eta'\pi^-$ and $\pi^-\pi^-\pi^+$ final states that have already been studied at COMPASS. We will explain how they arise and show how they evolve with the mass of the system, as well as present approaches to resolve them completely or to reduce the number of ambiguous solutions for the amplitudes, by introducing terms that break the exact invariance.

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

HK 7.4 Mon 17:30 SCH/A316

Untersuchung von Charmonium-Zerfällen in $\phi\eta$, $\phi\eta'$ und $\phi\pi^0$ bei BESIII — •Frederike Hanisch — Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44780 Bochum

Das BESIII-Experiment wird seit 2009 am Elektron-Positron Collider BEPCII in Peking am Institut für Hochenergiephysik (IHEP) betrieben und zeichnet sich durch große Datensätze mit Schwerpunktsenergien zwischen $\sqrt{s} = (2 - 4.95)$ GeV aus, wodurch die Untersuchung seltener Charmonium-Zerfälle möglich ist. Auf Basis von QCD-Rechnungen wird ein 12%-Verhältnis zwischen den Verzweigungsverhältnissen von J/ψ und $\psi(2S)$ in Hadronenzerfällen mit drei Gluonen oder einem Photon vorausgesagt. Diese Vorhersage wird in einigen Zerfällen, beispielsweise dem Zerfall über $\rho\pi$, nicht erfüllt. Die Ursache dieses sogenannten „$\rho\pi$-Puzzles“, welches bereits seit 1983 erforscht wird, ist jedoch nicht vollständig bekannt. Durch die Bestimmung bisher nicht bekannter oder ungenau vermessener Verzweigungsverhältnisse von $\psi(2S) \to \phi\pi^0$, $\psi(2S) \to \phi\eta$ und $\psi(2S) \to \phi\eta'$ soll ein Beitrag zum besseren Verständnis des $\rho\pi$-Puzzles geleistet werden. Die Analyse basiert auf einem Datensatz von über $22 \cdot 10^8$ $\psi(2S)$-Ereignissen. In diesem Beitrag werden vorläufige Ergebnisse für die Verzweigungsverhältnisse der Zerfälle von $\psi(2S)$ in $\phi\eta$, $\phi\eta'$ und $\phi\pi^0$ vorgestellt.
Gefördert durch die DFG (CRC 110 / NSFC-DFG).

HK 7.5 Mon 17:45 SCH/A316

Untersuchung der Zerfallskanäle $\psi(2S) \to \omega\pi^0, \omega\eta$ und $\omega\eta'$ bei BESIII — •Lisa Lou Krümmel — Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44780 Bochum

Die Quantenchromodynamik sagt ein Verhältnis von 12,7 % zwischen hadronischen J/ψ- und $\psi(2S)$-Zerfällen voraus. Dies ist als "12 %-Regel" bekannt. Eine Abweichung wurde erstmals für den Zerfall in $\rho\pi$ festgestellt. Seitdem werden Zerfallskanäle, die diese Regel nicht erfüllen, unter dem $\rho\pi$-Puzzle zusammengefasst.
Um das Verhältnis zwischen J/ψ- und $\psi(2S)$-Zerfallsbreiten zu bestimmen, ist es essenziell, die einzelnen Zerfallsbreiten genau zu vermessen. Die Zerfallsbreiten $\psi(2S) \to \omega\pi^0$ und $\omega\eta'$ sind mit großen statistischen Fehlern behaftet. Der Prozess $\psi(2S) \to \omega\eta$ wurde bisher nicht beobachtet.
Das BESIII-Experiment am Elektron-Positron Collider BEPCII in Peking hat Datensätze mit hoher Statistik für die J/ψ- und $\psi(2S)$-Resonanzen aufgezeichnet. Die Prozesse $\psi(2S) \to \omega\pi^0, \omega\eta, \omega\eta'$ werden auf Basis von über $22 \cdot 10^8$ Ereignissen untersucht. Vorläufige Ergebnisse für die Bestimmung der Verzweigungsverhältnisse werden vorgestellt.
Gefördert durch die DFG (CRC 110 / NSFC-DFG).

HK 8: Nuclear Astrophysics I

Time: Monday 16:30–18:00 Location: SCH/A419

Group Report HK 8.1 Mon 16:30 SCH/A419
Activation experiments for *p*-process nucleosynthesis at the University of Cologne — •Martin Müller, Felix Heim, Svenja Wilden, Pina Wüstenberg, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

For modeling the vast reaction networks involved in the production of heavy proton-rich isotopes in *p*-process nucleosynthesis, reaction cross sections for ten thousands of reactions are needed. It is impossible to measure all of these reactions in the laboratory because of which theoretical calculations of cross sections are imperative. To verify and adjust these calculations a comprehensive experimental database is needed [1]. A powerful method for extending the available database is the activation technique, which has been applied in various forms at the University of Cologne utilizing its 10 MV FN tandem and 6 MV HVE tandetron accelerators as well as the Cologne Clover Counting setup constisting of two clover-type HPGe detectors. Experiments combining the activation technique with in-beam measurements or the stacked-target method will be reported on, a method for utilizing two-step decays will be introduced, and results for the ^{168,170,172}Yb$(\alpha,n)^{171,173,175}$Hf, ^{55}Mn$(\alpha,(2)n)^{57,58}$Co, and ^{58}Fe$(p,n)^{58}$Co will be presented [2,3].
Supported by the DFG (ZI 510/8-2).

[1] M. Arnould and S. Goriely, *Phys. Rep.* **384**, 1 (2003)
[2] L. Netterdon *et al.*, *Nucl. Phys. A* **916**, 149-167 (2013)
[3] M. Müller *et al.*, submitted (2022)

HK 8.2 Mon 17:00 SCH/A419
New Cross Section Data for Radiative Proton Capture on Carbon for Nuclear Astrophysics at LUNA — •Axel Boeltzig[1] and Jakub Skowronski[2] for the LUNA-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Università degli Studi di Padova and INFN Sezione di Padova, Padua, Italy

The observable ratio of ^{12}C/^{13}C can be used as a probe for stellar nucleosynthesis as well as for mixing processes during hydrogen burning, provided that the reaction rates of ^{12}C(p,γ)^{13}N and ^{13}C(p,γ)^{14}N are known. To obtain direct cross section measurements at low energies, which are required to better constrain these rates in astrophysical scenarios, both reactions were studied in a series of experiments at the LUNA-400 accelerator. Different targets and complementary detector setups were employed for a systematic study, and the sensitivity afforded by the low-background underground environment allowed for precise measurements at lower energies than previously available. We will present these experiments and their results for both reactions.

HK 8.3 Mon 17:15 SCH/A419
Cross section measurements of the ^{12}C(p,γ)^{13}N reaction in the energy range of 130 keV to 640 keV — •Simon Rümmler — Helmholtz-Zentrum Dresden-Rossendorf, Institute of Radiation Physics — TU Dresden, Institute of Nuclear and Particle Physics

The CNO-cycle is the dominant hydrogen burning process in stars above a temperature of 17 million Kelvin. The rate of this cycle in the initial phase and in the outer shells of the burning zone is dominated by the rate of the ^{12}C(p,γ)^{13}N reaction. Furthermore, this reaction affects the ratio of ^{12}C to ^{13}C abundances. Efforts are underway to re-measure the cross section of the ^{12}C(p,γ)^{13}N in the energy region of the 400 keV resonance, leading to an improved extrapolation to astrophysically relevant energies.

In 2017 the reaction was studied in inverse kinematics at the 3 MV Tandetron accelerator at Helmholtz-Zentrum Dresden-Rossendorf in an energy range of 130 keV to 450 keV. Further measurements in the energy range of 330 keV to 640 keV with low background were done at the 5 MV Pelletron accelerator at the Felsenkeller shallow-underground laboratory in Dresden in 2022. The methods and results of these measurements, as well as a conclusion of the two campaigns, will be presented.

HK 8.4 Mon 17:30 SCH/A419
3α-Zerfälle der angeregten 3^-_1, 1^-_1 und 4^-_1 Zustände von ^{12}C — •Joe Roob[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], Madalina Ravar[1,3], Dirk Rudolph[2], Alessandro Salice[1] und Luis Sarmiento[2] — [1]University of Cologne, Institute for Nuclear Physics, Cologne, Germany — [2]Lund University, Department of Physics, Lund, Sweden — [3]TU Darmstadt, Institute of Nuclear Physics, Darmstadt, Germany

Die Eigenschaften des 3-Körper-Zerfalls der angeregten Zustände von ^{12}C ermöglichen einen direkten Vergleich mit theoretischen Modellen zur Struktur von ^{12}C. Es wurde ein Experiment mit einer $^{12}C(\alpha,\alpha')$ Reaktion mit einem 27 MeV α Strahl am 10-MV Tandem Beschleuniger des Instituts für Kernphysik der Universität zu Köln durchgeführt. Das Lund-York-Cologne-Calorimeter (LYCCA), mit 18 Silizium Streifen Detektoren (18432 Pixel), wurde für die Messung eingesetzt um die vollständige Rekonstruktion der 4 α-Kerne durch die hohe Raumwinkelabdeckung und gute Ortsauflösung zu ermöglichen. Es wurden der Hoyle-State und die höher liegenden 3^-_1, 1^-_1 und 4^-_1 Zustände bei 9641 keV, 10847 keV und 13316 keV in ^{12}C untersucht. Die Zerfälle der Zustände oberhalb des Hoyle-States werden insbesondere durch die Dalitz-Plots der 3 α-Teilchen charakterisiert. Vorläufige Ergebnisse werden diskutiert.

HK 8.5 Mon 17:45 SCH/A419
Analysis of the 3α-decay of the 0^+_2 state in ^{12} — •David Werner[1], Joe Roob[1], Peter Reiter[1], Konrad Arnswald[1], Maximilian Droste[1], Pavel Golubev[2], Rouven Hirsch[1], Hannah Kleis[1], Nikolas Königstein[1], Madalina Ravar[1,3], Dirk Rudolph[2], Alessandro Salice[1], 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 between the direct and sequential three-particle decay of the 0^+_2 excited state in ^{12}C, the Hoyle state, are important probes for the inner structure of ^{12}C and provide insights into stellar nucleosynthesis. Two high-statistics experiments were performed at the 10 MV FN-tandem accelerator of the Institute for Nuclear Physics of the University of Cologne. A ^{12}C(α,α') reaction at a beam energy of 27 MeV was utilized to populate the state of interest. The Lund-York-Cologne-Calorimeter (LYCCA) was used to study the three-particle decay branches of the Hoyle state. The 18 segmented double-sided silicon strip detectors allowed individual detection of the reaction's four α particles with high angular precision. Results from particle spectra are compared with Geant4 Monte-Carlo simulations. Latest analysis results, in particular Dalitz plots and the search for the direct 3α decay, will be presented.

HK 9: Structure and Dynamics of Nuclei I

Time: Monday 16:30–18:00 Location: SCH/A118

Group Report HK 9.1 Mon 16:30 SCH/A118
Studying the Low-Energy Electric Dipole Response With Different Hadronic Probes — •Michael Weinert, Florian Kluwig, Markus Müllenmeister, Miriam Müscher, Barbara Wasilewska, 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]. Recently, another experimental access was added to the repertoire by investigating the population of states via (d,p) reactions [2]. The strong single-particle character of

excited states could be identified by combined experimental and theoretical efforts, describing various realistic observables with great accuracy [3]. This contribution presents an overview of the current status of the hadronic experiments on several nuclei with data taken with the SONIC@HORUS spectrometer at the University of Cologne. The comparison of ^{119}Sn$(d,p\gamma)$ data at $E_d = 8.5$ MeV and ^{120}Sn$(\alpha,\alpha'\gamma)$ data at $E_\alpha = 130$ MeV will be highlighted, as well as their theoretical comprehension within the Quasiparticle-Phonon-Model and corresponding reaction theory. Supported by the DFG (ZI 510/10-1).

[1] J. Endres *et al.*, Phys. Rev. C **80**, 034302 (2009)
[2] M. Spieker *et al.*, Phys. Rev. Lett. **125**, 102503 (2020)
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127**, 242501 (2021)

HK 9.2 Mon 17:00 SCH/A118

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 U., Durham, NC, USA — [6]ESS, Lund, SE — [7]Univ. Köln — [8]GSI, Darmstadt

The Brink-Axel (BA) hypothesis states that the transition probability between two groups of states, described by the photon strength function (PSF) for a given multipolarity, only depends on the energy difference of the states. For ^{96}Mo, significant discrepancies between upward (excitation) and downward (deexcitation) PSF were found [1] with various experimental probes. A new method [2] allows for the simultaneous measurement of upward and downward PSF in a single nuclear resonance fluorescence (NRF) experiment. To test the discrepancies and BA hypothesis, NRF experiments on ^{96}Mo were performed at the High Intensity γ-ray Source (HIγS) and will be discussed.

Supported by the State of Hesse, grant "Nuclear Photonics" (LOEWE program), the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 279384907 – SFB 1245, and the U. S. DOE, Grant No. DE-FG02-97ER41041 and No. DE-FG02-97ER41033.

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

HK 9.3 Mon 17:15 SCH/A118

Investigation of the dipole strength distribution in ^{70}Zn up to the particle threshold[a] — •J. Hauf[1], V. Werner[1], M. Beuschlein[1], R. Beyer[2], T. Hensel[2], J. Isaak[1], J. Kleemann[1], P. Koseoglou[1], C. Nickel[1], O. Papst[1], 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

The dipole strength distribution of the neutron-rich nucleus ^{70}Zn has been investigated up to its particle threshold of around 9.2 MeV. This study is motivated by shedding light on the E1 strength, typically attributed to the pygmy dipole resonance on top of the low-energy tail of the giant dipole resonance. A Nuclear Resonance Fluorescence (NRF) experiment was conducted at the γELBE-Setup at the Helmholtz- Zentrum Dresden-Rossendorf using a bremsstrahlung beam with an endpoint energy of 11.5 MeV. The experiment will be described. NRF spectra and the status of the data analysis, including integrated NRF cross sections and transition strengths, will be presented and discussed.

[a]This work was supported by DFG project number 279384907-SFB 1245

HK 9.4 Mon 17:30 SCH/A118

Investigation of the low-lying dipole strength in ^{62}Ni — •Tanja Schüttler[1], Florian Kluwig[1], Miriam Müscher[1], Ronald Schwengner[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]Helmholtz-Zentrum Dresden-Rossendorf

Systematic studies within isotopic and isotonic chains are essential to investigate the properties of the low-lying dipole strength below and around the neutron-separation threshold. The nickel (Z = 28) isotopic chain is a well-suited candidate for this purpose because it consists of four stable, even-even isotopes covering a large range of N/Z ratios. Since photons just transfer small angular momenta, (γ,γ') experiments are ideally suited to study the dipole response in atomic nuclei [1]. The isotopes ^{58,60,64}Ni have already been measured in (γ,γ') experiments [2-5]. To complete the systematics, ^{62}Ni was investigated using energetically continuous bremsstrahlung with a maximal photon energy of $E_{\max} = 8.7$ MeV at the γELBE facility [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
[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] M. Müscher, private communication (2022)
[6] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211

HK 9.5 Mon 17:45 SCH/A118

Parity-quantum numbers and branching ratios of ^{96}Mo dipole-excited states* — •V. Skibina[1], O. Papst[1], J. Isaak[1], A. D. Ayangeakaa[2,3], T. Beck[1,4], M. L. Cortés[1,5], S. W. Finch[3,6], U. Friman-Gayer[3,6,7], D. Gribble[2,3], X. James[2,3], R. V. F. Janssens[2,3], S. Johnson[2,3], J. Kleemann[1], F. Kluwig[8], P. Koseoglou[1], B. Löher[9], M. Müscher[8], N. Pietralla[1], D. Savran[9], V. Werner[1], and A. Zilges[8] — [1]IKP, TU Darmstadt — [2]UNC, NC, USA — [3]TUNL, NC, USA — [4]MSU, MI, USA — [5]RIKEN, JP — [6]Duke U., NC, USA — [7]ESS, SE — [8]IKP, U. Köln — [9]GSI, Darmstadt

Photonuclear reactions are well-suited to provide fundamental spectroscopic quantities of nuclei such as γ-ray transition energies, spin and parity quantum numbers [1]. The present work focuses on the study of the dipole strength distribution, its disentanglement into electric and magnetic contributions, and the decay behavior of excited states of ^{96}Mo. For that purpose, Nuclear Resonance Fluorescence (NRF) experiments were performed at the High Intensity Gamma-ray Source (HIγS) with linearly-polarized, quasi-monochromatic photon beams to assign parity quantum numbers and determine branching ratios of observed states. In this contribution, first results will be presented.

* Supported by the State of Hesse, grant "Nuclear Photonics" (LOEWE program), the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project-ID 279384907 – SFB 1245 and the U.S. DOE, Grant Nos. DE-FG02-97ER41041 & DE-FG02-97ER41033.

[1] A. Zilges et al., Prog. Part. Nucl. Phys. **122**, 103903 (2022).

HK 10: Structure and Dynamics of Nuclei II

Time: Monday 16:30–18:00 Location: SCH/A215

Group Report HK 10.1 Mon 16:30 SCH/A215

Collinear laser spectroscopy at NSCL/FRIB — •Kristian König[1,2], Ronald Garcia-Ruiz[3], Kei Minamisono[2], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Facility for Rare Isotope Beams, Michigan State University, USA — [3]Massachusetts Institute of Technology, USA

The National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University was recently upgraded to the Facility for Rare Isotope Beams (FRIB). With in-flight fragmentation, rare isotope beams from all over the nuclear chart can be produced and investigated, e.g., with collinear laser spectroscopy at the BECOLA setup. In this talk, we will summarize the latest results on Nickel, Scandium and Silicon that gave new insights in the nuclear structure at the neutron shell closures at $N = 20$ and 28. Furthermore, the investigation of the nuclear charge radius of mirror nuclei allowed us to constrain L, the slope parameter of the nuclear equation of state. Our result is consistent with results derived from the dipole polarizability and neutron star mergers. The capabilities of BECOLA in the FRIB era will be discussed as well as the status of the currently ongoing upgrade that will allow us to perform the more sensitive collinear resonance ionization spectroscopy with particle detection (RISE). This work was supported in part by US NSF Grant No. PHY-21-11185 and DOE Office of Science Award No. DE-SC0000661, DE-SC0021176 and DE-SC0021179 and by the DFG – Project-Id 279384907*SFB 1245.

HK 10.2 Mon 17:00 SCH/A215

The Charge Radius of ^{26,26m}Al and its implication for CKM unitarity — •Peter Plattner — Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany

For the COLLAPS and IGISOL collaborations.

In the study of atomic nuclei, nuclear charge radii provide intriguing physics insights into the evolution of nuclear structure far away from stability. Furthermore, charge radii have been used as experimental input for the determination of V_{ud} of the CKM quark mixing matrix from superallowed nuclear β-decays. In the Standard Model of particle physics, the CKM matrix is predicted to be unitary but recent reviews of the matrix values show a 2.2σ deviation for one of its unitarity tests.

This contribution will present the recent work of combined measurements of the charge radii of ^{26,26m}Al by means of Collinear Laser Spectroscopy (CLS) at the COLLAPS experiment/ISOLDE and at the IGISOL facility/Jyvaskyla, Finland. CLS takes advantage of the interaction between the atomic nucleus and its surrounding electrons giving rise to the hyperfine structure. Thus, properties of nuclear ground states and long-lived isomers, including nuclear charge radii, can be inferred from measured hyperfine spectra. Prior to the present work, the charge radius of the superallowed β emitter ^{26m}Al was not known experimentally but was extrapolated to evaluate the isospin symmetry breaking (ISB) correction required for the determination of V_{ud}.

The present measurements reveal a charge radius of ^{26m}Al which differs by more than 4 standard deviations from the value assumed in previous ISB calculations.

HK 10.3 Mon 17:15 SCH/A215

^{83m}Kr N-line spectrum measurement at KATRIN — Matthias Böttcher[1], Moritz Machatschek[2], Magnus Schlösser[2], and •Jaroslav Storek[2] for the KATRIN-Collaboration — [1]Institute of Nuclear Physics, University of Münster — [2]Institute for Astroparticle Physics, Karlsruhe Institute of Technology

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. In this talk, results of a dedicated measurement of the ^{83m}Kr electron N-spectrum with emphasis on N_1 line position and width conducted at unprecedented precision at KATRIN will be presented.

This work is supported by the Ministry for Education and Research BMBF (05A17PM3, 05A17PX3, 05A17VK2, and 05A17WO3) 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 10.4 Mon 17:30 SCH/A215

Implementation of silicon photomultipliers to detect single photons — •Imke Lopp[1], Laura Renth[1], Bernhard Maass[2], Patrick Müller[1], Julian Palmes[1], Julien Spahn[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Argonne National Laboratory, Chicago, IL, USA

Precise and sensitive measurements in collinear laser spectroscopy require detectors with a high detection efficiency for single photons. At the same time, the dark count rate of the detector and the generated background, e.g., from scattered light, should be as low as possible. Common systems use a combination of mirrors or lenses and photomultiplier tubes.

We investigated whether silicon photodiodes (SiPMs) are suitable for this application. Due to their square detection area, the photodiodes can be better arranged to cover the optimal detection area than photomultiplier tubes with their circular detection area. Collinear laser spectroscopy on $^{12}C^{4+}$ and Sr^+ ions was used to compare the detectors in the UV and optical region, respectively. Funded by BMBF, contract 05P21RDFN1.

HK 10.5 Mon 17:45 SCH/A215

Collinear Laser Spectroscopy on Neutron Rich Palladium — •Laura Renth for the ATLANTIS-Collaboration — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Collinear laser spectroscopy gives access to isotope shifts and hyperfine parameters at high precision. From this, nuclear charge radii, nuclear magnetic and electric moments and nuclear spins can be determined. The LASPEC beamline, originally designed for collinear laser spectroscopy at FAIR, has been connected to the Californium Rare Isotope Breeder Upgrade (CARIBU) and is now the central part of ATLANTIS (**A**rgonne **T**andem hall **LA**ser bemli**N**e for a**T**om and **I**on **S**pectroscopy). Results from its commissioning and a first physics run on neutron-rich palladium isotopes will be presented. Short-lived Pd ions were delivered from CARIBU and neutralized to a fast atomic beam. Laser fluorescence spectroscopy was performed on the isotopes $^{110,112-116}$Pd. Spectra of all stable isotopes (even $^{102-110}$Pd and ^{105}Pd) were taken for reference with ions delivered by a laser-ablation ion source. Further measurements will be performed on products of the CARIBU successor nuCARIBU.

This work was supported by DFG – Project-Id 279384907-SFB 1245, and by BMBF 05P19RDFN1

HK 11: Outreach Public/Teilchenwelt (joint session T/HK)

Time: Monday 16:30–18:00 Location: HSZ/0204

HK 11.1 Mon 16:30 HSZ/0204

The german LHC-Office for outreach, transfer and promotion of young talents — •Marius Hoffmann[1], Marie-Lena Dieckmann[2], Harald Appelshäuser[3], Johannes Haller[2], Stephanie Hansmann-Menzemer[4], and Arnulf Quadt[1] — [1]Georg-August-Universität Göttingen — [2]Universität Hamburg — [3]Goethe-Universität Frankfurt — [4]Universität Heidelberg

Communicating the scientific results to the public, fostering cooperation with partners in industry and the promotion of young talents are key tasks of the german LHC research groups. For this reason in 2020, the research focuses (”Forschungsschwerpunkte” short ErUM-FSPs) of the four LHC experiments have initiated a joint ”LHC-Office” which is funded by the Federal Ministry for Education and Research(BMBF). Since then, the LHC-office has been active in a multitude of areas, including a common broschure, a new joint website, the participation at major industry fairs as well as several workshops and events to promote young researchers. This talk will give an overview of the work of the LHC-office's work of the last two years and present an outlook into future activities.

HK 11.2 Mon 16:45 HSZ/0204

KCETA event summer — •Katrin Link — Karlsruhe Institute of Technologie, KIT Center Elementary Particle and Astroparticle Physics KCETA, Karlsruhe, Germany

In the summer of 2022, the traveling exhibition "Code of the Universe" (codeoftheuniverse.eu) designed by CERN, was displayed for four weeks in the center of Karlsruhe. Accompanying this, the KIT Center for Elementary Particle and Astroparticle Physics (KCETA) organized a colorful program of events for a broad audience. The series of events included a vernissage, a lecture evening as part of the Karlsruhe EFFEKTE series and a panel discussion on the topic "Kommen große Forschungsinfrastrukturen an ihre Grenzen? Neue Energiekonzepte für die Forschung der Zukunft". The main focus was on "Science Afternoons", during which the individual working groups of KCETA presented their research with a small exhibition, hands-on experiments and short lectures. Additionally a special programm for pupils was offered, including masterclasses and "Physik am Samstag". In this talk we want to present the different formats we used to interact with a broad audience and report from our experiences.

HK 11.3 Mon 17:00 HSZ/0204

Belle II - The Beauty goes public — •Johanna Häusler and Thomas Kuhr — LMU, München, Deutschland

Public outreach is an element feature of modern science. In particular,

the large and internationally organized particle physics experiments have great potential to raise public awareness of physics - both in terms of the physics questions themselves and the technological developments associated with fundamental research. The Belle II experiment is a rather novel experiment based in Japan and involving worldwide collaboration. The German Belle II institutes - in close cooperation with partner organizations and supported by a BMBF *Forschungsschwerpunkt* - are in the process of building a network and developing a strategy to present Belle II particle physics research to the German public. This is particularly interesting in view of the important scientific results that are expected from Belle II in the coming years. The outreach strategy includes a corporate design, a strategy to present the Belle II institutes, scientific results and staff both on Twitter and on the Belle II homepage, basic outreach activities in education (such as Belle II Masterclasses, a Belle II coursework for students and the design of a Belle II model) and industry transfer to promote technological development and human potential in the broad field of industry.

HK 11.4 Mon 17:15 HSZ/0204

Urknall unterwegs: eine mobile Ausstellung zur Teilchenphysik — Uta Bilow, •Sarah Kästner, Michael Kobel und Philipp Lindenau für die Netzwerk Teilchenwelt-Kollaboration — TU Dresden, Institut für Kern- und Teilchenphysik

Urknall unterwegs ist eine mobile Ausstellung, die von Weltmaschine bei DESY in Hamburg in Zusammenarbeit mit Netzwerk Teilchenwelt und Expert:innen aus der Teilchenphysik und Didaktik der TU Dresden entwickelt wurde. Besucher:innen erfahren bei einer kurzen Zeitreise in fünf Schritten, wie das Universum sich seit dem Urknall entwickelt hat. Außerdem können sie etwas über die Menschen erfahren, die in der Teilchenphysik wissenschaftlich tätig sind: Wie und warum geforscht wird und vor allem wie sich das auf ihren Alltag und die Gesellschaft auswirkt. Interaktive Elemente wie der Teilchen-Twister vervollständigen die Ausstellung. Studierende und Physiker:innen vermitteln als Urknall-Guides wissenschaftliche Inhalte. Im Juli 2022 wurde die Ausstellung zum 10jährigen Jubiläum der Higgs-Entdeckung gezeigt. Es folgten weitere Stationen bei der Langen Nacht der Wissenschaften in Dresden, der Mainzer Science Week und Stadtteilfesten in Hamburg. Für das Wissenschaftsjahr 2023 Unser Universum gibt es bereits Planungen für bundesweite Stationen. Die Ausstellung wird auch an die MS Wissenschaft andocken und in einigen Häfen vor dem schwimmenden Science-Center zu sehen sein. Der Vortrag zeigt Beispiele der bisherigen Ausstellungstour, stellt Erweiterungen vor und gibt eine Aussicht auf Entwicklungen. Urknall unterwegs kann während der Tagung vor dem Hörsaalzentrum angeschaut werden.

HK 11.5 Mon 17:30 HSZ/0204

Nachwuchs für die Forschung gewinnen: Das Fellow-Programm von Netzwerk Teilchenwelt — •Andrea Mayer-Houdelet, Uta Bilow und Michael Kobel für die Netzwerk Teilchenwelt-Kollaboration — TU Dresden, Institut für Kern- und Teilchenphysik

Jedes Jahr kommen etwa 3.500 Jugendliche an den 30 Standorten von Netzwerk Teilchenwelt mit der Physik der kleinsten Teilchen in Kontakt. Die besonders Interessierten besuchen dann einen CERN-Workshop oder die Teilchenphysik-Akademie Mainz. Viele dieser Jugendlichen studieren danach Physik. Für diese vorgebildeten jungen Leute hat das Netzwerk Teilchenwelt das Fellow-Programm ins Leben gerufen. Ziel ist es sie möglichst früh mit den Forschungsgruppen zu vernetzen, sie fachlich weiter zu qualifizieren und so langfristig Nachwuchs für die Forschungsgruppen zu gewinnen. Wir stellen das Fellow-Programm vor, berichten von unseren bisherigen Erfahrungen und präsentieren die Ergebnisse einer Evaluation zu den vielfältigen Online- und Präsenz-Angeboten für Fellows.

HK 11.6 Mon 17:45 HSZ/0204

Die Netzwerk Teilchenwelt Projektwochen: aktive Teilhabe an der aktuellen Forschung für Jugendliche am CERN — •Uta Bilow[1], Niklas Herff[1,2], Michael Kobel[1], Franziska Rauscher[3] und Sascha Schmeling[2] für die Netzwerk Teilchenwelt-Kollaboration — [1]TU Dresden, Institut für Kern- und Teilchenphysik — [2]CERN — [3]Gymnasium Olbernhau

Im Stufenprogramm von Netzwerk Teilchenwelt bilden die Projektwochen am CERN eine außergewöhnliche Möglichkeit für motivierte Jugendliche. Bis zu zehn Jugendliche, die durch ihr vorheriges Engagement bereits ein umfassendes Wissen und eine große Begeisterung für die "Physik der kleinsten Teilchen" mitbringen, bekommen die Chance, selbst einmal richtig in die Forschung einzutauchen. Im Rahmen einer umfangreichen Forschungsarbeit, die von schulischer Seite und mit Unterstützung vom Netzwerk Teilchenwelt betreut wird, finden individuelle Projekte in verschiedenen Bereichen am CERN statt. Betreut von Wissenschaftler:innen arbeiten die Jugendlichen zwei Wochen in einem Team am CERN, in dem sie beispielsweise Daten analysieren oder Detektorkomponenten vermessen und auswerten.

In einem gemeinsamen Vortrag von Niklas Herff (der verantwortlichen Person am CERN) und Franziska Rauscher (einer Teilnehmerin der Projektwochen 2022) werden die besonderen Chancen dieses Programms genauer vorgestellt.

HK 12: Invited Talks II

Time: Tuesday 11:00–12:30 Location: HSZ/0002

Invited Talk HK 12.1 Tue 11:00 HSZ/0002

Baryon spectroscopy at ELSA and MAMI — •Farah Afzal for the CBELSA/TAPS-Collaboration — HISKP, Uni Bonn

To improve our knowledge of the exact dynamics between the constituents of baryons and to better understand quantum chromodynamics (QCD) in the non-perturbative regime, the baryon excitation spectrum is investigated.

Experimentally, it can be probed with a real photon beam by studying photoproduction reactions. Partial wave analyses are performed to extract the baryon resonance parameters from the experimental data. For an unambiguous solution it is not enough to only measure the unpolarized cross section, but several single and carefully chosen double polarization observables are essential as well.

Worldwide, various experimental facilities have dedicated programs to measure these polarization observables in different photoproduction reactions using polarized photon beams and polarized targets. Two of the leading experimental facilities are located in Germany, the CBELSA/TAPS experiment at the accelerator facility ELSA in Bonn and the Crystal Ball experiment at the accelerator facility MAMI in Mainz. Both experiments are excellent at measuring neutral mesons in the final states, using electromagnetic calorimeters covering almost the full angular range, while exploring complementary beam energy regions. This talk will give an overview about recent results in non-strange baryon spectroscopy at ELSA and MAMI.

Invited Talk HK 12.2 Tue 11:30 HSZ/0002

ALICE upgrades, status and perspectives for ALICE-3 — •Robert Muenzer for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe Universität Frankfurt, Deutschland

The ALICE experiment at CERN has undergone a major upgrade in preparation of LHC Run 3. A new Inner Tracking System and a system of new trigger detectors were installed while the Time Projection Chamber was upgraded with GEM-based readout chambers. The muon system was extended by the Muon Forward Tracker. In addition, the readout of all detectors and the computing infrastructure have been redesigned for continuous readout including a synchronous reconstruction. The whole system was running successfully during the first year of LHC Run 3. For the next long shutdown, a further upgrade of the inner tracking systems and an installation of a forwards calorimeter is planned. For the operation in LHC Run 5 and 6 a next-generation experiment named ALICE 3 is proposed to address unresolved questions about the quark-gluon plasma by precise measurements of heavy-flavour probes and thermal radiation. In order to achieve the best possible pointing resolution and the required particle identification performance a concept for the installation of a high-resolution vertex tracker in the beam pipe, surrounded by a silicon-pixel tracker, a combination of time-of-flight system and a Ring-Imaging Cherenkov detector is foreseen. Further detectors, such as an electromagnetic calorimeter, a muon identifier, and a dedicated forward detector for ultra-soft photons, are being studied. In this presentation, the status of the ALICE upgrades as well as the future perspectives will be presented.

Invited Talk HK 12.3 Tue 12:00 HSZ/0002

Nuclear parton distribution functions — •Michael Klasen — University of Münster, Münster, Germany

Investigations of the nuclear structure at high energies are not only important for our theoretical understanding of the fundamental quark and gluon dynamics in protons and neutrons bound in nuclei and of the initial conditions for the formation of the quark-gluon plasma, but also for precise predictions of scattering processes studied at the LHC and the future EIC. In this talk, we will review the recent rapid progress in global determinations of nuclear parton distribution functions (PDFs) from neutral-and charged deep-inelastic scattering, the Drell-Yan process and various hard probes at the LHC. Theoretical developments with respect to correlations with the underlying proton PDFs, saturation, shadowing, short-range correlations of nucleon pairs, higher-order perturbative and lattice QCD will also be briefly discussed.

HK 13: Instrumentation IV

Time: Tuesday 17:00–18:15 Location: SCH/A251

HK 13.1 Tue 17:00 SCH/A251

SiPM-characteristics after proton irradiation — •Vincent Verhoeven[1], Dieter Grzonka[3], and James Ritman[1,2,3] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [2]Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44801 Bochum, Germany — [3]Institut für Kernphysik, Forschungszentrum Jülich, 52428 Jülich, Germany

Silicon photomultipliers (SiPM) are frequently used for the photon read out of scintillation detectors as an alternative to a conventional photomultiplier. SiPMs exhibit a high photon detection efficiency in the order of 40%, achieve internal amplifications of 10^6 to 10^7, require rather low operating voltages, are insensitive to magnetic fields and, due to the small size, simplify the mechanical construction of detector components. A drawback is the sensitivity of SiPMs to irradiation resulting in a remarkable change of the behavior already at a rather low radiation dose.

In order to determine the effect of irradiation for the SiPM operation as photon sensors, the characteristics of SiPMs after irradiation with a 35 MeV proton beam have been studied. In addition to the basic properties, the performance as a photon detector at various photon numbers was investigated. With a bake-out at temperatures of up to 150 $°C$ a regeneration to a certain degree was achieved.

The characteristics of SiPMs as a function of radiation dose and its possible regeneration at high temperatures will be presented.

HK 13.2 Tue 17:15 SCH/A251

Systematic Studies of Radiation Damage and Stimulated Recovery of PWO — •Pavel Orsich, Valery Dormenev, Hans-Georg Zaunick, Markus W. H. Moritz, Rainer W. Novotny, and Kai-Thomas Brinkmann — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

Degradation of the optical transmittance of lead tungstate (PWO) scintillation crystals in the luminescence spectrum under ionizing radiation leads to loss of the light output, which results in the deterioration of the energy resolution. Stimulated recovery allows to restore the optical transmittance losses and is achieved by inducing photons of different wavelengths via external light sources (laser diode, LED). Here we report on new results of studies on the stimulated recovery and the radiation damage under gamma irradiation cooled down and at room temperature of lead tungstate crystals. It includes light output and transmittance degradation of PWO, correlations between variations of transmittance at 420 nm and the radiation induced absorption coefficient. Moreover, we present the first lab experiment results of in-situ recovery of the PWO optical transmittance during radiation period[3]. We also propose the model of the radiation damage and the stimulated recovery of damaged PWO after gamma irradiation as well as spontaneous recovery.
This work is supported by BMBF, GSI and HFHF.

HK 13.3 Tue 17:30 SCH/A251

Pre production tests of the PANDA BARREL EMC Slice* — •Thorsten Erlen — II. Physikalisches Institut, JLU Gießen, Deutschland

The Electromagnetic Calorimeter (EMC) of the future PANDA-Experiment at the FAIR complex in Darmstadt will use lead tungsten scintillator crystals (PWO II) to convert energy into an according amount of light and in most parts 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 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 measurments with the first in 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.
*gefördert durch das BMBF, GSI und HIC for FAIR.

HK 13.4 Tue 17:45 SCH/A251

Calibration of Detector Modules for the PANDA FAIR Phase-0 Calorimeter — Nicolo Baldicchi[1], Luigi Capozza[1], •Samet Katilmis[1], Dong Liu[1], Frank Maas[1,2,3], Julian Moik[1], 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 FAIR Phase-0 Calorimiter consists of 48 submodules. Each submodule houses detector components, such as high voltage distribution boards, charge sensitive preamplifiers, avalanche photo diodes (APDs) and temperature sensors. The characteristics of these components must be determined to run the calorimeter in an optimal operating mode. Following parameters were determined and optimised. The APD gain as a function of the bias voltage at -25 °C, the entrance area of the PANDA charge sensitive preamplifier and the characteristic curves of both the HV boards and the platinum temperature sensors. Furthermore a first energy calibration of the submodules by utilising atmospheric muons was performed. The talk points out both technical developments and results.

HK 13.5 Tue 18:00 SCH/A251

Series calibration of the slow-control of the barrel part of the PANDA EMC front-end electronics* — •Christopher Hahn — Justus Liebig Universität, 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, the individual high-voltage adjustments for the Large Area Avalanche Photodiodes (LAAPDs) demands innovative and customized electronics, such as, for example, the individual bias voltage adjustments for the Photodiodes with an accuracy of 0.1V or better. In the same time, no space can be occupied in the inner detector volume for individual cable routing and connections for the LAAPD bias voltage. The key elements of the high-voltage adjustment concept and the frontend electronics as well as environmental dependencies will be described. The first results of the calibration of the high-voltage distribution and the resulting calibration algorithm will be presented. *supported by BMBF, GSI und HFHF.

HK 14: Instrumentation V

Time: Tuesday 17:00–18:45 Location: SCH/A.101

Group Report HK 14.1 Tue 17:00 SCH/A.101

A State-of-the-Art Cluster-Jet Target for the PANDA Experiment at FAIR — •Philipp Brand, Daniel Bonaventura, Hanna Eick, Jost Froning, Lennart Halstenberg, Christian Mannweiler, Sophia Vestrick, Michael Weide, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The PANDA cluster-jet target that will be installed at the High Energy Storage Ring (HESR) at FAIR is the world's leading target of its kind. It allows for hydrogen target thicknesses of more than 10^{15} atoms/cm^2 at the interaction point, which is located more than 2 m below the nozzle. This is achieved by a complex machine that has been developed over the last years, including several systems for adjustment and diagnosis. Most of them are special developments just for this purpose. This also includes the diagnostic systems that will be mounted into a modified version of the cluster-jet beam dump, which is the latest development.

Furthermore, the target has already been tested extensively in our institute but also at the COoler SYnchrotron (COSY) at FZ Jülich, where the interaction of a proton beam with the target in presence of the HESR stochastic cooling devices has been studied.

The target with all the technical developments that will be installed at its final version will be presented and some results of measurements with the PANDA target will be discussed.

This project has received funding from BMBF (05P21PMFP1), GSI FuE (MSKHOU2023) and the EU's Horizon 2020 programme (824093).

Group Report HK 14.2 Tue 17:30 SCH/A.101

LHCspin: First Tests of the SMOG2 gas target at the LHC — •Erhard Steffens[1], Paolo Lenisa[2], Vito Carassiti[2], Giuseppe Ciullo[2], Pasquale Di Nezza[3,4], Luciano L. Pappalardo[2,4], and Marco Santimaria[3,4] — [1]FAU, Erlangen-Nürnberg, Germany — [2]U. Ferrara and INFN, Italy — [3]INFN Lab. Nat. di Frascati, Italy — [4]LHCb Collaboration, CERN

The LHCspin project aims at unpolarized (SMOG2) and polarized fixed-target measurements by means of a gas target upstream of the LHCb detector, close to the vertex detector VELO. The forward geometry of the LHCb spectrometer ($2 < \eta < 5$) allows for the reconstruction of particles produced in fixed-target collisions, with CM energies from $\sqrt{s_{NN}} = 72$ GeV with Pb beam, to $\sqrt{s} = 115$ GeV in pp collisions.

SMOG2 is an openable storage cell with wake field suppressors and unpolarized gas feed system, producing a localized pressure bump inside the 200mm long storage tube, with i.d. 10 mm in the closed state. The two halves of the cell are connected to and moving with the VELO detector boxes, opening during beam injection. The 7 TeV/1A beam traversing the target might develop instabilities which must be suppressed by a suitable coating and shape of the conducting surfaces. - The target was successfully tested with beams (p, Pb) in November 2022. It has been verified that beam-beam and beam-gas events can be measured simultaneously by the detector.

HK 14.3 Tue 18:00 SCH/A.101

Clustersize distribution measurement using the three wavelength extinction method — •Sophia Vestrick, Philipp Brand, Hanna Eick, Jost Froning, ErenCem Göktas, Lennart Halstenberg, Christian Mannweiler, Michael Weide, and Alfons Khoukaz — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

In a cluster source, cryogenic hydrogen, gaseous or liquid, is forced through a Laval nozzle and expanded into a vacuum. The hydrogen formes droplets consisting of millions of atoms. The diameters of the resulting clusters vary by severeral orders of magnitude. When starting, e.g., with liquid hydrogen, the clusters can reach diameters from some nanometers up to several micrometers, but the specific distribution is not yet known. In the three wavelength extinction method (3WEM), three lasers with different wavelengths are aligned to an interaction region and collimated onto one detector each. When the cluster-jet crosses the interaction region the intensity of all three lasers is reduced. Since the resulting extinction ratio depends on the known wavelength of the laser as well as on the clustersizes, this method can be used to determine the size distribution of the clusters. The 3WEM was first tested with sprays of known diameter distribution for verification and afterwards installed at a Münster Cluster-Jet Target. First results are presented in this talk. This project has received funding from BMBF (05P21PMFP1), GSI FuE (MSKHOU2023) and the EU's Horizon 2020 programme (824093).

HK 14.4 Tue 18:15 SCH/A.101

Determination of hydrogen cluster size distributions for different cluster-jet target stagnation conditions — •Hanna Eick, Philipp Brand, Christian Mannweiler, Sophia Vestrick, and Alfons Khoukaz — Institute for Nuclear Physics, Westfälische Wilhelms-Universität Münster

The internal and windowless cluster-jet targets from the WWU Münster are a key component of several experiments at various research facilities. One of them is the HHU Düsseldorf where the 200 TW ARCTURUS laser was used to investigate the laser-cluster interaction. In this context measurements are performed in order to study some important properties of the used hydrogen clusters, like the size of the clusters and their size distribution. To find out the size of the clusters, they are visualized by the shadowgraphy method. For this purpose, the ultrashort pulse ARCTURUS laser is illuminating the cluster beam and shadowgrapy images are taken. The evaluation of cluster diameters has to be automated due to the large number of recorded photos. This talk provides an overview of the results of the analyzed shadowgraphy measurements for various target settings and also for different positions in the cluster beam. By comparing the effective flow of material through the nozzle with the flow of clusters visible in these shadowgraphs, the amount of (invisible) gas embedded in the clusters can be estimated. This project has received funding from BMBF (05P21PMFP1), GSI FuE (MSKHOU2023) and the EU's Horizon 2020 programme (824093).

HK 14.5 Tue 18:30 SCH/A.101

Transforming targets: Adapting a cluster-jet target for use as a droplet target — •Christian Mannweiler, Daniel Bonaventura, Jost Froning, Eva-Maria Hausch, Elena Lammert, and Alfons Khoukaz — WWU, Münster, Deutschland

Internal targets such as H_2 cluster-jet targets and H_2 pellet targets have found widespread use in different fields of physics such as particle- and plasma physics. A prominent example is the future PANDA experiment at FAIR which will employ both target technologies for hadron physics experiments using antiproton accelerator beams.

Both types of target make use of cryogenic hydrogen in different forms. In the cluster-jet target it takes the form of a continuous beam made up of many small hydrogen clusters which achieve sizes from the nanometer scale up to several microns in diameter while a droplet target produces a stream of mono-sized, well separated hydrogen droplets at diameters in the tens of microns. Up until now, both target technologies were considered separately from each other, with a target device either creating cluster-jet beams or pellet beams. However, they remain closely related, which led us to initiate an R&D program on the development of a hybrid target which can produce both types of beam with only short downtime between swapping modes.

In our contribution we will present how we successfully transformed a cluster-jet target into a droplet target as well as first, encouraging results.

This project has received funding from the EU Horizon 2020 programme (824093).

HK 15: Instrumentation VI

Time: Tuesday 17:00–18:45 Location: SCH/A117

HK 15.1 Tue 17:00 SCH/A117

Decelerating Antiprotons from 100keV to 4keV — •Jonas Fischer for the PUMA-Collaboration — IKP TU Darmstadt

The PUMA collaboration aims at trapping, storing and transporting 10^9 antiprotons in a cryogenic penning trap to perform experiments with radioactive nuclei and investigate the nuclear density at the outermost part of the nucleus itself. To achieve this, antiprotons delivered from the ELENA storage ring at CERN need to be decelerated from 100keV to 4keV in a first step to be able to capture them in the penning trap [1].

To minimise losses in the deceleration process, a Pulsed Drift Tube (PDT) was installed at a beam line connected to the ELENA storage ring (LNE51) at CERN. A vacuum of below 10^{-10} mbar is necessary to avoid the annihilations of the antiprotons with the residual gas. This, and the required high voltage of about 100 kV, impose strict restrains on the design and operation of the pulsed drift tube. In this talk I will introduce the current setup and its mayor design considerations. Furthermore, the first successful tests of the setup with antiprotons will be presented.

[1] Aumann, T., Bartmann, W., Boine-Frankenheim, O. et al. PUMA, antiProton unstable matter annihilation. Eur. Phys. J. A 58, 88 (2022). https://doi.org/10.1140/epja/s10050-022-00713-x

HK 15.2 Tue 17:15 SCH/A117

The PUMA trap setup at ELENA — •Alexander Schmidt for the PUMA-Collaboration — IKP TU Darmstadt

The antiProton Unstable Matter Annihilation (PUMA) experiment at CERN will provide the ratio of protons and neutrons in the nuclear density tail as a new observable to test nuclear structure theories. To determine this ratio, the concept of antiprotonic atoms is used. After capture onto an antiprotonic orbital, the antiproton cascades towards the nucleus and eventually annihilates with a nucleon in the tail of the nuclear density distribution [1].

As there is no facility worldwide which provides both low-energy antiprotons and radioactive ions, PUMA uses a transportable setup which combines a cryogenic Penning trap for the long-term storage of antiprotons after accumulation at the ELENA ring and a detection system for the identification of pions originating from annihilations of antiprotons and ions of interest, which are either provided by the offline ion source of PUMA at ELENA, for experiments with stable nuclei, or the ISOLDE facility at CERN for investigating radioactive nuclei.

The first commissioning of a part of the PUMA beam line is currently performed at the Antimatter factory at CERN. This talk will give an status report of the trap and cryostat development and its foreseen implementation for the upcoming ELENA beam time starting in April 2023.

[1] Aumann T. *et al.*, PUMA, antiProton unstable matter annihilation. Eur. Phys. J. A 58, 88 (2022).

HK 15.3 Tue 17:30 SCH/A117

Recent developments at the sources for ultra-cold neutrons located at the TRIGA research reactor Mainz — •Simon Kaufmann for the tauSPECT-Collaboration — Department of Chemistry, TRIGA site, Johannes Gutenberg University Mainz

Neutrons created by fission inside the TRIGA research reactor have kinetic energies in the range of MeV. When they are moderated in the range below kinetic energies of 350 neV, they are called ultra-cold neutrons (UCNs). Using materials with a larger Fermi potential than the kinetic energies allows to guide and trap these UCNs. This makes UCNs especially attractive for a variety of neutron based experiments.

In order to provide these UCNs, two UCN-sources are currently operated regularly at TRIGA's beam ports C&D. While the source at beam port C is mainly operated in a continuous irradiation mode of the reactor, the one at beam port D is operated in a pulsed mode of the reactor. Both face the challenge of converting the kinetic energy of the neutrons from MeV down to neV with a solid deuterium crystal as the main converter. Their efficiency is strongly influenced by the structure of the crystal. This structure can be influenced by controlled thermal changes in order to increase the conversion efficiency.

This talk will present the latest measurements that were performed at beam port D with the aim to create a controlled thermal change sequence to increase and saturate the moderation efficiency.

HK 15.4 Tue 17:45 SCH/A117

Simulations for the ultra-cold neutron lifetime experiment τSPECT — •Niklas Pfeifer for the tauSPECT-Collaboration — Institut für Physik, Mainz, Deutschland

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. To study and understand systematic effects and reduce systematic uncertainties, simulations of neutron trajectories and their parameters during the whole measurement cycle are needed. For this we evaluate and use several software packages that can accurately simulate the trajectories of ultra-cold neutrons, protons, and electrons in complex electromagnetic fields as well as the precession of their spins.

This talk will present how the simulation for the τSPECT experiment is set up, challenges and limits of the simulation software and the latest results of the simulations.

HK 15.5 Tue 18:00 SCH/A117

A nuclear magnetic resonance magnetometer for position verification of a neutron spin-flipper — •Viktoria Ermuth for the tauSPECT-Collaboration — Institut für Physik, Johannes Gutenberg-Universität, Mainz

To measure the free neutron lifetime the τSPECT experiment stores ultracold neutrons fully using magnetic field gradients. By flipping the spin of spin-polarized neutrons and thereby transforming high-field-seeking neutrons, whose magnetic moments are aligned with the field, to the low-field-seeking state, where the magnetic moment is aligned opposite the field, the neutrons are filled into the magnetic trap. For the spin flip to be successful the frequency of the spin flipper has to be the Lamor frequency of the neutron at that point in the magnetic field. Therefore, it is necessary to know the magnetic field at the location of the spin flipper. The magnetic field is measured using a nuclear magnetic resonance (NMR) probe to monitor the stability of the magnetic field and provide a reference for the spin flipper. Although the NMR probe does not sit directly at the spin flipper, conclusions about the field at the spin flipper can be made. Despite of environmental challenges, like cryogenic temperatures in vacuum, it is possible to measure the magnetic field with a high accuracy and a constant offset and temperature dependency.
This talk will show the construction and functionality of such an NMR probe as well as commissioning data.

HK 15.6 Tue 18:15 SCH/A117

n2EDM - production and coating of ultra-cold neutron storage vessel — •Noah Yazdandoost — Department of Chemistry, Johannes Gutenberg-University, Mainz

A non-zero nEDM would break time and parity reversal symmetry and if large enough could explain observations like the matter-antimatter asymmetry of the universe. The standard model of particle physics predicts a neutron electric dipole moment (nEDM) on the order of (10^{-29}-10^{-34}) e·cm. To probe the standard model of particle physics and constrain the parameter space for other theories, a more precise measurement of the nEDM is needed (current upper limit $1.8 \cdot 10^{-26}$ e·cm). The aim of the n2EDM experiment is to measure or exclude an nEDM on the order of 10^{-27} e·cm.

In the n2EDM experiment polarized ultra cold neutrons (UCNs) are stored in a vessel across which a combination of a constant electric and magnetic field is applied along the cylinder axis. The vessel consist of the high voltage and ground electrodes and the insulating ring. The Larmor precession frequency of the neutrons is measured by the Ramsey method of separated oscillatory fields. If a shift in the Larmor precession frequency between parallel and antiparallel field orientation is measured, the nEDM is non-zero. To ensure long storage and long depolarization times of the UCNs which directly influence the sensitivity of the experiment, a special coating of the storage vessel is needed.

This talk gives an overview of the n2EDM experiment and the production and coating process of the insulating rings of the experiment.

HK 15.7 Tue 18:30 SCH/A117

Ion optical simulations for the NEXT solenoid separator —

•Arif Soylu[1], Xiangcheng Chen[1], Julia Even[1], Alexander V. Karpov[2], Vyacheslav Saiko[2], Jan Sáren[3], and Juha Uusitalo[3] — [1]University of Groningen, Groningen, The Netherlands — [2]Dubna, Russia — [3]University of Jyväskylä, Jyväskylä, Finland

The NEXT project aims to study Neutron-rich, EXotic heavy nuclei produced in multi-nucleon Transfer reactions[1]. In order to focus and separate these transfer products from unwanted by-products and unreacted primary beam, a 3T solenoid magnet with an 87-cm wide bore will be used.

A Python code was developed to simulate the trajectories of ions through the magnetic field of the solenoid magnet. The purpose of this simulation is to determine the optimal settings for the solenoid separator in order to achieve the highest transmission yields for the ions of interest and the strongest background suppression.

In my contribution, I will explain the various stages involved in the simulations of the ion trajectories through the magnetic field. I will present the simulation results obtained for selected multinucleon transfer products that are of interest for nuclear structure and nuclear astrophysics.

References [1] J. Even et al., Atoms 10 (2022) 59.

HK 16: Heavy-Ion Collisions and QCD Phases III

Time: Tuesday 17:00–18:30 Location: SCH/A216

Group Report HK 16.1 Tue 17:00 SCH/A216

Hyperon and Hypernuclei Production in the High Baryon Density Region — •Yue Hang Leung — Physikalisches Institut, Heidelberg University

Hyperon and hypernuclei have been suggested to be sensitive probes to the medium properties of the nuclear matter created in heavy-ion collisions. Measurements on the properties of hypernuclei can also give constraints to the hyperon-nucleon interaction, which is an essential ingredient in the equation-of-state of high baryon density matter, such as neutron stars. In this presentation, recent results on hyperon and hypernuclei production from intermediate to low energy heavy-ion collisions will be discussed. Future prospects at FAIR, including the ongoing mCBM project, will be discussed.

HK 16.2 Tue 17:30 SCH/A216

Pining down the (anti-)hypertriton production with ALICE at the LHC — •Michael Hartung for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität, Frankfurt, Germany

At the Large Hadron Collider at CERN, copious production of light (anti-)hypernuclei has been measured in Pb–Pb collisions by the ALICE collaboration. The production of such (anti-)hypernuclei has recently become a topic of high interest, in particular since the properties of these objects are not measured to high precision.

The most prominent example is the (anti-)hypertriton, which is a bound state of a proton, a neutron and a Λ hyperon. It is often discussed as a bound state of a deuteron and a Λ hyperon. If one uses the known Λ separation energy of the hypertriton (about 130 keV) one can estimate a size of about 10 fm of the state, which would be larger as a lead nucleus. The size has consequences for its probability to be formed in a coalescence process, which is not expected from a statistical-thermal model approach.

The (anti-)hypertriton is reconstructed by its decay products, e.g. in the case for the charged two-body decay channel of the hypertriton: ${}^{3}_{\Lambda}\mathrm{H} \rightarrow {}^{3}\mathrm{He} + \pi^{-}$.

We will show the latest measurement of the (anti-)hypertriton production in different collision systems and a comparison to different production models. Furthermore, we will present a novel technique for the determination of the object size of the (anti-)hypertriton.

HK 16.3 Tue 17:45 SCH/A216

Investigation of mass $A = 4$ (anti-)hypernuclei production at the LHC — •Janik Ditzel for the ALICE Germany-Collaboration — 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 hypernuclei which 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 Y-N or Y-Y interaction. Recent measurements revealed excited states for two mass $A = 4$ (anti-)hypernuclei which make their measurement 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 hyperhydrogen-4 and the hyperhelium-4. Furthermore, first insights into the measurement of double-strange (anti-)hypernuclei will be shown.

HK 16.4 Tue 18:00 SCH/A216

Hypernuclei studies in heavy-ion collisions at CBM — •Susanne Gläßel and Christoph Blume — IKF Frankfurt

Under the extreme conditions of relativistic heavy-ion-collisions the creation of exotic matter like hypernuclei is possible. Hypernuclei measurements provide insights into the equation-of-state of hadronic matter at high net-baryon densities, as well as into hyperon-nucleon and hyperon-hyperon-interactions. The Compressed Baryonic Matter (CBM) experiment at the future Facility for Anti-Proton and Ion Research (FAIR) in Darmstadt offers the perfect conditions to explore the production of hypernuclei. At beam energies of around 12A GeV, in combination with high interaction rates of up to 10 MHz, an exceptionally high amount of hypernuclei will be created, and even very rare double hypernuclei like ${}^{6}_{\Lambda\Lambda}\mathrm{He}$ are expected. The reconstruction of hypernuclei was implemented into the CBM software PFSimple and optimized with respect to important performance indicators. Expected efficiencies and signal-to-background-ratios were calculated for a reliable estimation of the number of reconstructable hypernuclei; the detector areas with the best performance were identified. Systematical uncertainties were estimated based on simulations from different transport models, like e.g. the novel PHQMD approach, as well as on the signal extrapolation to the full rapidity and transverse momentum range. The experimental sensitivity to properties of hypernuclei, such as their lifetime, was evaluated. Results for ${}^{3}_{\Lambda}\mathrm{H}$ will be discussed as an example. DFG-grant BL 982/3-1, DFG-grant BR 4000/7-1.

HK 16.5 Tue 18:15 SCH/A216

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

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

In order to optimize the detector geometry, CBMRoot simulation data are converted into a data format called AnalysisTree, which provides more user-friendly access to all physical quantities of the particles generated in the experiment. Before analyzing the performance of the MVD, it is necessary to clarify how the reconstruction and mapping in AnalysisTree is implemented, i.e. the criteria according to which AnalysisTree assigns Monte-Carlo particles to reconstructed tracks. The focus in this study is on the gain in tracking performance by the MVD, also considering alternative detector geometries.

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

HK 17: Heavy-Ion Collisions and QCD Phases IV

Time: Tuesday 17:00–18:30 Location: SCH/A315

Group Report HK 17.1 Tue 17:00 SCH/A315

Hydrodynamic modeling of J/ψ p_{T} spectra and anisotropic flow in the Statistical Hadronization Model — Anton Andronic[3], Peter Braun-Munzinger[1,2], •Hjalmar Brunssen[1], Jana Crkovská[1], Johanna Stachel[1], and Martin Völkl[1] — [1]Physikalisches Institut, Universität Heidelberg — [2]ExtreMe Matter Institute EMMI, GSI — [3]Institut für Kernphysik, WWU Münster

The Statistical Hadronization Model (SHM) has been shown to describe the observed particle yields in heavy-ion collisions very successfully. This is true not only for hadrons consisting of light-flavor valence quarks, but also for those containing charm quarks with the corresponding enhancement when one incorporates in the SHM that charm quarks are produced in initial hard collisions.

In this talk, we present the calculation of the transverse momentum spectra and anisotropic flow coefficients of the J/ψ. The assumption underlying the statistical hadronization of charm quarks is that they thermalize in the medium. This is supported by experimental evidence that they participate in the collective expansion. In order to come from a yield predicted by the SHM to the p_{T}-dependent anisotropic flow coefficients and transverse momentum spectra, the evolution of the quark gluon plasma (QGP) needs to be modeled by a hydrodynamic simulation. For the QGP evolution and the freeze-out, results from three different viscous hydrodynamic models are presented: 2+1D and 3+1D MUSIC as well as FluiduM. The results of these three approaches are compared to recent ALICE data.

HK 17.2 Tue 17:30 SCH/A315

Prompt and non-prompt J/ψ production as a function of multiplicity in pp collisions with ALICE — •Gauthier Legras for the ALICE Germany-Collaboration — Institut für Kernphysik, WWU 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 determined by soft particle production processes, in small systems allows to investigate the interplay between hard and soft scales. However, a substantial part of the J/ψ, called non-prompt J/ψ, comes from the decay of open-beauty hadrons. Since open-beauty hadron production mechanism is different from the one for prompt J/ψ, it becomes necessary to disentangle the prompt contribution from the non-prompt one in order to know if the non-prompt fraction could impact the inclusive (prompt + non-prompt) distribution of J/ψ as a function of multiplicity.

This study aims at determining the fraction of non-prompt J/ψ as a function of multiplicity in pp collisions at $\sqrt{s} = 13$ TeV, through its decay of J/ψ to an electron-positron pair at midrapidity. The fraction is determined from the study of displaced J/ψ decay vertices, using a Boosted Decision Tree algorithm for the identification of the J/ψ and its classification.

HK 17.3 Tue 17:45 SCH/A315

Statistical hadronization model for Au-Au collisions at SIS18 energies — •Szymon Harabasz[1], Jedrzej Kolas[2], Radoslaw Ryblewski[3], Wojciech Florkowski[4], Tetyana Galatyuk[5,1], Malgorzata Gumberidze[5], Piotr Salabura[4], Joachim Stroth[5,6], and Hanna Paulina Zbroszczyk[2] — [1]TU Darmstadt — [2]Warsaw University of Technology — [3]Institute of Nuclear Physics PAS — [4]Jagiellonian University in Krakow — [5]GSI Helmholtzzentrum für Schwerionenforschung GmbH — [6]Institut für Kernphysik, GU Frankfurt

We show that the transverse-mass and rapidity spectra of p and $\pi^{\pm}$ produced in Au-Au collisions at $\sqrt{s_{\mathrm{NN}}} = 2.4$ GeV can be well reproduced in a thermal model of particle emission from a spheroid single freeze-out hypersurface. This scenario extends the one used by Siemens and Rasmussen in the original formulation of the blast-wave model by allowing for elongation or contraction of the source. We incorporate a Hubble-like expansion of QCD matter and resonance decays.

This work was supported in part by: the Polish National Science Center Grants No. 2018/30/E/ST2/00432, No. 2017/26/M/ST2/00600, No. 2020/38/E/ST2/00019 and No. 2021/41/B/ST2/02409; IDUB-POB-FWEiTE-3, project granted by Warsaw University of Technology under the program Excellence Initiative: Research University (ID-UB); 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.

HK 17.4 Tue 18:00 SCH/A315

Studies on J/ψ production as a function of the charged-particle multiplicity in pp collisions at the LHC — •Ailec de la Caridad Bell Hechavarria for the ALICE Germany-Collaboration — Institut für Kernphysik, Westfälische Wilhelms- Universität Münster

The inclusive J/ψ yields as a function of the charged-particle multiplicity exhibit a stronger than linear increase when the J/ψ is measured at midrapidity (|y|<0.9) than when it is measured at forward rapidity (2.5 <|y|< 4). Insight into this effect could be gained by using the J/ψ as a leading particle and studying the associated underlying events in the collision.

Data collected in pp collisions with ALICE at the LHC during Run 2 is used to investigate the relative J/ψ yield, measured at mid-rapidity (|y|<0.9) in its dielectron decay channel and as a function of the charged-particle multiplicity, in various regions of the azimuthal angle with respect to the emission of the J/ψ meson. This contribution will show these measurements in pp collisions at $\sqrt{s}$=13 TeV.

***Supported by DFG under GRK2149**

HK 17.5 Tue 18:15 SCH/A315

Mid-Rapidity J/ψ production as a function of multiplicity at different rapidities in p–Pb collisions at the LHC with ALICE — •Tabea Eder for the ALICE Germany-Collaboration — Institut für Kernphysik, Westfälische Wilhelms- Universität Münster

ALICE results from 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 $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV.

To better understand the multiplicity dependent J/ψ production and possible contributions from auto-correlation effects, the J/ψ production at mid-rapidity is studied as a function of multiplicity in different rapidity ranges. This can be done in ALICE using the V0A and V0C detectors for the multiplicity estimation, which are situated at different rapidities at either side of the collision point.

In this talk the inclusive J/ψ production at mid-rapidity will be shown as a function of multiplicity at different rapidity ranges for proton-lead collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV using ALICE Run 2 data. In addition studies of J/ψ production in ANGANTYR, the heavy-ion machinery of PYTHIA8, will be shown.

Supported by BMBF within the ErUM Program.

HK 18: Hadron Structure and Spectroscopy II

Time: Tuesday 17:00–19:00 Location: SCH/A316

Group Report HK 18.1 Tue 17:00 SCH/A316

Measurement of the proton charge radius at AMBER — •Martin Hoffmann for the AMBER-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The proton charge radius can be measured either by hydrogen spectroscopy or in lepton-proton elastic scattering. Previous measurements resulted in discrepant radii, which became known as the proton ra-

dius puzzle. The AMBER collaboration at CERN plans to perform a new precision measurement of the proton form factor at low momentum transfer using high-energy muon-proton elastic scattering. This measurement has different systematic uncertainties compared to those of low-energy elastic scattering. The recoil proton will be detected with a high-pressurized hydrogen-filled Time Projection Chamber (TPC), measuring the transferred energy and thus the squared four-momentum Q^2. The muon kinematics will be measured with high-precision vertex detectors around the TPC and a downstream spectrometer, which allows to select for elastic scattering events.

The core setup consisting of silicon tracking detectors and a prototype TPC was studied under realistic beam conditions during a pilot run in 2021. In 2022, the newly developed unified tracking system consisting of scintillating fibers for accurate timing and monolithic pixel-silicon detectors for high spatial precision was tested. This talk will present results of the on-going analyses and an overview of further developments towards the final setup.

Supported by EU.

HK 18.2 Tue 17:30 SCH/A316

Testing Predictions of the Chiral Anomaly in Primakoff Reactions at COMPASS* — •Dominik Ecker and Andrii Maltsev for the COMPASS-Collaboration — Physik-Department, Technische Universität München

Chiral Perturbation Theory (ChPT) makes effective predictions for low-energy phenomena of QCD, i.e. dynamics and decays of light mesons, and their couplings to photons and nucleons. Processes, which are governed by the chiral anomaly, are described in the effective Lagrangian by the Wess-Zumino-Witten (WZW) term. The WZW term describes for example the coupling of one pion to two photons. Hence, it describes the π^0 lifetime, which has been well confirmed by multiple measurements.

There are however many more couplings governed by the chiral anomaly, which lack precise experimental verification: for example, the direct coupling of one photon to three pions. The corresponding coupling constant $F_{3\pi}$ is described by the WZW term and can experimentally be accessed in $\pi^- + \gamma \to \pi^- + \pi^0$ scattering reactions.

At the COMPASS experiment at CERN, we study pion-photon scattering reactions via the Primakoff effect. These data allow us to verify the ChPT prediction for $F_{3\pi}$. We will present preliminary result of this measurement and ongoing efforts to improve its accuracy.

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

HK 18.3 Tue 17:45 SCH/A316

Small Angle Initial State Radiation Analysis of the Pion Form Factor at BESIII — •Yasemin Schelhaas, Riccardo Aliberti, and Achim Denig for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

The anomalous magnetic moment of the muon is one of the most precisely measured quantities in modern physics. However, there is a discrepancy of 4.2 standard deviations between the Standard Model (SM) prediction and the average of the latest direct measurements at BNL and FNAL. This discrepancy is known as the Muon $(g-2)$-puzzle. For the SM prediction the main uncertainty arises from hadronic contributions and can be improved systematically using measurements of hadronic cross sections at e^+e^- colliders. One of the most important processes is $e^+e^- \to \pi^+\pi^-$. Using a data set of $1.9\,\mathrm{fb}^{-1}$ (in the near future $20\,\mathrm{fb}^{-1}$) at a center of mass energy of 3.77 GeV, the $\pi^+\pi^-$ cross section is measured at the BESIII experiment located at the BEPCII collider in Beijing, exploiting the initial state radiation technique at small angles. The analysis aims to determine the pion form factor at masses above 0.8 GeV, which is also interesting for hadron spectroscopy. In this talk the current status of the analysis is presented.

Supported by DFG.

HK 18.4 Tue 18:00 SCH/A316

SIDIS Kaon Beam Spin Asymmetry Measurements 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 $F_{LU}^{\sin(\phi)}/F_{UU}$ has been performed for $K^{\pm}$, 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. $F_{LU}^{\sin(\phi)}$ 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^-) 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, x_B, p_T and Q^2 for the first time. This multidimensional binning will allow a comparison with different reaction models.
This work is supported by HFHF and funded by DFG (project number: 508107918).

HK 18.5 Tue 18:15 SCH/A316

Exposing the structure of pion — •Minghui Ding — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

As the theory of quantum chromodynamics has unfolded, the pion has come to be understood as Nature*s most fundamental Nambu-Goldstone boson. It is attached to chiral symmetry, which is dynamically broken, quite probably as a corollary of emergence of hadron mass. Continuum Schwinger function methods are well suited to tackling the pion. This presentation describes the theoretical developments on pion structure in which the methods preserve the fundamental underlying symmetries, thereby providing challenges and opportunities for modern and anticipated high-luminosity, high-energy facilities - JLab at 12GeV, the AMBER project at CERN, and electron ion colliders in the USA and China - and surveys the developments in global phenomenological fits and lattice regularised QCD, enabling the picture of the pion to be drawn.

HK 18.6 Tue 18:30 SCH/A316

Numerische Analyse der nichtlinearen GLR-MQ-Gleichungen für nukleare Partondichtefunktionen — •Janik Rausch[1], Vadim Guzey[2] und Michael Klasen[3] — [1]Humboldt-Universität Berlin, Deutschland — [2]Universität Jyväskylä, Finnland — [3]Westfälische Wilhelms-Universität Münster, Deutschland

Wir untersuchen erstmalig die nichtlinearen GLR-MQ-Gleichungen für die Entwicklung nuklearer Partondichtefunktionen (nPDFs) numerisch bis zur next-to-leading order für verschiedene Kerne und quantifizieren den Einfluss von Gluonen-Rekombination bei kleinem Bjorken-x. Mit den nCTEQ15 nPDFs als Input bestätigen wir die Relevanz der nichtlinearen Korrekturen, deren Größe mit fallendem x und steigender Massenzahl A wächst, für $x \lesssim 10^{-3}$. Wir zeigen, dass die Quark-Singlet- und Gluon-Distributionen $\Omega(x,Q^2)$ und $G(x,Q^2)$ bei $x = 10^{-5}$ für schwere Kerne nach der nichtlinearen Evolution von $Q_0 = 2\,\mathrm{GeV}$ bis $Q = 10\,\mathrm{GeV}$ verglichen mit der linearen Evolution um $9-15\%$ verringert sind. Wenn abwärts von $Q_0 = 10\,\mathrm{GeV}$ bis $Q = 2\,\mathrm{GeV}$ entwickelt wird, ist der relative Effekt deutlich größer, $\Omega(x,Q^2)$ ist um 40% reduziert und $G(x,Q^2)$ um 140% erhöht. Diese Trends finden sich in den Strukturfunktionen $F_2^A(x,Q^2)$ und $F_L^A(x,Q^2)$ wieder, die nach der Abwärtsentwicklung um 45% reduziert bzw. um 80% erhöht sind. Unsere Ergebnisse zeigen, dass die nichtlinearen Effekte in $F_L^A(x,Q^2)$ am deutlichsten auftreten und für schwere Kerne bereits bei $x \sim 10^{-3}$ erheblich sind.

HK 18.7 Tue 18:45 SCH/A316

Measuring Generalized Distribution Amplitudes in Proton-Antiproton Annihilation with PANDA at FAIR — •Faiza Khalid, Stefan Diehl, and Kai-Thomas Brinkmann — II. Physikalisches Institut, Justus Liebig Universität Gießen

The future PANDA experiment at FAIR with the HESR antiproton beam provides unique possibilities to study the 3D nucleon structure with exclusive channels in $\overline{p}p$ annihilation. One of the channels of interest for the measurement of Generalized Distribution Amplitudes (GDAs) is $\overline{p}p \to \pi^0\gamma$. Simulations at several center-of-mass energies were done for this signal channel ($\overline{p}p \to \pi^0\gamma$) and for the main background channel($\overline{p}p \to \pi^0\pi^0$) to check the feasibility of the measurement. The talk will present the feasibility study for the measurement of the $\cos(\theta)$ dependence of the differential cross-section for $\overline{p}p \to \pi^0\gamma$ at different integrated luminosities. The cross sections have been estimated based on data from the E760 experiment at Fermilab, which is available in a limited kinematic range. Various optimal set of cuts were investigated to reduce the high background in this channel. Results of count rate estimates and estimates of the expected statistical uncertainty are presented. Different event selection cuts have been investigated to optimize the signal to background ratio while

keeping a reasonable reconstruction efficiency. Also presented is the feasibility study of the channel $\overline{p}p \to \pi^0\pi^0$ whose cross-section needs to be measured to subtract the high background in the channel $\overline{p}p \to \pi^0\gamma$.

The work is supported by BMBF and HFHF

HK 19: Nuclear Astrophysics II

Time: Tuesday 17:00–18:30 Location: SCH/A419

Group Report HK 19.1 Tue 17:00 SCH/A419

Neutrino flavor instability and nucleosynthesis associated with charged-current weak interactions in black hole accretion disks — •Zewei Xiong[1], Lucas Johns[2], Meng-Ru Wu[3], Huaiyu Duan[4], Gabriel Martínez-Pinedo[1,5], and Oliver Just[1] — [1]GSI Helmholtzzentrum für Schwerioneneforschung, Darmstadt, Germany — [2]UC Berkeley, CA, USA — [3]Academia Sinica, Taipei, Taiwan — [4]University of New Mexico, Albuquerque, NM, USA — [5]Technische Universität Darmstadt, Germany

Charged-current weak interactions destroy the flavor coherence among the weak-interaction states of a single neutrino. In a dense neutrino gas, however, these collision processes can trigger flavor conversion in cooperation with the strong neutrino-neutrino refraction. We show that the collisional flavor instability can exist in black hole accretion disks. As a result, large amounts of heavy-lepton flavor neutrinos can be produced through flavor conversion, which can have important ramifications in the subsequent evolution of the remnant.

In addition to the charged-current neutrino interactions with nucleons, the neutrino-nucleus interactions can possess larger cross sections in neutron-rich nuclei and affects the r-process nucleosynthesis. We investigate those neutrino-nucleus interactions in black hole accretion disks and show that they can affect electron fraction moderately in specific trajectories with high neutrino fluxes.

Z.X. is supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC Advanced Grant KILONOVA No. 885281).

HK 19.2 Tue 17:30 SCH/A419

Nuclear equation of state from Δ-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 at zero temperature using a set of recently developed Δ-full interactions based on chiral effective field theory that exhibit smaller chiral uncertainties compared to previous calculations using Δ-less potentials. Our computations are carried out in many-body perturbation theory, where we include contributions from nucleon-nucleon forces up to third and three-nucleon forces up second order.

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

HK 19.3 Tue 17:45 SCH/A419

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

We use Gaussian processes as a non-parametric emulator for the nuclear equation of state based on chiral effective field theory interactions and to provide statistical uncertainties based on the effective field theory truncation. Moreover, the Gaussian process enables us to calculate observables that are obtained via thermodynamic derivatives. We use this to calculate properties relevant to neutron stars and properties of symmetric nuclear matter.

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

HK 19.4 Tue 18:00 SCH/A419

Magnetar crusts - influence of the magnetic field on the composition and the unified equation of state — •Yuliya Mutafchieva[1], Zhivko Stoyanov[1], Nicolas Chamel[2], John Michael Pearson[3], and Lyubomir Mihailov[4] — [1]Institute For Nuclear Research And Nuclear Energy, Bulgarian Academy of Sciences, Sofia, Bulgaria — [2]Institute of Astronomy and Astrophysics, Universite Libre de Bruxelles, Brussels, Belgium — [3]Departement de Physique, Universite de Montreal, Montreal, Canada — [4]Institute of Solid State Physics, Bulgarian Academy of Sciences, Sofia, Bulgaria

At the end point of stellar evolution, strongly magnetised neutron stars - magnetars, are not only among the most compact stars in the universe, but also the strongest magnets. These conditions can significantly alter the properties of the outermost regions of a neutron star. We have recently studied the influence of a very strong magnetic field on the equilibrium properties of magnetar crusts when taking into account the Landau-Rabi quantization of electron motion. Both the outer and inner regions of the crust are treated consistently within the framework of the nuclear-energy density functional theory, thus allowing us to calculate their composition and their equation of state in a unified way. Our study covers a wide range of magnetic-field strengths necessary for modelling astrophysical phenomena. Results using accurately calibrated Brussels-Montreal nuclear energy density functionals, which were constructed from generalized Skyrme effective nucleon-nucleon interactions, will be presented.

HK 19.5 Tue 18:15 SCH/A419

Supernova Simulations with Consistent Six Species Neutrino Transport — •Ignacio L. Arbina[1,2], Gabriel Martinez-Pinedo[2,1], and Tobias Fischer[3] — [1]Institut für Kernphysik (Theoriezentrum), Fachbereich Physik, Technische Universit *at Darmstadt, Schlossgartenstraße 2, 64289 Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerioneneforschung, Planckstraße 1, 64291 Darmstadt, Germany — [3]Institute of Theoretical Physics, University of Wroclaw, Pl. M. Borna 9, 50-204 Wroclaw, Poland

Core-Collapse Supernova (CCSN) are expected to explode by the delayed neutrino-driven mechanism. It requires an accurate treatment of the neutrino-matter interactions together with a solution to the neutrino radiation transport for all lepton flavours. Typical implementations usually consider four species neutrino schemes assuming identical distributions for the muon and tau neutrino flavours. However, the conditions shortly after bounce allow for the production of muons as discussed in the studies by Bollig et al. (2017) and Fischer et al. (2020). This muon formation adds new reaction channels in the lepton sector that couple the electron and muon flavours through weak interaction processes. For this purpose, we implement a Boltzmann neutrino transport scheme for the six neutrino species that are evolved consistently with the internal energy, and the electron and muon abundances. We explore the sensitivity to different sets of opacities computed consistently with the underlying equation of state and determine the most important reactions contributing to the muonization of supernova matter.

HK 20: Structure and Dynamics of Nuclei III

Time: Tuesday 17:00–18:45 Location: SCH/A118

Group Report HK 20.1 Tue 17:00 SCH/A118
Recent R3B experiments with radioactive nuclear beams — •Valerii Panin for the R3B-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Planckstraße 1, Darmstadt 64291, Germany

R3B is a versatile experimental setup designed to tackle some of the most forefront problems in modern nuclear physics. The setup is developed within the FAIR project in Darmstadt and it has been extensively used for various experiments over the past few years. The studies conducted thus far include short-range correlations in unstable nuclei, density-dependence of the symmetry energy, helium burning in stars, fission of heavy radioactive nuclei and isospin evolution of single-particle shells. Owing to the radioactive-ion beams provided by the GSI accelerator facility, the involved nuclear reactions can be studied in relativistic energy regime and in some cases also around extremes of nuclear stability. An overview on the R3B experiment, its recent research program and detector upgrades, as well as ongoing developments will be presented.

Group Report HK 20.2 Tue 17:30 SCH/A118
Ab initio structure of neutron-rich calcium isotopes — •Matthias Heinz[1,2,3], Kai Hebeler[1,2,3], Jan Hoppe[1,2], Takayuki Miyagi[1,2], 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

The in-medium similarity renormalization group (IMSRG) has emerged as a flexible and powerful method for the ab initio description of atomic nuclei. Its current standard truncation including up to normal-ordered two-body operators, the IMSRG(2), has been very successful in the description of systems up to mass numbers 100 and beyond. For certain observables, however, the IMSRG(2) truncation is not sufficient and the inclusion of three-body operators, the IMSRG(3), is required.

We apply the IMSRG(3) to neutron-rich calcium isotopes, delivering a more precise many-body treatment of these systems. We find an improved description of the shell-closure at ^{48}Ca. We also discuss sources of observed discrepancies between experiment and theory in the charge radii of these systems.

* Funded by the ERC Grant Agreement No. 101020842.

HK 20.3 Tue 18:00 SCH/A118
Halo-EFT desription of one-neutron halo nuclei with perturbative inclusion of core excitations — •Live-Palm Kubushishi and Pierre Capel — Institute of Nuclear Physics, Johannes Gutenberg-Universität Mainz - Johann-Joachim-Becher Weg 45 D-55099 Mainz, Deutschland.

Halo nuclei are fascinating short-lived nuclear objects found near the dripline. In standard reaction models, halo nuclei are usually described as an inert core with one or two weakly bound neutrons. However, some breakup data suggest that the excitation of the core to its excited states to have a significant influence in the dynamics of the reaction [1]. In order to shed more light on this phenomenon, we study the typical one-neutron halo nucleus Be11 and we propose a simple structure model of it based on the rigid rotor model. We assume the core to be weakly deformed, which we treat at the first order of perturbations to couple it to its 2+ first excited state. In this way, we explicitly account for core excitations as a new degree of freedom while still describing the interaction between the core and the neutron in halo-EFT [2]. Our calculations were performed using the calculable R-Matrix method on a Lagrange mesh. We have been able to reproduce with a good agreement, the coupled-channels results [3], improve the halo-EFT model [2] and bring another physical insight on the structure of the bound states of Be11.

[1] R. de Diego et al., Phys. Rev. C 95, 044611 (2017).
[2] P. Capel et al., Phys. Rev. C 98, 034610 (2018).
[3] F.M. Nunes et al., Nucl. Phys. A 596, 171 (1996).

HK 20.4 Tue 18:15 SCH/A118
Total Reaction Cross-Section Measurements in the S444 Commissioning Experiment for R3B — •Lukas Ponnath[1], Roman Gernhäuser[1], Tobias Jenegger[1], Philipp Klenze[1], and Thomas Aumann[2] for the R3B-Collaboration — [1]Technische Universität München — [2]Technische Universität Darmstadt

The R3B (Reactions with Relativistic Radioactive ion Beams) experiment at the research facility FAIR, currently under construction in Darmstadt, enables kinematically complete reaction studies for the most exotic nuclei.

The S444 commissioning experiment for R3B, performed in the FAIR Phase-0 campaign in 2019, was the first operation of many new R3B detectors in a common setup. With a stable 12C beam and a set of different beam energies ranging from 400AMeV to 1AGeV we challengend this large installation around the GLAD magnet using the 12C(p,2p)11B benchmark reaction.

During this successful commissioning we could measure the energy-dependence of total reaction cross-sections of a 12C beam on a 12C target, which is poorly known for energies above 400AMeV. This is an important input for current calculations based on the eikonal reaction theory in order to validate in-medium extensions of a parameter-free Glauber model.

I will present the current status and preliminary results of the analysis and discuss the technique and evaluated error budget for the different steps. (supported by BMBF 05P19WOFN1 & 05P21WOFN1)

HK 20.5 Tue 18:30 SCH/A118
Improving Skryme energy density functionals with chiral effective field theory — •Lars Zurek[1,2], Scott K. Bogner[3], Richard J. Furnstahl[4], Rodrigo Navarro Pérez[5], Nicolas Schunck[6], and Achim Schwenk[1,2,7] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Facility for Rare Isotope Beams and Department of Physics and Astronomy, Michigan State University — [4]Department of Physics, The Ohio State University — [5]Department of Physics, San Diego State University — [6]Nuclear and Data Theory group, Nuclear and Chemical Science Division, Lawrence Livermore National Laboratory — [7]Max-Planck-Institut für Kernphysik, Heidelberg

Nuclear energy density functionals (EDFs) successfully reproduce experimental binding energies but due to their phenomenological nature it is at present unclear how to improve the currently established forms. We construct hybrid EDFs by starting from a standard Skyrme functional, here considered to represent short-range physics, and adding explicitly pion exchanges derived from chiral effective field theory. Pions are included at the Hartree-Fock level without introducing further fit parameters to the functional. When going beyond next-to-leading order in the chiral expansion the functionals are significantly improved compared to a reference Skyrme EDF constructed with the same protocol. We compare the different functionals and analyze their performance.

* Funded by BMBF Contract No. 05P21RDFNB.

HK 21: Structure and Dynamics of Nuclei IV

Time: Tuesday 17:00–18:45 Location: SCH/A215

Group Report HK 21.1 Tue 17:00 SCH/A215
Recent Highlights of the DESPEC Experiment at FAIR Phase-0 — •Nicolas Hubbard for the DESPEC-Collaboration — Institut für Kernphysik, Technische Universitität Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschug, Darmstadt, Germany — Helmholtz Forschungsakademie Hessen für FAIR (HFHF) GSI Campus Darmstadt, Darmstadt, Germany

The DESPEC (DEcay SPECtroscopy) experiment is part of the NUS-

TAR pillar of FAIR and involves the measurement of decay properties of exotic radioisotopes far away from the valley of stability, in order to understand the nuclear force and the origin of the elements. This group report will report on the recent activities during 2022 of the DESPEC collaboration, including recent technical developments and preliminary results from two physics experiments performed at GSI in Darmstadt as part of the FAIR Phase-0 programme: The study of isomeric and beta decays of the $N = 126$ Nuclei ^{202}Os and ^{203}Ir, and the investigation of the β-strength crossing $N = 126$ and the formation of the 3rd r-process abundance peak via total absorption spectroscopy

HK 21.2 Tue 17:30 SCH/A215

Nuclear shell structure studies in the vicinity of doubly magic ^{100}Sn and ^{132}Sn — •Michał Mikołajczuk[1,2] and Magdalena Górska-Ott[2] — [1]Faculty of Physics, University of Warsaw, Poland — [2]GSI, Darmstadt, Germany

In the field of nuclear structure physics, the neighborhood of doubly magic nuclei such as ^{100}Sn and ^{132}Sn remains one of the most intriguing regions along the Segrè chart. Over the last few decades many experimental efforts were made to acquire data neccessary to describe and understand shell structure evolution in the aforementioned regions. Based on experimental data, the state-of-the-art shell model calculations provide further insight into the properties of nuclear structure, broadening our understanding of nucleon-nucleon interaction. This presentation will discuss results of employing well established interactions such as JUN45 [1], Gross-Frenkel [2] and MHJ [3], to neutron closed shell nuclei, namely ^{98}Cd, ^{130}Cd, ^{96}Pd, ^{128}Pd. Calculation results are compared with up to date available experimental data and validity of the used models and obtained conclusions will be discussed.

[1] M. Honma et al., PRC80, 064323 (2009).
[2] R. Gross and A.Frenkel, Nucl. Phys. A267, 85 (1976).
[3] M. Hjorth-Jensen et al., Phys. Repts, 267 (1995).

HK 21.3 Tue 17:45 SCH/A215

Investigation of shape coexistence in ^{116}Te via lifetime measurements — •Franziskus v. Spee[1], Marcel Beckers[1], Andrey Blazhev[1], Arwin Esmaylzadeh[1], Felix Dunkel[1], Christoph Fransen[1], Jan Jolie[1], Lisa Kornwebel[1], Casper-David Lakenbrink[1], and Claus Müller-Gatermann[2] — [1]Institut für Kernphysik, Cologne, Germany — [2]Physics Division, Argonne National Laboratory, Argonne, Illinois, USA

In mid-shell Te isotopes, hints for shape coexistence have been found [1]. However, experimental evidence is scarce, since experiments on neutron-deficient Te isotopes are challenging. Experimental data on transition strengths in ^{116}Te could give further insight. Therefore, a recoil distance Doppler shift experiment was performed to investigate transition strengths between low-lying states in ^{116}Te at the FN-Tandem accelerator facility of the IKP Cologne. To populate low-lying, low-spin states, the reaction ^{112}Sn(^{12}C,^{8}Be)^{116}Te was used. The γ rays were detected in coincidence with α particles stemming from the decay of ^{8}Be. To detect the α particles, silicon particle detectors were used. These were covered with aluminum foil that prevented any heavier ions to penetrate the detector. This results in very clean γ spectra even though the cross section for the reaction of interest is rather low. This allowed for the first-time determination of lifetimes of low-lying off-yrast states. This work was supported by the Deutsche Forschungsgemeinschaft (DFG) under contract numbers FR 3276/2-1 and DE 1516/5-1.

[1] P. Garrett *et al.*, Prog. Part. Nucl. Phys. **124** (2022) 103931.

HK 21.4 Tue 18:00 SCH/A215

Exploring the isoscalar - isovector symmetries in 94Ru, 95Rh, 94Pd and 96Pd nuclei by means of lifetime measurements — •Biswarup Das for the DESPEC-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH - Darmstadt, Germany

The nuclei of interest were produced in the projectile fragmentation of a 850 MeV/nucleon 124Xe beam impinging on a 4 g/cm2 9Be target, as the first of a series of commissioning *FAIR-0* experiments with the DESPEC experimental setup at the GSI- FAIR facility in Germany. The isomeric state of 94Pd and 96Pd were populated directly, whereas the β-decay of 95Pd populates the isomeric states of 94Ru and 95Rh. The nuclei were implanted on an active stopper, AIDA, and the γ-rays of interest were detected using the six triple cluster HPGe detectors as well as 36 LaBr3(Ce) detectors of the FAst Timing Detector Array (FATIMA). Direct lifetime measurements via γ- γ coincidences using FATIMA has been applied to determine the lifetimes for the yrast states below the isomer of the mentioned nuclei. The Generalised Centroid Difference (GCD) method was implemented for the lifetimes residing in the picosend regime. The transition rates were obtained from the measured lifetimes and the BE(2) values were compared with the standard shell model calculations. With the remeasured 96Pd lifetimes the new results for the 94Ru nucleus was successfully described using the $\Delta\nu$=2 seniority admixture allowed in the fpg model space using the Jun-45 interaction , on the other hand a large anomaly from the seniority scheme was found for the 95Rh.

HK 21.5 Tue 18:15 SCH/A215

Structural investigation of neutron-deficient ^{168}W — •Christoph Fransen[1], Lisa Kornwebel[1], Kalle Auranen[2], Marcel Beckers[1], Mike Carpenter[3], Tuomas Grahn[2], Paul Greenlees[2], Rauno Julin[2], Jan Jolie[1], Filip G. Kondev[3], Casper-David Lakenbrink[1], Claus Müller-Gatermann[1,3], Darek Seweryniak[3], Franziskus von Spee[1], Nigel Warr[1], and Shaofei Zhu[3] — [1]IKP, Univ. of Cologne, Germany — [2]JYFL, Jyväskylä, Finland — [3]Argonne Natl. Lab, Illinois, USA

In several neutron deficient nuclei in the A=180 region both shape coexistence and rapid shape transitions were identified. Further, $B(E2;4_1^+ \rightarrow 2_1^+)/B(E2;2_1^+ \rightarrow 0_1^+) = B_{4/2}$ ratios < 1 were found in some neutron deficient Os–W–Pt nuclei far from closed shells. This cannot be explained with any collective model. Shape coexistence could be an explanation, but there are no such cases known so far. Older data [1] yield that ^{168}W is just at the transition point from "normal" collectivity to the "island" of nuclei with $B_{4/2} < 1$. However, these data might suffer from assumptions on side feeding of the related states. Therefore, and to learn on the structural evolution within the yrast band of ^{168}W, we performed an experiment with the recoil distance Doppler-shift technique on ^{168}W at Argonne National Laboratory with the GAMMASPHERE spectrometer to determine transition strengths from level lifetimes using $\gamma\gamma$ coincidences. We present these data with respect to rapid shell evolution in this region.

Supported by the DFG, grant Nos. FR 3276/2-1 and DE 1516/5-1.

[1] G.D. Dracoulis et al. Phys. Rev. C 29, 1576 (1984)

HK 21.6 Tue 18:30 SCH/A215

Isomer and excited-state lifetimes around ^{190}W * — •Sultan Alhomaidhi[1,2], E. Sahin[1,2], V. Werner[1], P.H. Regan[3], J. Jolie[4], N. Pietralla[1], and J. Gerl[2] — [1]IKP, TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]U Surrey, UK — [4]IKP, U Köln, Germany

In March 2021, the DESPEC experiment S452 was performed at GSI. The focus of the experiment was to measure the lifetimes and energies of exited states of neutron-rich isotopes in the A$\sim$190 mass region, to probe a predicted [1,2] prolate-oblate shape transition. The experimental setting allowed us to investigate the single-particle structures of isomers and connect their decays to the shape evolution. The main nuclei of interest, ^{189}Ta and ^{190}W, were populated by the fragmentation of a ^{208}Pb primary beam impinging on a ^{9}Be target. The cocktail beam was separated and identified using FRS to implant the nuclei of interest in AIDA. The γ rays from the implanted ions were detected by 36 $LaBr_3$(Ce) detectors of FATIMA and 2 EUROBALL cluster detectors, surrounding AIDA. Data obtained in this experiment is analyzed on an event-by-event basis, for which the analysis is in progress. An overview of the DESPEC setup, the analysis procedures and preliminary results of the isomeric lifetime of ^{189}Ta and the B(E2) strength of the first 2^+state of ^{190}W will be presented in the conference.

[1] J. Jolie et al., Phys. Rev. Lett. 89, 182502 (2002).
[2] J. Jolie and A. Linnemann, Phys. Rev. C 68, 031301(R), (2003).

* Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grants 05P21PKFN1 and 05P21RDFN1.

HK 22: Outreach (joint session HK/T)

Time: Tuesday 17:00–18:45 Location: SCH/A252

HK 22.1 Tue 17:00 SCH/A252

Förderung des kritischen Denkens durch Teilchenphysikunterricht: Chancen und Herausforderungen — •Farahnaz Sadidi und Gesche Popsiech für die Netzwerk Teilchenwelt-Kollaboration — Professur für Didaktik der Physik, TU Dresden

Kritisches Denken (KD) ist eine der wünschenswerten Fähigkeiten, die in der Schule vermittelt werden sollten. Das Fehlen einer klaren, durch empirische Befunde gestützten Theorie für die Entwicklung eines fachspezifischen Unterrichts zur Förderung des kritischen Denkens der SchülerInnen stellt die Lehrkräfte jedoch vor große Herausforderungen. Um diese Lücke zu schließen, wurden im Rahmen eines Promotionsprojekts die Gestaltungsprinzipien für einen Teilchenphysikunterricht zume Thema Antimaterie für SchülerInnen der Klassen 10, 11 und 12 nach dem Ansatz der Design-Based Research (DBR) entwickelt, um KD zur fördern. In der Hauptstudie wurde der Antimateriekurs in 3 Klassen in verschiedenen Bundesländern Deutschlands durchgeführt. Die Daten wurden induktiv ausgewertet, um die Lernprozesse der SchülerInnen zu identifizieren. Die Ergebnisse zeigten die Effektivität des Antimateriekurses bei der Förderung der KD-Fähigkeiten der SchülerInnen und offenbarten auch die Herausforderungen, denen die SchülerInnen beim kritischen Denken gegenüberstehen. Die in dieser Studie angewandten und empirisch getesteten Gestaltungsprinzipien können für die Entwicklung anderer fachspezifischer Unterrichtseinheiten zur Förderung des KD verwendet werden.

HK 22.2 Tue 17:15 SCH/A252

Vorstellung einer Netzwerk Teilchenwelt Masterclass über das MuonPi-Projekt — •Lara Dippel, Hans-Georg Zaunick und Kai-Thomas Brinkmann für die Netzwerk Teilchenwelt-Kollaboration — II. Physikalisches Institut, Justus-Liebig-Universität, Giessen

Das MuonPi-Projekt ist ein verteiltes Netzwerk von Raspberry-Pi basierten Detektorstationen zur Messung von Myonenschauern, die bei der Wechselwirkung ultrahochenergetischer, kosmischer Primärstrahlung mit der Erdatmosphäre ausgelöst werden. Die Detektoren werden mit geringen Anschaffungskosten angeboten, sodass interessierte Laien einen Einblick in das Forschungsgebiet der Astroteilchenphysik gewinnen können. Für interessierte Schüler:innen wird im Rahmen des *Netzwerks Teilchenwelt* eine Masterclass angeboten, die durch verschiedene Experimente mit MuonPi-Detektoren die Grundlagen der hochenergetischen Teilchenphysik einführen soll. Dabei können sowohl Themen aus der theoretischen Physik, wie z.B. Konzepte der speziellen Relativitätstheorie und Teilchenzerfälle, als auch experimentelle Messtechniken vermittelt werden. Dazu stehen sowohl betreute Kurzzeitexperimente an Schulen als auch die angeleitete Durchführung von Langzeitversuche mit einer eigenen Station zur Verfügung.

HK 22.3 Tue 17:30 SCH/A252

A new Nuclear Astrophysics Masterclass - A Journey through the Elements — •Hannes Nitsche[1], Uta Bilow[1], Lana Ivanjek[1], Kai Zuber[1], and Daniel Bemmerer[2] for the Netzwerk Teilchenwelt-Collaboration — [1]Technische Universität Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf

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, a new Masterclass on Nuclear Astrophysics has 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 Masterclass picks up this didactic potential. It includes the analysis of measurement data from a nuclear reaction studied at the Felsenkeller Laboratory in Dresden. Furthermore, the processes behind nucleosynthesis are reconstructed with the help of various gamification elements. The talk will present the teaching materials, the didactic concept as well as the experiences made so far in the implementation of the Masterclass.

HK 22.4 Tue 17:45 SCH/A252

The Particle Therapy Masterclass for targeted education and outreach on real-world application of fundamental physics — •Niklas Wahl for the Netzwerk Teilchenwelt-Collaboration — Deutsches Krebsforschungszentrum (DKFZ), Heidelberg, Germany

The Particle Therapy Masterclass (PTMC) was established in 2019 by the piloting institutes CERN, DKFZ and GSI to showcase how fundamental physics can translate to applications with directly visible societal benefit. Over a day the PTMC introduces how fundamental physics research on accelerators as well as particle, hadron and detector physics enable cancer treatments utilizing the Bragg-peak. A hands-on session with the open source toolkit "matRad" facilitates interactive treatment planning for participants using open, virtual patient data.

In the following, the PTMC was integrated into the International Physics Masterclasses by IPPOG targeting high school students with more than 40 international course sessions during spring 2022. With Netzwerk Teilchenwelt, customized Masterclasses were held in fellowship meetings of senior grade students, intermediate level school project days or as interactive outreach events to the general public. Integration into university level courses at DKFZ was also successful.

Held over the last years in Germany, these sessions showed that the PTMC can be adapted to different educational levels from the general public to undergraduate students and is especially suited for online courses. The PTMC thus proved to be a flexible and interactive tool in education and outreach for different target groups to show directly visible "real-world" impact of fundamental physics research.

HK 22.5 Tue 18:00 SCH/A252

Machine Learning Masterclass - Physik trifft Daten — •Maike Hansen[1], Johanna Rätz[2] und Barbara Valeriani-Kaminski[1] — [1]Physikalisches Insitut, Universität Bonn — [2]Argelander-Institut für Astronomie, Universität Bonn

"Wieso sollen wir jetzt was programmieren? Ist doch Physik und kein Informatik..." - Schüler:innen ist kaum bewusst, welche zentrale Bedeutung Datenauswertung und Maschinelles Lernen in der modernen Physik sowie in anderen Naturwissenschaften haben. Die Machine Learning (ML) Masterclass vom Netzwerk Teilchenwelt, der Universität Münster und PUNCH4NFDI fördert das fächerübergreifende Denken und macht moderne Datenverarbeitung in der Teilchenphysik erlebbar. Neben dem Standardmodell der Teilchenphysik und der Funktionsweise eines Teilchendetektors geht es bei der ML Masterclass um den Einsatz Neuronaler Netze bei der Datenauswertung. Angeleitet durch junge Wissenschaftler:innen programmieren die Schüler:innen nach interaktiven Einführungsvorträgen und Übungen in einer Browser-basierten Programmierumgebung das Neuronale Netz, um so einen authentischen Datensatz aus der Teilchenphysik auszuwerten. Einzelne Schulpraktikant:innen und zwei Lerngruppen haben die Masterclass bereits getestet und Feedback zur Weiterentwicklung gegeben. In diesem Vortrag werden der aktuelle Entwicklungsstand und die bisherigen Erfahrungen mit der ML Masterclass vorgestellt.

HK 22.6 Tue 18:15 SCH/A252

Belle II Masterclass - Teilchenidentifikation und Dunkle Materie mit interaktiven Jupyter Notebooks — •Jonas Eppelt, Torben Ferber, Filipp Gostner, Isabel Haide, Alexander Heidelbach und Lea Reuter — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

Eine Masterclass im Rahmen des Netzwerk Teilchenwelt Projektes soll Schüler:innen physikalische Konzepte näher bringen und das Interesse an der Physik wecken. Dafür wurde am Karlsruher Institut für Technologie in der Belle II Gruppe eine Masterclass entwickelt, in welcher die Interaktionen der Teilchen mit Detektorkomponenten simuliert werden. Die Teilnehmer:innen können mithilfe interaktiver Jupyter Notebooks Spuren in einem vereinfachten Spurdetektor rekonstruieren, Energiedepositionen im elektromagnetischen Kalorimeter von Belle II zu einem Cluster zusammenfassen und durch zusätzliche Informationen aus dem Belle II-Myonendetektor Teilchen identifizieren. Die Ausnutzung von Energie- und Impulserhaltungssätze ermöglicht den Schüler:innen zudem, fehlender Energie Teilchenhypothesen zuzuordnen. Wir präsentieren das Konzept und die technische Umsetzung unserer Masterclass.

HK 22.7 Tue 18:30 SCH/A252

Higgs Entdeckung als ein Masterkurs für Fortgeschrittene — •Artur Monsch und Günter Quast — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Im Rahmen des Vortrags wird ein Konzept einer fortgeschrittenen Masterclass vorgestellt, welche an die bestehende CMS Masterclass anknüpft und diese um zusätzliche Themen erweitert. Im Fokus stehen dabei interessierte Schülerinnen und Schüler der Oberstufe, welche Interesse daran haben, Ideen und Methoden der experimentellen Teilchenphysik anhand tatsächlicher Messdaten kennenzulernen. Hierzu werden die vom CERN Open Data Portal bereitgestellten Mess- und Simulationsdaten verwendet, welche auch zur Entdeckung des Higgs-Bosons ausgewertet wurden. Diese Entdeckung können die Schülerinnen und Schüler dann durch die Bearbeitung eines interaktiven, auf der Programmiersprache Python basierendem, Jupyter-Notebook selbst erleben. Ausgehend von aufbereiteten Originaldaten aus dem 'goldenen Zerfallskanal' $H \to ZZ \to 4\ell$ lernen Schülerinnen und Schülern grundlegende Konzepte aus der Physik und der Datenauswertung kennen, wie die Bedeutung der invarianten Masse oder die Notwendigkeit einer Datensatz-Bereinigung. Die anschließende Frage, inwieweit der beobachtete Überschuss in der Verteilung der invarianten Masse dem vorhergesagtem Higgs Boson der Masse $125\,\mathrm{GeV}/c^2$ entspricht und ob die gewonnene Beobachtung signifikant ist, lässt sich mit den kennengelernten Methoden auch auf Themengebiete außerhalb der Teilchenphysik anwenden.

HK 23: Invited Talks III

Time: Wednesday 11:00–12:30 Location: HSZ/0002

Invited Talk HK 23.1 Wed 11:00 HSZ/0002

High-Precision Laser Spectroscopy of C^{4+} for an All-Optical Determination of the Nuclear Charge Radius — •Phillip Imgram[1], Kristian König[1], Bernhard Maass[2], Patrick Müller[1], and Wilfried Nörtershäuser[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Argonne National Laboratory, Chicago, IL, USA

Nuclear charge radii of radioactive isotopes are typically referenced to a stable nucleus in the isotopic chain through an atomic isotope shift measurement. In some cases, this can limit the uncertainty of the obtained charge radii of radioactive nuclei to the uncertainty of the reference measurements from elastic electron scattering or muonic atom spectroscopy. To overcome this limit in light mass nuclei like ^{10,11}B, an all-optical approach for the charge radius determination purely from laser spectroscopy measurements and non-relativistic QED calculations was tested with the well-known nucleus of ^{12}C through laser excitation of helium-like $^{12}C^{4+}$ from the metastable $2\,^3S_1$ state with a lifetime of 21 ms to the $2\,^3P_J$ states. The high-precision collinear laser spectroscopy of $^{12}C^{4+}$ has been performed at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) at the Institute of Nuclear Physics of TU Darmstadt. This contribution will give an overview of the project and present the measured transition frequencies along with the extracted all-optical nuclear charge radius of ^{12}C. This project is supported by DFG (Project-ID 279384907 - SFB 1245).

Invited Talk HK 23.2 Wed 11:30 HSZ/0002

ALICE determines the transparency of our galaxy to the passage of antihelium nuclei — •Laura Serksnyte for the ALICE Germany-Collaboration — Technical University of Munich

The measurements of the inelastic cross sections of antihelium-3 nuclei were performed by employing the ALICE detector material as a target. The antimatter-to-matter ratio and TOF-to-TPC matching methods were used in pp and Pb-Pb collisions, respectively. These, for the first time, measured inelastic cross sections have been implemented in the GALPROP propagation model to estimate the losses in the antihelium-3 cosmic ray fluxes due to inelastic interactions with the interstellar medium. Indeed, some dark matter candidates, such as the WIMPs, are expected to annihilate in our galaxy and produce, among other particles, light antinuclei, which can be observed as cosmic rays. However, the same antinuclei can also be produced in ordinary cosmic ray collisions with the interstellar gas. Thus, precise modelling of signal and background cosmic ray fluxes, including the inelastic losses in the interstellar medium, is required to draw conclusions from future antinuclei cosmic-ray measurements.

The results of this interdisciplinary study by ALICE allowed the determination of the transparency of our galaxy to the propagation of the antihelium-3 from dark matter annihilation and ordinary cosmic ray collisions, and to demonstrate that antihelium-3 nuclei are a promising probe for indirect dark matter searches. This research was funded by BMBF Verbundforschung (05P21WOCA1 ALICE) and the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

Invited Talk HK 23.3 Wed 12:00 HSZ/0002

The world of light and strange mesons: from spectroscopy puzzles to low energy QCD phenomena — •Stephan Paul for the COMPASS-Collaboration — Technical University of Munich, Physics Department, Garching, Germany — Max-Planck-Institute for Physics, Munich, Germany

After 20 years of data taking, the COMPASS experiment looks back on important contributions in the fields of nucleon spin-structure, light-hadron spectroscopy, and measurements related to very-low-energy QCD. Here, we report new insights into the mesonic excitation spectrum based on the world's largest data set, which provides access to all iso-vector mesons in a self-consistent manner using novel analysis techniques. In addition to excitations with high angular momentum, we have unraveled exotic mesons and discovered new mesonic structures even at low masses whose interpretation is still unclear. At very low energies, QCD can be described by effective interactions in the framework of chiral perturbation theory. We have challenged numerous precision calculations with high accuracy even in multidimensional analyses. COMPASS has proven to be a versatile precision instrument allowing for studies of QCD with high energy beams complementary to low energy facilities.

HK 24: Instrumentation VII

Time: Wednesday 14:00–15:30 Location: SCH/A251

Group Report HK 24.1 Wed 14:00 SCH/A251

Advances in CMOS MAPS for the next generation of collider detectors — •Bogdan-Mihail Blidaru for the ALICE Germany-Collaboration — Heidelberg University, Germany

CMOS Monolithic Active Pixel Sensors (MAPS) are continuously proven to comply with the severe constraints set by present and future collider detectors which require high granularity, low mass, excellent spatial resolution, as well as moderate radiation hardness and timing. Moreover, their ease of integration and cost effectiveness for large areas makes them alluring for almost all particle detection applications.

The first large scale MAPS-based silicon tracker is the new 10 m^2 ALICE Inner Tracking System (ITS2). Results from its first in-beam operation at the LHC confirm the excellent performance of the single ALPIDE MAPS chips that span its surface.

To profit from the advances in the field of CMOS technology, the ITS collaboration is pioneering the usage of bent, wafer-scale pixel sensors for the replacement of the innermost tracking layers of ITS2 in the next upgrades. This roadmap is accompanied by a change in the technology node from 180 nm (ALPIDE) to 65 nm which allows the stitching of sensors and paves the path to an almost massless detector.

This contribution will give an overview of some of the ongoing developments in the field of CMOS MAPS, specifically the research done in the context of the ALICE collaboration for its future upgrades. Performance of bent sensors, 65 nm test structures and progress towards wafer-scale sensors, as well as the motivation of building such devices from a physics and detector performance point of view will be reviewed.

HK 24.2 Wed 14:30 SCH/A251

Towards the Pre-Production Module of the Largest Station

of the CBM MVD — •Franz Alexej Matejcek for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD) of the Compressed Baryonic Matter Experiment (CBM) consists of four planar stations, each built of four independent quadrants (modules), that are equipped with dedicated CMOS pixel sensors (MIMOSIS) and will operate in vacuum. Each detector plane features a material budget x/X_0 ranging between 0.3 and 0.5 %, depending on size. The sensors are 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 well below 0 °C. The sensor are then wire-bonded to dedicated flex cables connecting the front end electronics which are 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 focus on integration aspects of the pre-production module of the largest quadrants.

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

HK 24.3 Wed 14:45 SCH/A251

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

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 μm thin sensor featuring 1024×504 pixels with a pitch of 27×30 μm^2 will combine a spatial resolution of ~ 5 μm with a time resolution of 5 μs and provide a peak rate capability of 80 MHz/cm^2. The first full size prototype, MIMOSIS-1, was tested with beams at CERN, DESY, COSY and GSI. Sensor performance including detection efficiency, spatial resolution and fake hit rate was tested for 12 different combinations of pixel micro-circuits and sensing elements. Moreover, the sensor tolerance to radiation doses of up to 5 MRad and 3×10^{14} n$_{eq}$/cm^2 was evaluated. The design and technology of the sensor is introduced and results from the beam tests are shown.

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

HK 24.4 Wed 15:00 SCH/A251

Beam test studies of bent MAPS for ALICE ITS3 — •Lukas Lautner for the ALICE Germany-Collaboration — Technische Universität München — CERN

Bent Monolithic Active Pixel Sensors (MAPS) provide the basis for the next generation of ultra low material budget, fully cylindrical tracking detectors. In this contribution, results of beam campaigns with 5.4 GeV electrons will be presented. They verify the performance of bent 50 μm thick ALPIDE chips in terms of efficiency and space point resolution after bending them to the ALICE ITS3 radii of 18, 24, and 30 mm. In particular, an efficiency larger than 99.9% and a space-point resolution of approximately 5 μm are observed, both in line with the nominal operation of flat ALPIDE sensors. These values are found to be independent of the bending radius and thus demonstrate the feasibility of the planned ITS3 detector in crucial aspects.

HK 24.5 Wed 15:15 SCH/A251

Test and characterization of an experimental apparatus with bent MAPS and CsI scintillators — •Laszlo Varga[1,2], Christopher Ehrich[1], Tobias Jenegger[1,2], Lukas Lautner[1,3], Lukas Ponnath[1], Isabella Sanna[1,3], Berkin Ulukutlu[1], Roman Gernhäuser[1], and Laura Fabbietti[1] for the ALICE Germany-Collaboration — [1]Technische Universität München, Germany — [2]Excellence Cluster ORIGINS, Garching, Germany — [3]European Organisation for Nuclear Research (CERN), Geneva, Switzerand

Particle detectors based on Monolithic Active Pixel Sensors (MAPS) provide the basis for the next generation of vertex detectors with ultra low material budget and truly cylindrical geometry. Arrays of sensor elements stitched into wafer-scale and curved in a barrel geometry serve as the next upgrade of the inner tracking system (ITS3) of the ALICE experiment at CERN. A test environment hosting six bent sensors in the uITS3 geometry and their read out synchronized with CsI scintillator crystals has been recently employed in the test beam experiment at the Bronowice Cyclotron Facility (CCB) in Poland.
In this talk, the sensors technique, the experimental setup and preliminary results of the CCB experiment will be discussed.
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 25: Instrumentation VIII

Time: Wednesday 14:00–15:30 Location: SCH/A.101

HK 25.1 Wed 14:00 SCH/A.101

Bending Losses in Scintillating-Plastic Fibers* — Christian Dreisbach, Karl Eichhorn, Jan Friedrich, Igor Konorov, Martin Losekamm, Stephan Paul, •Alicia Pechan, and Thomas Pöschl — Technische Universität München, Physik-Department E18, Garching, Germany

The AMBER experiment at CERN's Super Proton Synchroton aims to measure the proton radius in high-energy elastic muon-proton scattering. At the Technical University of Munich, we develop a scintillating-fiber hodoscope to provide precise time information for the incoming and outgoing muons. Each detector consists of four layers of 500-μm scintillating-plastic fibers read out by silicon photomultiplier (SiPM) arrays.

The detector layout requires bending of the fibers towards the SiPMs, resulting in signal-height variations due to the associated bending losses. To characterize this effect, we performed a dedicated experiment to study the dependence of the losses on the bending radius for the scintillating fibers we use. In this contribution, we present the experimental setup and the results of this investigation.

*funded by the DFG under Germany*s Excellence Strategy - EXC2094 - 390783311 and BMBF Verbundforschung (05H21WORD1 HighD)

HK 25.2 Wed 14:15 SCH/A.101

Simulation framework for the digitisation module of scintillators and its implementation in NeuLAND — •Yanzhao Wang[1], Jan Mayer[1], Igor Gasparic[2], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]GSI Helmholtzzentrum für Schwerionenforschung

The New Large-Area Neutron Detector NeuLAND, as a part of the R^{3}B experiment in FAIR, aims at providing a high detection efficiency and spatial-temporal resolution of the neutrons generated by the nuclear reaction from the high-intensity radioactive beam[1]. Simulations of the interactions between the neutrons and NeuLAND and its digitised output signals are imperative for the development of its event reconstruction algorithm.
In this talk, we are introducing a simulation framework and its implementation on the digitising module TAMEX most lately used in NeuLAND. Light yields of the scintillators are transformed into the actual energy values and time stamps of the particle interactions, taking into account multiple physical processes, such as light attenuation, PMT saturation, signal pile-up, the couplings between different PMT outputs and the variations among scintillators and digitiser channels. Additionally, the generic interface within the framework leaves a huge potential for similar implementations on different scintillation detectors in R^{3}B.
Supported by the BMBF (05P21PKFN1).
[1] K. Boretzky *et al.*, Nucl. Instrum. Methods Phys. Res. A1014 (2021) 165701

HK 25.3 Wed 14:30 SCH/A.101

Towards a spatially resolving detector for ultra-cold neutrons — •Konrad Franz for the tauSPECT-Collaboration — Department Chemie, Johannes Gutenberg Universität Mainz

One of the challenges in ultra-cold neutron (UCN) detection is to con-

vert the electrically inert neutron into an electrical signal. In the presented detector design this is achieved by employing a conversion layer stacked with a scintillation layer, in which the neutron induced α-particle generates a light pulse. This scintillation light is then guided onto an array of silicon photomultipliers (SiPMs). Spatial resolution can be achieved by reading out each SiPM individually. A main advantage of this setup is its compatibility with high magnetic fields, which allows for in-situ detection of UCNs in such environments. Combining spatial resolution with a magnetic field gradient enables UCN energy resolution.
The talk will give an overview of the detector design and will outline its advantages. Furthermore, the current status of the development will be presented and the main challenges moving forward will be discussed.

HK 25.4 Wed 14:45 SCH/A.101

A normalization detector for the neutron lifetime experiment τSPECT — •Martin Engler for the tauSPECT-Collaboration — Department of Chemistry, Johannes Gutenberg University, Mainz

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 individual measurements have 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, detecting light from a ^{10}B coated ZnS:Ag scintillator coupled to an array of silicon photomultipliers, has been designed and built.

This talk will cover the detectors design, challenges, as well as the results of the first runs.

HK 25.5 Wed 15:00 SCH/A.101

A neutron trigger detector for pulsed neutron sources — •Julian Auler for the tauSPECT-Collaboration — Institut für Physik, Johannes Gutenberg-Universität, Mainz

A variety of experiments investigating properties of neutrons can be performed at pulsed source facilities like the research reactor TRIGA Mainz. A typical problem faced by these experiments is the non-availibility of a reliable facility-provided trigger signal in coincidence with the neutron production. Here we present the design, implementation and experimental results of a neutron pulse detector that provides a coincident trigger signal for precise experimental timing.

The described neutron pulse detector is based on a multilayer design with a ^{10}B top layer (~ 80 nm) employing the ^{10}B(n,α)^{7}Li reaction and deposited on a scintillator foil (0.25 mm) with a one-sided coating of ZnS(Ag) as scintillation layer. A silicon photomultiplier (SiPM) is used as photosensor, which makes the detector suitable for use in experimental areas with high magnetic fields and at the same time has the advantage that no high-voltage supply is required.

HK 25.6 Wed 15:15 SCH/A.101

Polyethylene Naphthalate Based Neutron and Radon Detectors — •Kim Tabea Giebenhain, Hans-Georg Zaunick, Roman Bergert, and Kai-Thomas Brinkmann — Justus-Liebig-Universität, Giessen, Germany

Polyethylene naphthalate (PEN) is a material with intrinsically scintillating capabilities. Using a thin foil of PEN together with a SiPM array has shown to be an excellent combination for alpha detection and therefore as a radon detection device. Coupled with a BNNT mat with a high ^{10}B content, it was tested for its capabilities as a neutron detector in the thermal energy range.
Supported by BMBF via EFRE.

HK 26: Instrumentation IX

Time: Wednesday 14:00–15:30 Location: SCH/A117

Group Report HK 26.1 Wed 14:00 SCH/A117

Status of the readout system for the Micro-Vertex-Detector of the PANDA experiment — Kai-Thomas Brinkmann, •Marvin Peter, and Hans-Georg Zaunick — Justus-Liebig-Universtität Giessen, Germany

The Micro-Vertex-Detector (MVD) is situated in the center of the PANDA experiment and will take on an important role in particle tracking and identification. A readout system for the silicon strip detectors is currently in development and being tested in combination with the detectors. This talk will give an overview of the readout system of the MVD strip detector prototypes. *gefördert durch BMBF

HK 26.2 Wed 14:30 SCH/A117

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] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Helmholtz Institute Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is a very precise measurement of the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}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 will be built at the future MESA accelerator in Mainz.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics and therefore an integrating measurement with the associated integrating data acquisition readout chain. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is under development in collaboration with the University of Manitoba. The first 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 talk.

HK 26.3 Wed 14:45 SCH/A117

The Data Acquisition for PANDA FAIR Phase-0 at MAMI — Nicolo Baldicchi[1], Luigi Capozza[1], Samet Katilmis[1], Dong Liu[1], Frank Maas[1,2,3], Julian Moik[1], •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 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$_\mu$-2 puzzle). The detector system for the experiment is a modified version of the PANDA backward calorimeter, which was developed 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. Thus, new challenges arise in terms of radiation load of the components and the handling of high event rates for the electronics. The talk addresses the developments for the data acquisition system to cope with the demanding experiment environment.

HK 26.4 Wed 15:00 SCH/A117

Digital Signal Processing with FPGAs using Modern C++ and HLS — •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

In this talk, we discuss the use of Modern C++ and HLS to implement digital signal processing (DSP) algorithms on FPGAs for embedded systems. We introduce common design patterns for some simple algorithms that are suitable for continuous streaming data. The focus of this discussion is how modern C++ helps to control FPGA resource usage by applying compile-time C++ language features compared to traditional VHDL implementations. Furthermore, tests with common SOC systems and their implementation are presented.

HK 26.5 Wed 15:15 SCH/A117

Status of the Front-End-Electronics for the CBM-TRD de-

tector at FAIR — •Dennis Spicker for the CBM-Collaboration — Institut für Kernphysik, Max von Laue Straße 1, 60438 Frankfurt am Main

At the future Facility for Antiproton and Ion Research (FAIR) the Compressed Baryonic Matter experiment (CBM) is supposed to measure particles from heavy-ion collisions at very high interaction rates. For this purpose, the data acquisition will run in a free-streaming mode without a hierarchical trigger system.

For the Transition Radiation Detector (TRD) the readout system is based on the Self-triggered Pulse Amplification and Digitization ASIC (SPADIC). It features a charge-sensitive amplifier, a continuously sampling ADC, a programmable digital filter and a hit detection logic. The latest version introduces new switchable features such as a low-gain mode, an additional shaping order and digital baseline tracking.

This contribution presents the latest progress towards a final version of the SPADIC chip, as well as a slow-control software framework, including a GUI, that enables the operator to easily configure the SPADIC via the underlying communication protocol "IPbus". The software offers an automated testing routine that helps to assure the quality of the front-end-electronics before installing them on the detectors.

Supported by the German BMBF-grant 05P21RFFC3

HK 27: Heavy-Ion Collisions and QCD Phases V

Time: Wednesday 14:00–15:30 Location: SCH/A216

Group Report HK 27.1 Wed 14:00 SCH/A216

The CBM Experiment at FAIR - towards commissioning in 2027 — •Christian Sturm for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter experiment (CBM) is under construction at the Facility for Antiproton and Ion Research (FAIR). It aims to explore the phase structure of strongly interacting (QCD) matter at large net-baryon densities and moderate temperatures by means of heavy-ion collisions. The CBM experiment is designed as a fixed-target experiment, being equipped with fast and radiation-tolerant detector systems read out by a free-streaming data acquisition system. Performing online 4D reconstruction and selection CBM will measure with unprecedented interaction rates of up to 10 MHz. Hence, rare and penetrating probes like multi-strange hadrons, ΛΛ-hypernuclei, di-electrons/muons as well as charm production will be measured with high statistics in this region of the QCD phase diagram for the first time. This opens the opportunity to search for structures in the excitation functions and thus obtain experimental evidence for a first order phase transition and critical end point recently predicted to be present in the FAIR (SIS100) energy range. The presentation will summarize the preparation status of the CBM experiment on the way towards commissioning in 2027 including latest results of the mCBM experiment, a CBM demonstrator and full-system test-setup running within the FAIR phase-0 program.

HK 27.2 Wed 14:30 SCH/A216

Improving the CBM RICH lepton reconstruction — •Pavish Subramani, Christian Pauly, and Karl-Heinz Kampert — Bergische Universität Wuppertal

The Compressed Baryonic Matter experiment (CBM) is a heavy ion fixed target experiment, designed to probe the QCD phase diagram near the critical point at high μ_B and medium temperatures. The Ring Imaging Cherenkov Detector (RICH), situated directly behind the Micro Vertex Detector (MVD) and Silicon Tracking System (STS), is designed to distinguish electrons from pions, being the most abundantly produced particles in heavy ion collisions in the momentum range up to 10 GeV/c. One major source of background in the dilepton analysis is contamination by pions arising from false ring track matching in the RICH. Moreover, electrons from photon conversion inside the target and detector material are partly undetected by the STS tracking system, but cause additional Cherenkov rings in the RICH. If these rings are falsely matched to pion tracks they lead to electron misidentification, and thus can increase the combinatorial background and reduce the signal-to-background ratio.

This talk will focus on possible improvements in the efficiency of primary electron identification and pion suppression, for example by using additional information from the Transition Radiation Detector (TRD) situated directly behind the RICH.

* supported by BMBF (05P19PXFCA, 05P21PXFC1) and GSI.

HK 27.3 Wed 14:45 SCH/A216

CBM performance for the measurement of (multi)strange hadrons' anisotropic flow in Au+Au collisions at FAIR — •Oleksii Lubynets[1,2] and Ilya Selyuzhenkov[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung — [2]Goethe-Universität Frankfurt am Main

The main goal of the CBM experiment is to study highly compressed baryonic matter produced in collisions of heavy ions. The SIS-100 accelerator at FAIR will enable investigation of the QCD matter at temperatures up to about 120 MeV and net baryon densities 5-6 times larger than that of the normal nuclear matter. Hyperons produced during the dense phase of a heavy-ion collision provide information about the equation of state of the QCD matter. The measurement of (multi)strange hyperons' anisotropic flow is important for understanding the dynamics and evolution of the QCD matter created in the collision.

Performance studies for strange hadrons anisotropic flow measurement with the CBM experiment at FAIR will be presented. Strange hadrons are reconstructed via their decay topology using Kalman Filter algorithm methods. Directed flow of strange hadrons is calculated as a function of rapidity, transverse momentum and collision centrality. The effects due to non-uniformity of the CBM detector response in the azimuthal angle, transverse momentum and rapidity are corrected using the QnTools analysis package. 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 27.4 Wed 15:00 SCH/A216

Σ^0 reconstruction in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV with HADES — •Marten Becker for the HADES-Collaboration — Justus-Liebig-University Giessen

The HADES experiment at GSI investigates the moderate temperature and high density regime of the QCD phase diagram created by A+A collisions at a few AGeV kinetic beam energy. Besides leptons and photons, strangeness directly transports measurable information of the created dense matter to the laboratory. In 2019 HADES collected Ag+Ag collisions at 2.55 GeV center of mass energy which is of great interest since the energy is right at the strangeness production threshold. For the first time, the newly installed electromagnetic calorimeter allows direct photon detection. The RICH detector was upgraded in addition, which strongly improves electron identification and the detection of conversion-pairs.

This contribution shows work in progress results on the Σ^0 baryon reconstruction, decaying electromagnetically into $\Lambda + \gamma$. Feasibility studies in simulations prove the reconstruction methods in the $\Lambda + \gamma$ channel as well as the Λ+lepton channel where the photon converted and at least one low energetic $e^{\pm}$ is identified in the RICH. The Σ^0 yield is extracted and the resulting Λ/Σ^0 ratio is compared to statistical-thermal model calculations.

HK 27.5 Wed 15:15 SCH/A216

First measurements of Σ^+ and $\bar{\Sigma}^-$ with ALICE — •Benedict Heybeck for the ALICE Germany-Collaboration — Institut für Kernphysik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt, Germany

The first measurements of Σ^+- and $\bar{\Sigma}^-$-baryons with ALICE in pp collisions at $\sqrt{s} = 13$ TeV will be presented.
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 particular, since these photons have low momenta. However, Σ baryons are an important probe to study the strangeness production in pp collisions. Furthermore, the reconstructed Σ baryons can be used for correlation measurements with protons to improve the understanding of the interaction between nucleons and hyperons.

HK 28: Heavy-Ion Collisions and QCD Phases VI

Time: Wednesday 14:00–15:30 Location: SCH/A315

Group Report HK 28.1 Wed 14:00 SCH/A315

Transport Model Evaluation Project for Intermediate-Energy Heavy-Ion Collisions — •Hermann Wolter — University of Munich (LMU), unich, Germany

Transport models describing the evolution of a heavy-ion collision are indispensable to extract information on the equation-of-state of nuclear matter and medium properties of hadrons from such experiments in the intermediate energy range from several 100 MeV to a few GeV per nucleon. Of particular interest today is the high-density behavior of the nuclear symmetry energy, which is of great relevance for the understanding of astrophysical objects and processes. However, the highly complex and non-linear transport equations are commonly solved by simulations, which involve choices of strategies, which are not necessarily determined by the underlying equations. Thus it has occurred that studies using different transport models have deduced differing conclusions from the same data. In order to understand these differences and to reduce the systematical uncertainties of transport analyses of heavy-ion collisions, we have, within the TMEP collaboration, undertaken an extensive project of comparing many transport codes in different set-ups under controlled conditions (a review is given in H. Wolter et al., Progr. Part. Nucl. Phys. 125 (2022) 103962), also providing benchmark calculations. Here we will discuss the present status and future projects of this undertaking.

HK 28.2 Wed 14:30 SCH/A315

Mapping the quark-gluon plasma properties in Pb-Pb and Xe-Xe collisions at the LHC with FluiduM — •Luuk Vermunt[1,2], Yannis Seeman[1], Lukas Kreis[2], Christian Sonnabend[1], Andrea Dubla[2], Ilya Selyuzhenkov[2], and Silvia Masciocchi[1,2] — [1]Physikalisches Institut, Heidelberg, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

Fundamental properties of strongly-interacting matter under extreme conditions become accessible with ultra-relativistic collisions of heavy ions. We will present a phenomenological analysis of the experimental data for transverse momentum spectra of identified charged hadrons and (multi-)strange hyperons in Pb-Pb and Xe-Xe collisions at the LHC. The analysis is based on the relativistic fluid dynamics description implemented in the numerically efficient FluiduM approach. We separate in our treatment the chemical and kinetic freeze out, and incorporate the partial chemical equilibrium to describe the late stages of the collision evolution. We determine key parameters of the quark-gluon plasma evolution and its properties including the shear and bulk viscosity to entropy ratios, the initialisation time, initial density, and freeze-out temperatures. The physics parameters and their posterior probabilities are extracted using global search in multidimensional space with modern Machine Learning tools, such as ensembles of neural networks.

HK 28.3 Wed 14:45 SCH/A315

Global angular momentum generation in heavy-ion reactions within a hadronic transport approach — •Nils Sass[1], Oscar Garcia-Montero[1,2], Marco Müller[1], and Hannah Elfner[1,3,4] — [1]Goethe University Frankfurt — [2]University Bielefeld — [3]GSI — [4]FIAS

In 2017, the STAR collaboration at the Relativistic Heavy Ion Collider (RHIC) has measured finite global spin polarization of Λ hyperons. This measurement revealed a high angular momentum of the heavy ions and provided experimental evidence for vorticity in the quark-gluon plasma for the first time. In order to investigate the underlying mechanisms, a dynamic description of the transfer of angular momentum is required. In this work, the microscopic non-equilibrium transport approach SMASH is applied to study the generation of global angular momentum by the interaction of two nuclei. As SMASH provides access to the whole phase-space evolution of every particle at any given time, it allows to assess the fraction of angular momentum generated in the fireball by all participants. We confirm the previous modeling by Becattini within a geometric Glauber model approach, which found that the angular momentum transfer reaches a unique maximum in mid-central Au-Au collisions during time evolution. Even though angular momentum is not conserved locally in the transport approach a priori, we identify the contributions to the conservation violation and propose optimal setups for different energy regimes that recover conservation, based upon the test particle method and the treatment of Fermi motion.

HK 28.4 Wed 15:00 SCH/A315

First dielectron measurements in pp collisions at 13.6 TeV with ALICE in Run 3 — •Florian Eisenhut for the ALICE Germany-Collaboration — Goethe-Universität Frankfurt am Main

With the new and upgraded detectors of ALICE, the experiment is capable to read out collision data in a continuous mode. With a data acquisition rate 100 times larger than before, an integrated luminosity of more than 10 nb^{-1} is expected to be collected for Pb–Pb collisions during the Run 3 and 4 (2022-2032) data taking periods. Not only the improved readout of the detectors but also the reduced material budget, as well as the improved pointing resolution of the detectors, are crucial for the dielectron analysis. They will help to control the background from photon conversions and heavy-flavor hadron decays within the dielectron spectra.

This talk will give an overview of the first performance studies for dielectron analyses with the ALICE experiment based on data of pp collisions at 13.6 TeV in Run 3. It will summarize the techniques used to track, identify and select electrons and positrons. First results of the dielectron spectra and their corresponding signal-to-background ratios and significances will be presented together with a comparison to the results in Run 2.

HK 28.5 Wed 15:15 SCH/A315

Prompt and non-prompt J/ψ with machine learning and Kalman filter techniques with ALICE in Run 3 — •Pengzhong Lu for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 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 the commissioning of this new methodology in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV from Run 2 will be shown, followed by the study of the first Run 3 data from pp collisions at $\sqrt{s} = 13.6$ TeV.

HK 29: Hadron Structure and Spectroscopy III

Time: Wednesday 14:00–15:30 Location: SCH/A316

Group Report HK 29.1 Wed 14:00 SCH/A316
Probing the hadron spectrum with the GlueX experiment at Jefferson Lab — •Annika Thiel — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

One of the primary goals of non-pertubative QCD is the understanding of the hadron spectrum. A particular interesting aspect is the question, if and where states containing gluonic excitations contribute to the spectra. This issue has been tackled by different experiments using various production mechanisms without conclusive answers. A complementary production mechanism is the use of photoproduction, which is utilized by the GlueX experiment at Jefferson Lab.

The GlueX experiment started data taking in 2017 and is focused on the measurement of neutral as well as charged final states at photon energies up to 12 GeV. An important tool is the use of linearly polarized photons, which allows to shed light on the question whether natural or unnatural exchange dominates in the production of different states. Various results have been extracted in recent years, ranging from the extraction of polarization observables for different final states over the investigation of excited Λ states to the determination of the J/Ψ cross section at threshold.

This presentation will show the current status of the GlueX experiment and give an overview about the published results as well as ongoing analyses.

HK 29.2 Wed 14:30 SCH/A316
Partial-wave analysis of $\tau^- \to \pi^-\pi^-\pi^+\nu_\tau$ at Belle* — •Andrei Rabusov, Daniel Greenwald, and Stephan Paul — Technical University of Munich, James Franck Str. 1, 85748 Garching

We present preliminary results of a partial-wave analysis of $\tau^- \to \pi^-\pi^-\pi^+\nu_\tau$ in data from the Belle experiment at the KEK e^+e^- collider. We demonstrate the presence of the $a_1(1420)$, $a_1(1640)$, and $\pi(1300)$ resonances in τ decay and measure their masses and widths. 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.

*This work is funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and BMBF Verbundforschung (05H21WORD1 HighD, 05H21WOKBA BELLE2, 05P21WOCC1 COMPASS).

HK 29.3 Wed 14:45 SCH/A316
Diffractive resonance production in the reaction $\pi^- + p \to \pi^- K_S^0 K_S^0 + p$ at 190 GeV/c from COMPASS — •Mathias Wagner for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

Understanding of the light-meson spectrum is a necessity for the search for exotic states such as hybrid mesons. Especially the $\pi^-\pi^+\pi^-$ system proved very fruitful in this respect by providing, among others, clear evidence of the spin-exotic $\pi_1(1600)$ meson. A possible supernumerous state, the $a_1(1420)$, is established by the COMPASS collaboration as an evidence for a triangle singularity in the 3π-πKK coupled interaction. Therefore, it is extremely interesting to look for both the $\pi_1(1600)$ and the $a_1(1420)$ in the πKK final state.

Since the identification of charged kaons in COMPASS is severely limited at high momenta, we investigate the $\pi^- K_S^0 K_S^0$ system by reconstructing secondary K_S^0 decay vertices. First results of the event selection and the $\pi^- K_S^0 K_S^0$ mass spectrum in diffractive production at COMPASS are presented. Possible resonances are $a_{J\geq 1}$ and $\pi_{J\geq 0}$, and in the two-body subsystems we expect in the $K_S^0 K_S^0$ system the f and ρ states with even and odd spin, respectively, and K_J^* in the $\pi^- K_S^0$ system. For these, the corresponding invariant-mass spectra as well as the Dalitz-plots are presented.

Supported by BMBF.

HK 29.4 Wed 15:00 SCH/A316
Partial-Wave Analysis of the $\pi\pi\omega$ Final State at COMPASS* — •Philipp Haas for the COMPASS-Collaboration — Physik-Department, Technische Universität München

The COMPASS experiment is a multi-purpose fixed-target experiment at the CERN SPS. One of its major goals is to study the light-meson spectrum with high precision. Of special interest is the search for so-called exotic mesons which cannot be described as quark-antiquark states. To this end, COMPASS has acquired large data samples on diffractive production of excited light mesons by scattering a 190 GeV/c π^- beam off a proton target. Using this data set, COMPASS studied the $\pi_1(1600)$, which is a promising candidate for a so-called spin-exotic hybrid meson in great detail in the $\eta\pi$, $\eta'\pi$, and $\rho\pi$ decay modes. However, lattice QCD predicts that the $\pi_1(1600)$ dominantly decays into $b_1(1235)\pi$.

The $b_1(1235)\pi$ decay mode has so far not been studied at COMPASS. As $b_1(1235)$ dominantly decays into $\omega(782)\pi$, a partial-wave analysis of $\omega\pi\pi$ including the $\omega \to 3\pi$ decay is necessary to access the $b_1(1235)\pi$ decay mode. We will present our development of a partial-wave analysis of the $\omega\pi\pi$ final state. We will focus on modeling the $\omega(782)$ decay in the partial-wave analysis.

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

HK 29.5 Wed 15:15 SCH/A316
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, Hannah Neuwirth, Ann-Christin Schluse, Anna Theimann, and Alfons Khoukaz for the BESIII-Collaboration — Westfälische Wilhelms-Universität, Münster, Germany

In recent years the search for exotic hadrons has produced more and more states which seem to be incompatible with the conventional classification as a two or three quark state. However, in most of these cases the classification of these particles is inconclusive. An interesting opportunity is given by states with quantum numbers which cannot be produced by the conventional quark model, such as $J^{PC} = 1^{-+}$ in case of the $\pi_1(1600)$, which was seen in multiple experiments.
With the BESIII experiment decays of the χ_{cJ} mesons can be investigated through their production in radiative decays of the $\psi(2S)$ meson. Here, a large number of events has been recorded by the BESIII detector and additional data taking is ongoing. 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 the charmonium system. In this talk the current status of the search for the $\pi_1(1600)$ in the decay $\chi_{c2} \to \eta'\pi^+\pi^-$ by the means of a partial wave analysis will be presented.
This work is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - 269952272, 271236083 and 443159800.

HK 30: Nuclear Astrophysics III

Time: Wednesday 14:00–15:30 Location: SCH/A419

Group Report HK 30.1 Wed 14:00 SCH/A419
Science highlights from the shallow underground laboratory Felsenkeller Dresden — •Konrad Schmidt and Daniel Bemmerer — Helmholtz-Zentrum Dresden-Rossendorf

Underground accelerator laboratories are important instruments to measure nuclear reactions with low cross sections in experimental nuclear astrophysics. The reduced detector background due the shielding from cosmic rays allows the study of astronuclear reactions at energies relevant to Big Bang nucleosynthesis and stellar burning. The reactions 3He(a,g)7Be and 12C(p,g)13N have recently been studied at the shallow underground laboratory Felsenkeller Dresden, where a 5 MV accelerator provides several high intensity ion beams and an ultra-low background counting setup for activation measurements. In the talk, the latest scientific results from the Felsenkeller laboratory, its current

capabilities and upcoming enhancements will be summarized.

HK 30.2 Wed 14:30 SCH/A419

The ^{58}Fe(p,n)^{58}Co activation experiment at the University of Cologne — •Pina Wüstenberg, Felix Heim, Martin Müller, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

The γ-process describes a large network of reactions that leads to the synthesis of proton-rich nuclei, the p nuclei. Not all of these reactions can be measured in the laboratory, therefore theoretical predictions are needed. These models can be tested and improved by comparing them to experimental data. This contribution deals with the determination of cross sections of the ^{58}Fe(p,n)^{58}Co reaction. The cross section of (p,n) reactions is mainly sensitive to the optical model potential that describes the interaction between a proton and a nucleus. For this purpose, highly-enriched ^{58}Fe targets were irradiated with protons with seven different energies in the energy range between 3.3 MeV and 5 MeV. The proton beam was delivered by the 10 MV FN Tandem accelerator of the Institute for Nuclear Physics at the University of Cologne. The total cross sections were derived by analyzing the emitted γ-rays during the decay of ^{58}Fe using a dedicated counting setup. The γ-ray spectra were recorded using two clover-type HPGe detectors in a face-to-face geometry. The resulting cross sections were compared to predictions from theoretical models.
Supported by the DFG (ZI 510/8-2)

HK 30.3 Wed 14:45 SCH/A419

Results of total and partial cross-section measurements of the ^{87}Rb(p,γ)^{88}Sr reaction — •Svenja Wilden, Felix Heim, Martin Müller, Pina Wüstenberg, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

The existence of most of the proton rich stable nuclei - the p nuclei - cannot be explained via neutron-capture reactions. Therefore, at least one other process has to exist in order to describe their origin, the γ process. Since most photodisintegration reactions involved in the process are not directly accessible, reliable statistical model calculations are needed to predict cross sections and reaction rates. The cross sections include total cross sections describing the probability of the reaction itself and partial cross sections describing the decay to certain discrete states in the final nucleus. To improve the calculations the nuclear input parameters need to be constrained. This requires a large experimental database. Via comparison of experimental data to theoretical predictions different models can be excluded or constrained. In order to study the ^{87}Rb(p,γ)^{88}Sr reaction an in-beam experiment at the high-efficiency HPGe γ-ray spectrometer HORUS at the University of Cologne was performed. Proton beams with energies between $E_p = 2.0-5.0$ MeV were provided by the 10 MV FN Tandem accelerator. Final results on absolute cross sections and first results on partial cross sections will be presented as well as comparisons to theoretical model calculations.
Supported by the DFG (ZI 510/8-2).

HK 30.4 Wed 15:00 SCH/A419

The ^{205}Pb/^{205}Tl s-process chronometry and pp neutrino flux — •Riccardo Mancino[1,2], Rui Jiu Chen[2], Iris Dillman[3], Chris Griffin[3], Guy Leckenby[4], Yuri Litvinov[2], Gabriel Martínez-Pinedo[2,1], Shahab Sanjari[2,5], and Ragandeep Singh Sidhu[2,6] — [1]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, DE — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, DE — [3]TRIUMF, Vancouver, CA — [4]University of British Columbia, Vancouver, CA — [5]Aachen University of Applied Sciences, Aachen, DE — [6]University of Edinburgh, Edinburgh, UK

The bound-state beta decay of fully ionized ^{205}Tl has been measured at GSI. Combining this new experimental information and the known electron capture decay of ^{205}Tl we can compute the weak processes connecting these two nuclei. This includes electron capture and beta decay operating during the age phase of intermediate-mass stars. These processes determine the ^{205}Pb/^{205}Tl ratio produced by the s-process. The new experimental information favors a larger production of ^{205}Pb that may be observable in the early Solar System. Another important weak process is the conversion of ^{205}Tl to ^{205}Pb by solar neutrinos capture. This reaction has such a low Q-value that probes the pp solar neutrino flux. Using the new experimental data together with shell-model calculations we provide an update to the neutrino absorption cross section for solar neutrinos on ^{205}Tl. We highlight the necessity of a measurement of the Gamow-Teller strength by charge exchange reactions. This work is funded by SFB 1245 "Nuclei: From Fundamental Interactions to Structure and Stars".

HK 30.5 Wed 15:15 SCH/A419

Linearity and dark rate of SiPMs for large scintillator bars — •Thomas Hensel[1,2], Daniel Bemmerer[2], Konstanze Boretzky[3], Igor Gašparić[5,3,4], Daniel Stach[2], Andreas Wagner[2], and Kai Zuber[1] — [1]Technische Universität Dresden, Institut für Kern- und Teilchenphysik, 01062 Dresden, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), 01328 Dresden, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany — [4]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, 64289 Darmstadt, Germany — [5]Ruđer Bošković Institute, Zagreb, Croatia

The NeuLAND (New Large-Area Neutron Detector) plastic scintillator based time of flight detector for neutrons is currently under construction at FAIR. NeuLAND will consist of 3,000 2.7 m long bars that are read out by photomultipliers. Here, data from a comprehensive study of an alternative light readout scheme using silicon photomultipliers (SiPM) are presented. For this purpose, a typical NeuLAND bar was instrumented on each end with a prototype of the same geometry as a 1" photomultiplier tube, including four 6×6mm* SiPMs, amplifiers, high voltage supply, and micro-controller. Using fast digitizers, time resolution and saturation tests were carried out at the 35 MeV electron beam from the ELBE superconducting linac with its ps-level time jitter with 1-60 electrons per bunch. It is found that the SiPM-instrumented NeuLAND bar shows $\leq$ 10% nonlinearity over a range of 10-300 MeV deposited energy. The dark rate due to random coincident triggers of SiPMs is lower than the cosmic ray induced rate in the NeuLAND bar.

HK 31: Structure and Dynamics of Nuclei V

Time: Wednesday 14:00–15:30 Location: SCH/A118

Group Report HK 31.1 Wed 14:00 SCH/A118

Real photon-scattering experiments for the study of dipole excitations — •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 — [2]TU Darmstadt, Institute for Nuclear Physics — [3]GSI, Darmstadt — [4]Helmholtz-Zentrum Dresden-Rossendorf

Absolute photoabsorption cross sections of atomic nuclei can have great impact on reaction rates in nucleosynthesis processes. Hence, they are crucial to understand the nuclear abundances in our universe. Real photon-scattering experiments are well suited to study the dipole response due to the small angular-momentum transfer of photons [1, 2]. Besides the determination of spin and parity quantum numbers of excited states in even-even nuclei, absolute and total photoabsorption cross sections can be extracted in a model-independent way by combining complementary (γ,γ') experiments. The most common photon sources are, on the one hand, energetically-continuous bremsstrahlung and, on the other hand, Laser-Compton Backscattering producing a linearly-polarized, quasimonoenergetic γ-ray beam.
In this contribution, the aforementioned complementary photon sources, examples for corresponding setups, and recent results will be presented.
This work is supported by the BMBF (05P21PKEN9).
[1] U. Kneissl *et al.*, Prog. Part. Nucl. Phys. **37** (1996) 349
[2] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903

Group Report HK 31.2 Wed 14:30 SCH/A118

Systematics of the dipole polarizability — •Isabelle Brandherm[1], Peter von Neumann-Cosel[1], Tobias Klaus[1], Hiroaki Matsubara[2], and Atsushi Tamii[2] — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]RCNP, Osaka, Japan

Inelastic proton scattering at extreme forward angles has been established as a tool to probe the electric dipole response in nuclei. From

that the electric dipole polarizability can be obtained, which is a key observable to set constraints to the symmetry energy parameters of the equation of state and neutron skin thickness of nuclei. Over the last decade the electric dipole response in numerous nuclei has been measured at the Research Center for Nuclear Physics in Osaka, Japan. In this talk new result about the dipole response and dipole polarizability of ^{58}Ni and ^{90}Zr will be presented. Also the now available systematics of of the dipole polarizability will be discussed.

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

HK 31.3 Wed 15:00 SCH/A118

Investigation of low-lying dipole excitations in ^{144}Nd via real photon-scattering experiments — •Florian Kluwig[1], Miriam Müscher[1], Ronald Schwengner[2], Tanja Schüttler[1], and Andreas Zilges[1] — [1]University of Cologne, Institute for Nuclear Physics — [2]Helmholtz-Zentrum Dresden-Rossendorf

Since photons only transfer small angular momenta, they are a well-suited probe to investigate dipole excitations in atomic nuclei [1]. Therefore, the (γ,γ') or also called Nuclear Resonance Fluorescence (NRF) technique is an established method to study among others the so-called Pygmy Dipole Resonance (PDR). The PDR occurs as a concentration of electric dipole strength around and below the neutron separation energy. For the last decades, this excitation mode has been a research topic of great interest [2,3] and further systematic studies are crucial. Due to its wide range of stable, even-even isotopes, the Nd isotopic chain is well suited for this purpose. Thus, two complementary (γ,γ') experiments on the rare-earth nucleus ^{144}Nd have been performed using a continuous bremsstrahlung beam at the γELBE facility [4] and utilizing quasi-monoenergetic γ rays at HIγS [5]. First results of these experiments will be presented in this contribution.

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

[1] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903
[2] D. Savran *et al.*, Prog. Part. Nucl. Phys. **70** (2013) 210
[3] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360
[4] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211
[5] H.R. Weller *et al.*, Prog. Part. Nucl. Phys. **62** (2009) 257

HK 31.4 Wed 15:15 SCH/A118

Photoexcitation of ^{76}Ge — Ronald Schwengner[1], Konrad Schmidt[1], Kai Zuber[2], •Hans F. R. Hoffmann[2], Marie Pichotta[2], and Steffen Turkat[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany — [2]Institute of nuclear and particle physics, TU Dresden, 01069 Dresden, Germany

The dipole strength of the nuclide ^{76}Ge was studied in photon-scattering experiments using bremsstrahlung produced with electron beams of energies of 7.8 and 12.3 MeV which were delivered by the electron linear accelerator of high brilliance and high brightness (ELBE). In total, 210 levels up to an excitation energy of 9.4 MeV were identified and a spin $J = 1$ was assigned to most of them. The quasi-continuum of unresolved transitions was included in the analysis of the spectra and the intensities of branching transitions were estimated on the basis of simulations of statistical γ-ray cascades. The photoabsorption cross section up to the neutron-separation energy was determined. The experimental procedure and results will be discussed including some implication on ^{76}Ge $0\nu\beta\beta$ experiments.

HK 32: Structure and Dynamics of Nuclei VI

Time: Wednesday 14:00–15:30 Location: SCH/A215

HK 32.1 Wed 14:00 SCH/A215

Probing the $N = 152$ neutron shell closure by laser spectroscopy of fermium isotopes — •Jessica Warbinek for the Fermium-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Germany — Johannes Gutenberg-Universität Mainz, Germany

Determining the limits of existence of the heaviest nuclides is a forefront topic in nuclear-physics research. Nuclei in this region are stabilized by shell effects that retard spontaneous fission and feature properties distinctly different from those of lighter nuclei. Experimental information on the deformed shell closures around the heavy actinides like fermium (Fm, $Z = 100$) can help to benchmark state-of-the-art theoretical models to improve their predictive power in the range of the heaviest elements.

Laser spectroscopy serves as a powerful tool to extract experimental information on nuclear parameters such as the change in the mean-square charge radius and nuclear moments in a nuclear-model independent manner. Recent studies in fermium allowed the determination of the isotope shift in an atomic transition for a long chain of eight isotopes ranging from the accelerator-produced ^{245}Fm to reactor-bred ^{257}Fm. Direct and indirect production methods were combined and associated on-line and off-line measurement techniques significantly advanced to access isotopes spanning well across the known deformed shell gap at $N = 152$. Results on the extracted changes in the mean-square charge radii revealing a discontinuity around the neutron shell closure will be discussed.

HK 32.2 Wed 14:15 SCH/A215

Proton-neutron interaction strength studies via accurate mass measurements far from stability — •Gabriella Kripkó-Koncz for the FRS Ion Catcher-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany — Tel Aviv University, Tel Aviv, Israel

The average interaction strength between the last (highest energy orbitals) proton(s) and neutron(s) in a nucleus (denoted as δV_{pn}), may be derived from differences of accurate atomic masses, and in turn point empirically to various aspects of nuclear structure and interactions. The FRS Ion Catcher 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. Confirmed by mass measurements at the FRS Ion Catcher, the detailed structure of δV_{pn} along the $N = Z$, $N - Z = 2$, $N - Z = 4$ lines near the $Z = 29 - 37$ region has been investigated [1]. These studies will be presented and an analysis of mass measurements via higher-order mass-difference indicators, the deviations of which from their expected trends may indicate questionable mass values in the Atomic Mass Evaluation and highlight distinctive nuclear structure effects, will be motivated.

[1] I. Mardor et al., Phys. Rev. C 103, 034319 (2021)

HK 32.3 Wed 14:30 SCH/A215

The search for double alpha decay of ^{224}Ra at the FRS Ion Catcher — •Heinrich Wilsenach for the Double Alpha IN2P3-CEA-GSI-Collaboration — Justus-Liebig-Universität Gießen, Gießen, Germany — Tel Aviv University, Tel Aviv, Israel

Double alpha decay has been predicted since the 1980s. The most probable scenario for this decay mode is the simultaneous tunnelling of two alpha particles through the coulomb barrier and their emission in opposite directions. Recent theoretical studies [1] have predicted a back-to-back double alpha decay branching ratio for ^{224}Ra of 1.8×10^{-7}%.

A project to measure this small branching ratio has been performed at the FRS (FRagment Separator) Ion Catcher at Gesellschaft für Schwerionenforschung (GSI). This project utilized the thermalization of ^{228}Th alpha recoils in a cryogenic stopping cell (CSC) and the preparation of a clean beam of ^{224}Ra by a radio-frequency-quadrupole (RFQ) beamline. Two double-sided silicon strip detectors (DSSD) were used to read out each alpha particle's position, time and energy coming from the implanted ^{224}Ra.

This talk will give insight into the design and setup of the experiment, including Monte Carlo simulations. It will conclude with preliminary results from the first 135 day long data taking run.

[1] F. Mercier *et al.*, PRL 127, 012501 (2021)

HK 32.4 Wed 14:45 SCH/A215

Precise measurement of the nn scattering length using a new neutron detector — •Meytal Duer[1], Thomas Aumann[1,2,3], Dominic Rossi[1,2], and Marco Knösel[1] for the SAMURAI-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz-Zentrum für Schwerionenforschung — [3]Helmholtz Forschungsakademie Hessen für FAIR

An accurate knowledge of the nucleon-nucleon (NN) scattering lengths,

characterize the NN interaction at low energies, is fundamental for nuclear physics. The NN interaction is not only basis for the description of nuclei as a many-body systems, but the difference on the nn and pp interaction is also an important measure of charge symmetry breaking. For the nn scattering length, however, there is a systematic and significant discrepancy between values extracted from several measurements.

In this talk a new method will be presented to determine the nn scattering length with high accuracy. The basic idea of the measurement, which will take place at the SAMURAI experimental setup at RIBF in Japan, is to use a knockout reaction in inverse kinematics to produce a localized two-neutron system. By measuring the nn relative-energy spectrum after the reaction, the value of the nn scattering length can be extracted. To achieve sufficient precision, a newly developed high-resolution neutron detector HIME has been constructed. This work is supported by the DFG, Project-ID 279384907 - SFB 1245.

HK 32.5 Wed 15:00 SCH/A215

Fission Isomers studies at the FRS — •Nazarena Tortorelli for the S530-Collaboration — Ludwig-Maximilians-University, Munich, Germany — GSI Helmholtzentrum für Schwerionenforschung, Darmstadt, Germany

The potential energy landscape in actinide nuclei ($Z = 92 - 97$, $N = 141 - 151$) shows a super-deformed second minimum. The ground state in this minimum is called a fission isomer, as it will preferably decay via isomeric (delayed) fission. So far 35 fission isomers with lifetimes between 5 ps and 14 ms have been observed using only direct reactions (like (d,pf)). At the FRS the fragmentation mechanism (i.e., the collision of a heavy relativistic beam on a light target) can be exploited to offer rapid production, hence access to isomers with short half-lives, and most importantly, highly pure fragmented beams and event-by-event identification. Recently, fission isomer studies have been made with the FRS at GSI, where a 1 GeV/u ^{238}U beam on a Be target was used. Different detection methods by implanting into a fast plastic scintillator and in the cryogenic stopping cell at the FRS Ion Catcher were used, and technical provisions have been implemented to cover a half-life range from about 50 ns to 50 ms. In this talk, the technical improvements as well as the status of the ongoing analysis will be presented. This work was supported by GSI R&D via LMTHI2023.

HK 32.6 Wed 15:15 SCH/A215

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]Institute for Nuclear Physics, TU Darmstadt, Germany — [2]HZDR, Dresden, Germany — [3]FRIB, MSU, East Lansing, MI, USA

Nuclear resonance fluorescence (NRF) of a sample of ^{242}Pu was studied at the Darmstadt High-Intensity Photon setup. The superconducting Darmstadt linear electron accelerator S-DALINAC was used to produce bremsstrahlung up to an endpoint energy of 3.7 MeV to irradiate a sample of PuO_2, which had a total mass of about 1 g. It was highly enriched in the isotope of interest ^{242}Pu and kept in a special target container. Photons were detected with two high-purity Germanium detectors placed at different angles relative to the beam axis. NRF signals from the sample were identified by comparison with measurements using an empty target container and measurements of the sample's radioactivity. Evidence for NRF signals from ^{242}Pu was observed. This makes this isotope the heaviest nuclide for which NRF information is available. Details of the experiment will be described and γ-ray spectra will be presented and discussed.
We thank the Institute of Resource Ecology of HZDR for providing the ^{242}Pu-sample. This work was supported by the LOEWE research project 'Nukleare Photonik' by the State of Hesse.

HK 33: Fundamental Symmetries I

Time: Wednesday 14:00–15:30 Location: SCH/A252

Group Report HK 33.1 Wed 14:00 SCH/A252

τSPECT - A fully magnetic gradient trap to measure the free neutron lifetime — •Martin Fertl for the tauSPECT-Collaboration — Institut für Physik, Johannes Gutenberg-Universität Mainz

The free neutron lifetime τ_n critically influences the primordial nucleosynthesis and is indispensible to perform a CKM-matrix unitarity test without nuclear structure corrections related to the extraction of V_{ud} from $0^+ \to 0^+$ nuclear transitions. The τSPECT collaboration has implemented a 3D magnetic field gradient trap for ultracold neutrons (UCN) with the aim to determine τ_n with a statistical sensitivity below 1 s, complementary to the precision obtained with the current state-of-the-art magneto-gravitational UCN traps. Spin-polarized UCN are loaded into the storage volume via a double-spin-flip sequence and counted after a preset storage time with an in-situ UCN detector. This report will introduce the concept, the implementation and results from the commissioning runs at the UCN source facility at TRIGA Mainz.

Group Report HK 33.2 Wed 14:30 SCH/A252

Degaussing of a Magnetically Shielded Room for the ^{3}He-^{129}Xe Comagnetometer Experiment in Heidelberg — •Benjamin Brauneis[1], Fabian Allmendinger[1], Werner Heil[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Universität Heidelberg — [2]Institut für Physik, Universität Mainz

The permanent Electric Dipole Moment (EDM) of ^{129}Xenon is an experimentally accessible signal for potential sources of CP-violation not described by the Standard Model. It can be measured in a clock comparison experiment using a gas mixture of free spin precessing nuclear polarized ^{3}He and ^{129}Xe. To reach the desired accuracy this experiment has to be performed at low frequencies (few Hz) and therefore within a Magnetically Shielded Room (MSR). Furthermore, very small field gradients (pT per cm) are required in order to reach a sufficiently large spin coherence time. Our MSR consisting of three layers of Mu-metal and one layer of copper-plated aluminum was constructed in Heidelberg 2021. Efforts are made to develop an advanced degaussing routine yielding to reproducible low residual magnetic fields within the MSR. We report on the current status of preparation for next Xe-EDM measurements in Heidelberg with special focus on the degaussing procedure and the performance for our MSR.

HK 33.3 Wed 15:00 SCH/A252

Tracking of the spatial magnetic field distribution 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 Excellence Cluster PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The Fermilab Muon g−2 experiment E989 aims to measure the anomalous magnetic moment of the muon to a precision of 140 ppb. This experiment consists of muons stored in a ring-shaped quasi-penning trap within a uniform magnetic field of 1.45 T. The measurement is composed of a ratio of two frequencies, the anomalous spin precession frequency of the muons (ω_a) and the muon-weighted spin precession frequency of protons ($\tilde{\omega}_p$). $\tilde{\omega}_p$ is fundamentally the measure of the magnetic field experienced by these precessing muons, we measure this magnetic field using nuclear magnetic resonance (NMR) based probe systems. In this talk, I will be reviewing two of the sub-systems of the magnetic field measurement chain, namely, the trolley probe and the fixed probe systems which measure the magnetic field periodically and continuously, respectively. This will be followed by an overview of the procedure for synchronising the measurements of the two sub-systems in time and the independent cross-check performed on the procedure for removing the trolley system's magnetic signature in the fixed probe system.

HK 33.4 Wed 15:15 SCH/A252

The Search for Electric Dipole Moments of Charged Particles in Storage Rings — •Achim Andres for the JEDI-Collaboration — Institute for Nuclear Physics IV, FZ Jülich, Germany — III. Physikalisches Institut B, RWTH Aachen University, Germany

The matter-antimatter asymmetry in the universe cannot be explained by the Standard Model of elementary particle physics. According to A. Sakharov CP violating phenomena are needed in order to under-

stand the matter-antimatter asymmetry. Permanent Electric Dipole Moments (EDMs) of subatomic elementary particles violate both time reversal and parity asymmetries and therefore also violate CP if the CPT-theorem holds. Storage rings offer the possibility to measure EDMs of charged particles by observing the influence of the EDM on the spin motion. The Cooler Synchrotron (COSY) at Forschungszentrum Jülich provides polarized protons and deuterons up to a momenta of 3.7 GeV/c and is therefore an ideal starting point for the JEDI - Collaboration (Jülich Electric Dipole moment Investigations) to perform the first direct measurement of the deuteron EDM. During this talk, recent results of the first deuteron EDM measurements are presented.

HK 34: Instrumentation X

Time: Wednesday 15:45–17:15 Location: SCH/A251

Group Report HK 34.1 Wed 15:45 SCH/A251

Status of the CBM Micro Vertex Detector* — •Benedict Arnoldi-Meadows for the CBM-MVD-Collaboration — Goethe-Universität 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 stations, operating in the experiment's target vacuum. The $0.3-0.5\%$ X_0 thin stations will be equipped with 50 μm thin, highly granular Monolithic Active Pixel Sensors called MIMOSIS. MIMOSIS 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/cm^2.

The first full-size prototype MIMOSIS-1 was intensely tested for in-beam performance, radiation tolerance and robustness to Single Event Effects. The results of the tests will be summarized and the implications for the next and final prototype MIMOSIS-2, which has been submitted, will be discussed. Moreover, a status of the efforts with regard to integration and cooling in vacuum towards the final MVD will be given.

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

HK 34.2 Wed 16:15 SCH/A251

Characterization of APTS, a MAPS prototype fabricated in 65 nm CMOS technology for the ALICE ITS3 upgrade — •David Schledewitz for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt — European Organization for Nuclear Research (CERN), Geneva, Switzerland

For the next detector upgrade of the ALICE experiment, an extensive R&D program is carried out for the vertex detector to minimize the material budget and reduce the distance to the interaction point. From the currently installed ALICE Inner Tracking System (ITS2), the innermost three out of the seven layers of Monolithic Active Pixel sensors (MAPS) will be replaced. The proposed upgrade (ITS3) is based on curved, wafer-scale, ultra-thin silicon MAPS with a truly cylindrical geometry. The foreseen technology for this upgrade is the 65 nm CMOS imaging process by TowerJazz Panasonic Semiconductor Company, allowing the production of wafer-scale pixel sensors on 300 mm diameter wafers using stitching.

One of the current prototypes to evaluate the detection performance and radiation hardness of the technology is the Analog Pixel Test Structure (APTS). In particular, a set of 4 x 4 pixel matrices with parallel, analog readout realized in various geometries are used to characterize the parameter space of the technology. This contribution intends to provide an overview of the APTS, covering performance results from testbeam campaigns and laboratory measurements.

HK 34.3 Wed 16:30 SCH/A251

Characterisation of irradiated Digital Pixel Test Structures produced in 65 nm TPSCo CMOS process — •Pascal Becht for the ALICE Germany-Collaboration — Physikalisches Institut Universität Heidelberg

The future upgraded ALICE Inner Tracking System (ITS3) features wafer-scale, ultra-thin and truly cylindrical Monolithic Active Pixel Sensors (MAPS) as its innermost three layers around the beampipe. New sensors for this effort are intended to be produced in 65 nm CMOS technology in order to benefit from the smaller feature size and the larger commercially available wafers.

With the goal of qualifying this technology for the application in MAPS, an extensive R&D programme is ongoing. In view of a new pixel sensor for the ITS3, a Digital Pixel Test Structure (DPTS) has been designed and produced. Multiple of these prototypes are characterized in laboratory measurements and beam test campaigns at DESY and CERN. In order to evaluate the effects of radiation damage, some sensors have been neutron irradiated to different levels ranging from 10^{13} 1 MeV $n_{eq}cm^{-2}$ to 10^{16} 1 MeV $n_{eq}cm^{-2}$. Furthermore, several prototypes have been subject to an X-ray source and thereby received doses up to 100 kGy.

Detection efficiency and position resolution of the DPTS sensors are presented to characterize their performance. The outcome of these studies demonstrates the feasibility of the 65 nm CMOS technology for the application in future MAPS-based detectors.

HK 34.4 Wed 16:45 SCH/A251

ALPIDE Monolitic Active Pixel Sensors at GSI — •Martin Bajzek[1,2], Oleg Kiselev[1], Ivan Mukha[1], Christoph Scheidenberger[1,2], Luke Rose[3], Bastian Löher[1], and Andrea Jedele[1,4] for the R3B-Collaboration — [1]GSI, Darmstadt, Germany — [2]JLU, Gießen, Germany — [3]University of York, York, United Kingdom — [4]TU Darmstadt, Darmstadt, Germany

Precise particle tracking is important for complete kinematic reconstruction which gives insight into decay modes, cross-sections and excited states of exotic particles. In particular, tracking is important for the purpose of in-flight decay spectroscopy and particle identification.

We discuss the results of the on-going integration and adaptation of the ALPIDE Monolitic Active Pixel Sensors to be used for vertex reconstruction and tracking of charged particles in nuclear physics experiment at R3B and Super-FRS EC at GSI. This work was supported by GSI Erasmus scholarship.

HK 34.5 Wed 17:00 SCH/A251

Simulation studies for the Forward Conversion Tracker of ALICE 3 in run 5 — •Casper van Veen for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg, Heidelberg, Germany

During the Long Shutdown 4 of the LHC (LS4), the ALICE experiment will be upgraded to ALICE 3. Along with an advanced silicon-based tracking system placed closer to the interaction point, ALICE 3 will also come equipped with a Forward Conversion Tracker (FCT) which will measure the transverse momentum of soft photons in the forward direction. In the soft photon regime, the bremsstrahlung spectrum can be computed in a model- and process-independent way by Low*s theorem. Most previous experiments have observed a soft photon excess on top of what is expected by Low*s theorem, but some did not observe this excess at all. This makes the experimental status of the existence of the excess unclear. The FCT, an array of silicon layers, will provide a way to measure these photons via the photon conversion method. The FCT will be provided with an unprecedented position resolution from these silicon trackers which should result in a very clean photon identification.

This talk will give an overview of the current studies of the FCT and provide an overview of the upcoming challenges.

HK 35: Instrumentation XI

Time: Wednesday 15:45–17:00 Location: SCH/A.101

Group Report HK 35.1 Wed 15:45 SCH/A.101

MAGIX group report — •Pepe Gülker for the MAGIX-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany

The versatile, low energy electron scattering experiment MAGIX, located in Mainz at the new MESA accelerator, has switched gears and entered the construction phase. The design of the main components, e.g. the two magnetic spectrometers, their small-drift focal plane TPCs and the trigger-veto system, are fixed and production has already started.

The broad physics program, ranging from rare particle searches to electro-disintegration measurements, is scheduled according to the increasing energy and availability of the energy-recovering mode of the accelerator.

This group report will redraw the design process of the whole experiment, give an overview of finalized parameters and discuss the planned measurement campaign.

Group Report HK 35.2 Wed 16:15 SCH/A.101

Status of the CBM Time-of-Flight project — •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 93000 channels) 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 preproduction 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 35.3 Wed 16:45 SCH/A.101

The Endcap-Time-Of-Flight Detector at STAR and its implications for the CBM Time-Of-Flight-Wall — •Yannick Söhngen for the CBM-Collaboration — Physikalisches Institut Universität Heidelberg

The Endcap-Time-Of-Flight Detector (ETOF) at STAR was build with 108 MRPCs designed for the CBM Time-Of-Flight-Wall and successfully operated during the Beam-Energy-Scan II (BESII) from 2018 onwards. Its status in terms of operation, data acquisition and calibration will be presented and the conclusions that could be drawn for the design of the CBM Time-Of-Flight-Wall will be discussed.

HK 36: Computing I

Time: Wednesday 15:45–17:15 Location: SCH/A117

HK 36.1 Wed 15:45 SCH/A117

ALICE TRD: online-offline processing and electron identification in LHC Run 3 and 4 — •Felix Schlepper — Physikalisches Institut, Heidelberg, Deutschland

During the long shutdown 2 (LS2) of the LHC, the ALICE experiment was upgraded to exploit the full scientific potential. The upgrade was posed by the challenge of continuously reading out and online processing p-p and Pb-Pb collisions at rates of 1 MHz and 50 kHz, respectively. To meet these new requirements, the ALICE experiment developed a new online-offline software framework O2 for Run 3 and 4.

This talk will give an overview of the software, the calibration and particle identification (PID) strategies currently being implemented and commissioned for the Transition Radiation Detector (TRD). The TRD contributes to the electron identification capabilities of ALICE. In Run 1 and 2 a classical likelihood-based algorithm was used. Since the front end electronics (FEE) was upgraded, the data readout precision was notably reduced to cope with the higher rates. Hence, new algorithms for PID, including Machine Learning, will be used to recover and possibly improve the previous PID capabilities. First performance results will be shown as well.

HK 36.2 Wed 16:00 SCH/A117

Volunteer Computing for ALICE at CERN — •Felix Hoffmann and Udo Kebschull — Goethe Universität Frankfurt

The High Luminosity LHC era at CERN will require Monte Carlo simulations to be at an even higher level of accuracy in order for them be suited for tasks such as background subtraction and filtering of rare events. In order to be able to keep up with the required amount of computational power, distributed computing approaches such as the Worldwide LHC Computing Grid (WLCG) are combined with other measures such as frequent hardware upgrades.

This publication explores ideas of novel volunteer computing frameworks in the context of ALICE which aim to allow people from all around the world to donate available computational power to further help the experiment. In this publication, two fundamentally different approaches are described and their potential analyzed: The first approach is a traditional volunteer computing approach that builds on existing BOINC infrastructure. The second approach is blockchain-based and features a novel Proof-of-Useful-Work consensus algorithm which aims to both support real-world HEP experiments with the production of required MC data and to secure the underlying blockchain infrastructure at the same time. A prototype implementation of such an algorithm in the context of the Online-Offline simulation and analysis framework ALICE uses for Run 3 is currently being developed in C++.

HK 36.3 Wed 16:15 SCH/A117

Searching for Anomalous Hadronic Higgs Boson Decays at the LHeC — Subhasish Behera, •Manuel Hagelüken, and Matthias Schott — Johannes Gutenberg-Universität Mainz

The future Large Hadron electron Collider (LHeC) would allow collisions of an intense electron beam with protons or heavy ions at the High Luminosity-Large Hadron Collider (HL-LHC). Owing to a center of mass energy greater than a TeV and very high luminosity, the LHeC would not only be a new generation collider for deep-inelastic scattering (DIS) but also an important facility for precision Higgs physics, complementary to pp and electron-positron colliders. While anomalous hadronic decay signatures of the Higgs boson, e.g. to three or more partons, are difficult to probe at the LHC due to its enormous background rates, it might be possible to search for such decays at the LHeC. In this work, we present the expected sensitivity at the LHeC for $H \to 3jets$ and $H \to 4jets$ decay channels, assumed an integrated luminosity of $1 ab^{-1}$.

HK 36.4 Wed 16:30 SCH/A117

A language model based tracking algorithm for the Straw Tube Tracker of the PANDA experiment — •Jakapat Kannika[1,2], James Ritman[1,2,3], and Tobias Stockmanns[3] — [1]GSI Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany — [2]Ruhr-Universität Bochum, Bochum, Germany — [3]Forschungszentrum Jülich, Jülich, Germany

The Straw Tube Tracker (STT) is designed for momentum reconstruction of charged particles in the PANDA experiment. This talk will present a tracking algorithm that can group measured hit positions of

the STT into tracks of the particles based on the language model. The overall algorithm consists of two main parts, the language model which contains the probabilities for predicting the next hit point based on previous measurements, and the tracking algorithm, the program that uses the information from the language model to select the most probable track or filter possible track candidates. We performed track parameterizations perpendicular and parallel to the solenoidal magnetic field and compared the reconstructed tracks to the MC truth information. As a result, all the reconstructed parameters are shown to be reconstructed within the expected ranges according to the MC information. The algorithm is also being developed to include a branching algorithm that can select the best track out of multiple track candidates. The development involves improving the quality of hit information and creating a track selector. The talk will also present the efficiency and resolution of this algorithm to reconstruct tracks in the STT.

HK 36.5 Wed 16:45 SCH/A117

Implementation of the Acts tracking software into PandaRoot — •Ken Suzuki for the PANDA collaboration — Ruhr-Universität Bochum, Bochum, Germany — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The PANDA experiment at FAIR[1] combines the stored high-precision antiproton beam from the HESR with a hydrogen/nuclear target from cluster-jet/pellet target and 4π universal detector system equipped with a modern high-rate DAQ. The unique setup allows it to provide precision data to low/middle energy hadron structures where the experimental inputs are mostly awaited. We test the Acts Common Tracking Software[2] for particle track reconstruction as an alternative to be implemented to our analysis framework, PandaRoot. We will show the status of implementation and performance comparison to our current version using Genfit.

[1] PANDA collaboration, Eur. Phys. J. A 57, 184 (2021).
[2] https://acts.readthedocs.io .

HK 36.6 Wed 17:00 SCH/A117

Dynamically assisted nuclear fusion — •Daniil Ryndyk — Helmholtz-Zentrum Dresden-Rossendorf

We consider nuclear fusion at kinetic energies in the keV regime. At such low temperatures nuclear fusion is exponentially suppressed as it occurs via quantum tunneling through the Coulomb barrier between the nuclei. Our research goal is to increase the overall tunneling probability employing short-pulsed, high-intensity electromagnetic fields thus avoiding the negative aspects of hot plasmas, e.g., heat loss.

Latest publications:

F. Queisser and R. Schützhold, PRC, 100(4), 2019
C. Kohlfürst, F. Queisser and R. Schützhold, PRR, 3:033153, 2021

HK 37: Heavy-Ion Collisions and QCD Phases VII

Time: Wednesday 15:45–17:15 Location: SCH/A216

HK 37.1 Wed 15:45 SCH/A216

Anisotropic flow generation with $\eta/s(T,\mu_B)$ in a hybrid approach — •Niklas Götz[1,2], Lucas Constantin[1], and Hannah Elfner[3,1,2,4] — [1]Institute for Theoretical Physics, Goethe University, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Strasse 1, 60438 Frankfurt am Main, Germany — [3]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center, Campus Frankfurt, Max-von- Laue-Straße 12, 60438 Frankfurt am Main, Germany — [4]GSI Helmholtzzentrum für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt, Germany

In this work, the origin of anisotropic flow in hybrid approaches, combining different initial conditions, viscous relativistic hydrodynamics as well as hadronic transport, is studied. Previous works largely disregard a non-constant $\eta/s(\mu_B)$ and focus mainly on a temperature dependence. Here instead, we study qualitatively the effect of a generalized $\eta/s(T,\mu_B)$ in the hybrid approach SMASH-vHLLE-hybrid. The parameterization takes into account the constraints of matching to the transport coefficients in the hadronic phase and recent Bayesian analysis results. In addition, we quantify the uncertainty due to different initial state profiles, including the SMASH initial conditions as well as T$_{\mathrm{R}}$ENTo and IP-Glasma profiles. In order to investigate their interplay with the size of the transport coefficients and anisotropic flows as well as the impact of different initial state eccentricities, we compare the results with different inital conditions at $\sqrt{s_{NN}}$=200 GeV.

HK 37.2 Wed 16:00 SCH/A216

Flow Measurements of Λ, K^0_s and K^+ in $\sqrt{s_{NN}}$ = 2.55 GeV Ag+Ag Collisions with HADES — •Tan Lu for the HADES-Collaboration — Institute of Modern Physics, Chinese Academy of Sciences — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The collective motion of particles (flow) is driven by pressure gradients in fireballs created in heavy-ion collisions and shows patterns that reflect properties of the nuclear matter equation of states of QCD matter under extreme conditions. Due to its high rate capability the High-Acceptance Di-Electron Spectrometer (HADES) provides excellent conditions to study the flow patterns of the rarely produced strange hadrons. Since the strange hadrons are produced near to the free NN threshold at SIS18 beam energies, they are expected to be particularly sensitive to the in-medium potential.

In this talk, we report the measurements of directed and elliptic flow of Λ, K^0_s and K^+ from $\sqrt{s_{NN}}$ =2.55 GeV Ag+Ag collisions. The dependence on collision centrality, rapidity and transverse momentum of the measured collectivity will compared to results from microscopic transport model calculations.

HK 37.3 Wed 16:15 SCH/A216

New publications on higher-order flow observables in ALICE — •Ante Bilandzic, Farid Taghavi, Marcel Lesch, and Anton Riedel for the ALICE Germany-Collaboration — Technical University of Munich

In this contribution, the results from the two new publications on higher-order flow observables in ALICE are presented.

The newly developed Gaussian Estimator for correlations between symmetry planes, which characterize the direction of the anisotropic emission of produced particles, is measured in Pb-Pb collisions with ALICE. This allows for the first time the study of these quantities without the influence of correlations between different flow amplitudes, and therefore the extraction of unique and independent information about initial conditions and properties of Quark-Gluon Plasma from symmetry plane correlations.

In the second publication, the correlations between different moments of two flow amplitudes are measured for the first time with the recently developed asymmetric cumulants, which generalize the previous studies using symmetric cumulants of flow amplitudes.

For both sets of observables, comparison to state-of-the-art hydrodynamic model calculations is presented.

This project has received funding from the European Research Council (ERC) under the European Unions Horizon182020 research and innovation programme (grant agreement No 759257). Fundedf by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 37.4 Wed 16:30 SCH/A216

Bayesian analysis by using higher-order flow measurements at the LHC — •Seyed Farid Taghavi[1], Jasper Parkkila[2], Anna Onnerstad[3], Cindy Mordasini[4], Maxim Virta[5], Ante Bilandzic[6], and DongJo Kim[7] for the ALICE Germany-Collaboration — [1]Technische Universität München, Munich, Germany — [2]CERN, Experimental Physics Department, Geneva, Switzerland — [3]University of Jyväskylä, University of Jyväskylä, Finland — [4]University of Jyväskylä, University of Jyväskylä, Finland — [5]University of Jyväskylä, University of Jyväskylä, Finland — [6]Technische Universität München, Munich, Germany — [7]University of Jyväskylä, University of Jyväskylä, Finland

As a consequence of the theoretical improvements and a wide range of accurate experimental measurements, our understanding of the collective phenomena in heavy-ion collisions has advanced significantly over the past years. The Global Bayesian analysis has a substantial role in this advancement. In this talk, we present a global Bayesian analysis to infer the transport properties of QGP using the latest CERN Large Hadron Collider Pb-Pb data at $\sqrt{s_{\mathrm{NN}}}$=2.76 and 5.02 TeV. We show that including the latest multi-harmonic flow measurements significantly improves the uncertainties of the inferred specific shear and bulk

viscosities. This observation shows the necessity of accurate measurements of collective flow observables in the future. Based on: PLB., 835 (2022) 137485. Funded by BMBF Verbundforschung (05P21WOCA1 ALICE), ERC European Unions Horizon 2020 (No. 759257), Academy of Finland, the Centre of Excellence in Quark Matter (No. 346324).

HK 37.5 Wed 16:45 SCH/A216

Emission of abundant hadrons from Au+Au Collisions at $\sqrt{s_{NN}}$ = 2.42 GeV with HADES — •Simon Spies for the HADES-Collaboration — Goethe-Universität Frankfurt

In April 2012 we recorded 7.3 × 10^9 Au(1.23A GeV)+Au events with the HADES detector located at the *GSI Helmholtzzentrum für Schwerionenforschung* in Darmstadt, Germany. Based on these data the emission/production of protons, light nuclei, pions, hyperons and strange mesons have been studied as a function of transverse momentum/mass, rapidity and centrality, yielding the most precise data set on hadron emission currently available at this energy. In this contribution we discuss the challenges in confronting experimental data with predictions from various state-of-the-art transport models and present first preliminary results. These are put in context with available world data from other collaborations.

This work has been supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006).

HK 37.6 Wed 17:00 SCH/A216

Quasi-deuterons as surrogate for two-particle correlations in nuclear matter — •Stefan Typel[1,2] and Stefano Burrello[3] — [1]TU Darmstadt, Germany — [2]GSI, Darmstadt, Germany — [3]LNS-INFN, Catania, Italy

Properties of dense nuclear matter are often described using energy density functionals with nucleons as degrees of freedom and effective phenomenological interactions. They usually lack in an explicit treatment of correlations that are responsible for the formation of nuclear clusters at sub-saturation densities. Two-body correlations are also essential to explain the high-momentum tails of single-particle momentum distributions that are deduced from two-nucleon knockout experiments with energetic electrons or hadronic probes. In this contribution, the concept of quasi-deuterons in nuclear matter is introduced in a relativistic density functional to effectively describe two-nucleon correlations in dense nuclear matter above saturation. It extends the description of clustering in dilute nuclear matter using the concept of medium-dependent mass shifts.

HK 38: Heavy-Ion Collisions and QCD Phases VIII

Time: Wednesday 15:45–17:15 Location: SCH/A315

HK 38.1 Wed 15:45 SCH/A315

Critical dynamics in the real-time functional renormalization group — •Johannes Roth[1], Leon Sieke[1], and Lorenz von Smekal[1,2] — [1]Institut für Theoretische Physik, Justus-Liebig-Universität, 35392 Giessen, Germany — [2]Helmholtz Research Academy Hesse for FAIR (HFHF), Campus Giessen, 35392 Giessen, Germany

Real-time quantities such as spectral functions and transport coefficients can serve to examine the real-time evolution of a system close to equilibrium, as they encode the possible excitations in the medium and show universal static and dynamic scaling behavior near a critical point. The functional renormalization group (FRG) formulated on the Schwinger-Keldysh closed-time path provides an excellent calculational tool for such real-time correlations [1]. In this talk I will present a novel approach for the systematic construction of causal regulators for the FRG, which comply with the analytic structure of the propagators, and demonstrate that they can be interpreted as a coupling to a fictitious external heat bath with FRG scale dependent spectral distribution. As particular applications, I will discuss the relaxational Models A, B, and C according to the classification scheme by Halperin and Hohenberg, and show how they can be implemented in the real-time FRG. With this setup, I will then present results which demonstrate the generation of dynamic scaling behavior in spectral functions obtained from one and two-loop self-consistent truncation schemes.

[1] J. V. Roth, D. Schweitzer, L. J. Sieke, L. von Smekal, Phys. Rev. D **105** (2022) 116017.

HK 38.2 Wed 16:00 SCH/A315

A novel saturation-based 3+1D initial state model for Heavy Ion Collisions — •Oscar Garcia-Montero[1], Sören Schlichting[1], and Hannah Elfner[2] — [1]Fakultät für Physik, Universität Bielefeld — [2]GSI Helmholtzzentrum für Schwerionenforschung

We present a new 3+1D resolved model for the initial state of ultrarelativistic Heavy-Ion collisions, based on the $k_\perp$-factorized Color Glass Condensate hybrid approach. This new model responds to the need for a rapidity-resolved initial-state Monte Carlo event generator which can deposit the relevant conserved charges (energy, charge and baryon densities) both in the midrapidity and forward/backward regions of the collision. This event-by-event generator computes the gluon and (anti-) quark phase-space densities using the IP-Sat model, from where the relevant conserved charges can be computed directly. In the present work we have included the leading order contributions to the light flavor parton densities. As a feature, the model can be systematically improved in the future by adding next-to-leading order calculations (in the CGC hybrid framework), and extended to lower energies by including sub-eikonal corrections the channels included. We present relevant observables, such as the eccentricities and flow decorrelation, as tests of this new approach.

HK 38.3 Wed 16:15 SCH/A315

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 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-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 38.4 Wed 16:30 SCH/A315

Correlations in a Moat Regime — •Fabian Rennecke — Institut für Theoretische Physik, Justus-Liebig-Universität Giessen

The QCD phase diagram at large chemical potential is largely uncharted territory. Based on model studies, there are various phases that could occur in this regime. Among them are phases related to spatial modulations, such as inhomogeneous/crystalline phases, liquid crystals or a quantum pion liquid. A common feature of all these phases is that particles can have a moat dispersion, where the energy is minimized at nonzero momentum. This can directly affect particle production in the medium created by a heavy-ion collision and leads to characteristic signatures in particle correlations. I will discuss the underlying physics and present a formalism to study particle spectra on general hypersurfaces. Using this formalism, I will show that the correlations generated by the Hanbury-Brown–Twiss effect are promising probes for a moat regime in heavy-ion collisions.

HK 38.5 Wed 16:45 SCH/A315

Search for QCD Instantons with the ATLAS Detector — •Radek Vavricka and Matthias Schott for the ATLAS-Collaboration — Johannes Gutenberg University Mainz

The Standard Model of particle physics predicts the existence of quantum tunnelling processes across topological inequivalent vacua, known as Instantons. In the*electroweak sector, instantons provide a source

of baryon asymmetry within the Standard Model. In Quantum Chromodynamics they are linked to chiral symmetry*breaking and confinement. So far, no direct experimental evidence of instanton-induced processes has been found. Recently, new calculations for QCD Instanton processes in proton-proton collisions became public, suggesting promising experimental signatures at the LHC. In this work, we give an update on the ongoing searches for instanton signatures with the ATLAS Detector.

HK 38.6 Wed 17:00 SCH/A315

Fate of critical fluctuations in an interacting hadronic medium — •Jan Hammelmann[1], Marcus Bluhm[2], Marlene Nahrgang[2], and Hannah Elfner[3,1] — [1]Frankfurt Institute for Advanced Studies (FIAS) — [2]SUBATECH UMR 6457 — [3]GSI Helmholtzzentrum für Schwerionenforschung

We study the evolution of critical fluctuations in an expanding system within a hadronic transport approach. The system is initialized with particle number distributions coupled to the critical mode and the hadron gas then evolves in time with realistic hadronic interactions.

The initialization of the system with critical fluctuations is achieved by coupling the ideal hadron resonance gas cumulants to the ones from the 3d Ising model and generating the net and total particle numbers from the maximum entropy probability distribution.

We systematically investigate the evolution of the critical fluctuations initialized at various temperatures and chemical potentials along a freeze-out line and the dependency of the final state cumulants as a function of $\sqrt{s}$ is presented. Additionally, the sets of particles which are coupled to the critical mode are modified such that the strength of the propagation of correlations through interactions can be assessed. We find that in the scaling region of the critical point correlations are propagated through the whole collisional history and are still present after the kinetic freeze-out of the matter.

HK 39: Hadron Structure and Spectroscopy IV

Time: Wednesday 15:45–17:15 Location: SCH/A316

Group Report HK 39.1 Wed 15:45 SCH/A316

The BGOOD experiment at ELSA - exotic structures in the light quark sector? — •Thomas Jude for the BGOOD-Collaboration — Physikalisches Institut, Universität Bonn

The discoveries of the pentaquark states and XYZ mesons in the charmed quark sector initiated a new epoch in hadron physics, where the existence of exotic multi-quark states beyond the conventional three and two quark systems has been unambiguously realised. Similar structure may be evidenced in the light, uds sector, where access to a low momentum exchange and forward meson production region is crucial to study such phenomena. The BGOOD photoproduction experiment is uniquely designed to explore this kinematic region; it is comprised of a central calorimeter complemented by a magnetic spectrometer in forward directions.

Highlighted results include the indication of a peak-like structure in the $\gamma n \to K^0\Sigma^0$ cross section consistent with a meson-baryon interaction model which predicted the charmed P_C states. The same $K^*\Sigma$ molecular nature of this proposed $N^*(2030)$ is also supported in our measurement of $\gamma p \to K^+\Lambda(1405) \to K^+\pi^0\Sigma^0$, where it is predicted to drive a triangle singularity mechanism. In the non-strange sector, coherent meson photoproduction off the deuteron enables access to proposed dibaryon states, including the recently discovered $d^*(2380)$. Results will be presented which support recent experimental claims of higher mass isoscalar and isovector dibaryons.

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

HK 39.2 Wed 16:15 SCH/A316

Acceptance studies with pseudo data of the diffractive reaction $\pi^- + p \to a_2^-(1320)(\to \eta\pi) + p$ at COMPASS — •David Spülbeck, Henri Pekeler, and Bernhard Ketzer for the COMPASS-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

The COMPASS collaboration has recorded large data samples of diffractively produced final states with a 190 GeV hadron beam. First analyses of the final states $\eta^{(\prime)}\pi^-$ showed that these are golden channels to investigate the spin-exotic hybrid candidate $\pi_1(1600)$ experimentally.

For a successful partial-wave decomposition of the data using an extended likelihood fit, acceptance effects have to be corrected for. The presence of both charged and neutral particles in these final states makes a very good understanding of the full apparatus mandatory for a reliable acceptance correction. Wrong or missing acceptance corrections would lead to artifacts in the partial-wave decomposition and hence to possibly wrong conclusions.

In our ongoing analyses of the $\eta^{(\prime)}\pi^-$ final states, we use GEANT4-based Monte Carlo software to simulate the acceptance of our apparatus. To test its performance independently from any fit, we compare the kinematic distributions of real data and pseudo data for the almost isolated resonance $a_2^-(1320)$ decaying into $\eta(\to \pi^-\pi^+\pi^0(\gamma\gamma))\pi^-$ that have been accepted by our detector simulation.

Supported by BMBF.

HK 39.3 Wed 16:30 SCH/A316

Search for exotic states in η_c decays at BESIII — •Anja Brüggemann[1], Salleh Ahmed[1], Nils Hüsken[2], Nikolai in der Wiesche[1], Hannah Neuwirth[1], Ann-Christin Schluse[1], Anna Theimann[1], Frederik Weidner[1], and Alfons Khoukaz[1] for the BESIII-Collaboration — [1]Westfälische Wilhelms-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 taken from 2009 to 2019.

Resulting from the radiative J/ψ decay into $\gamma\eta_c$ we analyse the reactions $\eta_c \to \eta' hh$, where the hh system represents the K^+K^-, K_SK_S, $\pi^+\pi^-$, $\pi^0\pi^0$, $\eta\eta$ and $2\pi^+2\pi^-$ systems. Since the majority of these η_c decay modes are still unlisted in the particle data group database we determine the corresponding branching ratios. Furthermore, since these mesonic η_c decays constitute a gluon-rich environment they offer the opportunity to investigate possible exotic content in hh intermediate states, that lie in the mass region below 2 GeV/c^2, where the lightest glueball is predicted.

Incorporating all analysed η_c decay modes our study is based on a combined partial wave analysis approach, which gives access to the partial decay widths of contributing resonances decaying into the hh subsystems. These widths are directly comparable to theory predictions, that assume glueball admixtures carried by certain isoscalar scalar resonances. The current status of the analysis will be presented.

This work is funded by DFG - 269952272, 271236083 and 443159800.

HK 39.4 Wed 16:45 SCH/A316

Study of $e^+e^- \to K^+K^-\pi^+\pi^-\pi^+\pi^-$ at BESIII — •Sebastian Coen — Ruhr-Universität Bochum, Institut für Experimentalphysik I, 44801 Bochum

The BESIII experiment at the symmetric electron-positron collider BEPCII in Beijing has recorded large data samples at center of mass energies between 2.0 GeV and 4.9 GeV. This offers good opportunities for the spectroscopy of both charm and light hadrons. In the accessible mass range recent lattice QCD calculations predict a rich spectrum of glueball states.
In the reaction $e^+e^- \to K^+K^-\pi^+\pi^-\pi^+\pi^-$ at center of mass energies between 4.0 GeV and 4.9 GeV the production and decay of light mesons as well as the vector glueball, predicted at a mass of about 3.8 GeV/c^2 can be studied. Preliminary results and future prospects of the study will be presented.
Supported by DFG (CRC 110 / NSFC-DFG).

HK 39.5 Wed 17:00 SCH/A316

$K_S^0\Sigma^0$ photoproduction at the BGOOD experiment — •Adrian Sonnenschein and Katrin Kohl for the BGOOD-Collaboration — Physikalisches Institut, Nussallee 12, D-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_S^0 and hyperons is of particular interest. A cusp-like structure observed in the $\gamma p \to K_S^0\Sigma^+$ 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 at BGOOD from threshold to a beam energy of 2600 MeV. In this talk results will be presented using updated analysis techniques and improved statistical precision.

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

HK 40: Nuclear Astrophysics IV

Time: Wednesday 15:45–17:00 Location: SCH/A419

Group Report HK 40.1 Wed 15:45 SCH/A419
Nuclear astrophysics deep underground at LUNA and LUNA-MV — •Eliana Masha, Daniel Bemmerer, and Axel Boeltzig for the LUNA-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf (HZDR), 01328 Dresden, Germany

A precise knowledge of the cross sections of astrophysically relevant nuclear reactions is needed for understanding energy generation inside stars and the creation of the chemical elements. In stars, nuclear reactions take place at energies well below the repulsive Coulomb barrier. Hence, their cross-sections are often too small to be measured in laboratories at the Earth's surface, where the signal would be lost in the cosmic-ray-induced background. An efficient way to reduce the cosmic-ray-induced background is to perform experiments in underground laboratories. The Laboratory for Underground Nuclear Astrophysics (LUNA) is located deep underground at Gran Sasso National Laboratories (Italy). The reduced background achieved at LUNA allows to measure the nuclear cross sections directly at the relevant astrophysical energies. The presentation will give an overview of the recent results achieved at LUNA, and future perspectives on the LUNA experiment, including the new 3.5 MV LUNA-MV accelerator.

HK 40.2 Wed 16:15 SCH/A419
Low-background radioactivity counting at the most sensitive HPGe detector in Germany — •Steffen Turkat[1], Daniel Bemmerer[2], Axel Boeltzig[2], Jonas Koch[1,2], Till Lossin[1,2], Max Osswald[1,2], Konrad Schmidt[2], and Kai Zuber[1] — [1]Institut für Kern- und Teilchenphysik, TU Dresden, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The contribution reports about the commissioning of an ultra low-level γ-ray counting setup in the shallow-underground laboratory Felsenkeller in Dresden, Germany. It includes a high-purity germanium detector of 163 % relative efficiency within passive and active shields. The passive shield consists of 45 m rock overburden (140 meters water equivalent), 40 cm of low-activity concrete, 15 cm of high purity lead, 10 cm of oxygen-free radiopure copper, and an anti-radon box. The active veto is given by five large plastic scintillation panels surrounding the setup. All together, these shieldings attenuate the remaining background rate down to 116(1) $\mathrm{kg^{-1}d^{-1}}$ in an energy interval of [40 keV;2700 keV]. This is the lowest background of any HPGe detector in Germany, among the lowest worldwide, and enables studies of samples well below 1 mBq. In addition to the design of the setup, the underlying analysis techniques will be presented.

HK 40.3 Wed 16:30 SCH/A419
The new gas target system at the shallow underground laboratory Felsenkeller Dresden — •Anup Yadav, Konrad Schmidt, and Daniel Bemmerer — Helmholtz-Zentrum Dresden-Rossendorf

In experimental nuclear astrophysics, reaction studies with low cross sections are of interest. To measure those reactions directly, feasible possibilities include underground facilities to shield against cosmic rays and hence reduce the detector background, high intensity ion beams, and highly pure and stable targets. All those features will be available at the currently constructed und tested gas target setup for the shallow underground laboratory Felsenkeller Dresden. This setup combines a highly localized gas wall jet and an extended, static, windowless gas target. A unique feature in nuclear astrophysics applications is the in-situ monitoring of the jet thickness by a laser interferometry system. The talk will report on the gas target setup, its first thickness measurements, and suitable science cases in nuclear astrophysics.

HK 40.4 Wed 16:45 SCH/A419
Materie ist ein Aggregatzustand des Feldes der Raum-Energie — •Günter von Quast — Winterweg 4; 76344 Eggenstein-Leopolshafen

In dem isotropen Feld der Raum-Energie gibt es Ausgleichs- Strömungen. Die kugelförmigen Voids sind mit verdichteter Raum-Energie ausgefüllt und bauen sich ab. Das hat energetische Strömungen zur Folge. In diesen Strömungskanälen, den Filamenten zwischen den Voids, entstehen die Galaxien. Die Galaxien selber strömen wieder in Richtung der Galaxienhaufen und lösen sich dort als Elliptische Galaxien wieder zu der Raum-Energie auf. Das Feld der Raum-Energie ist ein Medium und hat Trägheitseffekte. Bei sehr starken Strömungen bilden sich deshalb Strudelsysteme aus, vergleichbar wie Hurrikane in dem Medium der Luft. Das sind die Zentren der Galaxien. In den Randbereichen dieser Strudelsysteme entstehen die Quarks als Grenzwirbel. Die Quarks sind elektrostatische Wirbelsysteme als Torkado- Strudel und Toroid-Strudel. Die Strudelfelder haben ultrahohe Rotationszahlen und bilden als Ergosphäre die Elektrostatische Ladung in Wechselwirkung mit dem ruhenden Feld der Raum-Energie aus. Die Elektrostatischen Felder der Strudelsysteme schließen sich wechselpolig zu den Nukleonen als Protonen, Neutronen und Elektronen zusammen. Aus den Nukleonen bilden sich die ersten Atome aus. Die Elektrodynamischen Felder zwischen den Quarks und Nukleonen sind dann die Bindungskräfte der Starken und der Schwachen Wechselwirkungen in den Atomen. Die Materie entsteht kontinuierlich in den Zentren der jeweiligen Galaxien vor Ort. Der Urknall der Standard- Theorien ist abgeschafft.

HK 41: Structure and Dynamics of Nuclei VII

Time: Wednesday 15:45–17:15 Location: SCH/A118

Group Report HK 41.1 Wed 15:45 SCH/A118
Lifetime measurements via the coincidence Doppler-shift attenuation method in Cologne — •Anna Bohn, Christina Deke, Felix Heim, Sarah Prill, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

A powerful tool to determine nuclear level lifetimes in the subpicosecond regime is the coincidence Doppler-shift attenuation method (DSAM) [1,2]. The target is positioned inside the combined particle-γ detector array SONIC@HORUS [3]. This allows reconstruction of the complete reaction kinematics for each event. Therefore, feeding contributions from higher lying states to the transition of interest are eliminated and specific transitions can be precisely selected. Hence, lifetimes of several dozens of excited states can be determined from a single experiment, using that the emission-angle dependent Doppler-shift of the deexciting γ-ray energy is linked to the attenuation time of the recoiling nucleus. Systematic studies were performed along isotopic chains [4-6], including Zr, Ru, Sn, and Te. Recent results obtained via the DSA method and by spectroscopy benefitting from coincidence measurements will be presented.

Supported by the DFG (ZI-510/9-1).

[1] A. Hennig *et al.*, NIM A **794** (2015) 171
[2] M. Spieker *et al.*, Phys. Rev. C **97** (2018) 054319
[3] S. G. Pickstone *et al.*, NIM A **875** (2017) 104
[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 41.2 Wed 16:15 SCH/A118

Nuclear Structure Studies from Mass Spectrometry of Isomeric States — •Lukas Nies — CERN, Switzerland — University of Greifswald, Germany

The nuclear binding energy arises from various effects that govern a nuclei's 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. Here, we present such measurements performed with the ISOLTRAP mass spectrometer located at ISOLDE/CERN. By evaluating the excitation energies of neutron-deficient indium isotopes down to the shell closure at N=50 against state-of-the-art shell model, DFT, and ab initio calculations, we contrast the performance of these theories applied to several nuclear properties. We further present evidence for shape-coexistences close to N=50 through the precise excitation energy measurement of the $(1/2)^+$ state in zinc-79, supported by accurate large-scale shell model calculations.

HK 41.3 Wed 16:30 SCH/A118

Lifetime measurement of excited states in ^{116}Xe — •Casper-David Lakenbrink[1], Marcel Beckers[1], Andrey Blazhev[1], Felix Dunkel[1], Arwin Esmaylzadeh[1], Christoph Fransen[1], Jan Jolie[1], Lisa Kornwebel[1], Claus Müller-Gatermann[2], and Franziskus v. Spee[1] — [1]IKP, Universität zu Köln, Deutschland — [2]Physics Division, Argonne National Laboratory, IL , USA

In the Sn, Te and Xe isotope chains, previous experiments showed a drop for the $B_{4/2} = B(E2; 4_1^+ \rightarrow 2_1^+)/B(E2; 2_1^+ \rightarrow 0_1^+)$ ratio of nuclei with mass $A \leq 114$. If this is caused by a shell effect, as is expected, the drop should correspond to the neutron number rather than the mass number and would be expected to happen at ^{116}Xe already. Transition strengths in ^{116}Xe have only once been measured using singles spectra, possibly suffering from undetected feeding. Thus, lifetimes in ^{116}Xe were evaluated using $\gamma\gamma$-coincidence data from a recoil-distance Doppler-shift experiment to investigate transition strengths without the need for assumptions on feeding. Excited states in ^{116}Xe were populated in the fusion-evaporation reaction ^{102}Pd(^{16}O,2n)^{116}Xe at the FN-tandem accelerator at the Institute for Nuclear Physics, University of Cologne. Lifetimes of the $2_1^+, 4_1^+$ and 6_1^+ states were evaluated using the differential decay-curve method as well as the lifetime of the 7_1^- state using simulations of spectra considering Doppler-shift attenuation effects. The corresponding B(E2), B(E1) values were calculated. We will present the results and compare these to a previous measurement as well as IBM1 calculations. This work was supported by the DFG, grant Nos. FR 3276/2-1 and DE 1516/5-1.

HK 41.4 Wed 16:45 SCH/A118

First direct lifetime determination of the 2_1^+ state of ^{210}Pb — •C. M. Nickel[1], M. Beckers[2], D. Bittner[2], A. Blazhev[2], A. Esmaylzadeh[2], B. Falk[2], C. Fransen[2], J. Garbe[2], L. Gerhard[2], K. Geusen[2], A. Goldkuhle[2], K. E. Ide[1], P. R. John[1], J. Jolie[2], V. Karayonchev[2], R. Kern[1], E. Kleis[2], L. Klöckner[2], M. Ley[2], N. Pietralla[1], G. Rainovski[3], F. Spee[2], M. Steffan[2], T. Stetz[1], V. Werner[1], and J. Wiederhold[1] — [1]TU Darmstadt — [2]U Cologne — [3]U Sofia

The investigation of transitions from the 2_1^+ to the g.s. in nuclei close to the doubly-magic ^{208}Pb allows to constrain parameters from nuclear models, e.g. the effective charges of the shell model. Nuclei containing two valence nucleons, like ^{210}Pb, are of particular importance [1], as their fundamental excitations form the low-lying nuclear states. The 2_1^+ state of ^{210}Pb was directly populated in a two neutron transfer reaction at the 10 MV FN Tandem Accelerator at the IKP of the University of Cologne. Its lifetime was measured using the Cologne plunger device and the RDDS method. The gamma radiation was detected with HPGe detectors and the back-scattered beam-like particles with silicon detectors. Corrections for contaminants were performed and, thus, for the first time the lifetime of the 2_1^+ state of ^{210}Pb was directly determined, being consistent with, but considerably more precise than, the only existing literature value obtained from triton scattering [2].

[1] D. Kocheva et al., Eur. Phys. J. A 53, 175 (2017).
[2] C. Ellegaard et al., Nucl. Phys. A 162, 1 (1971).
*Supported by the BMBF under Grant No. 05P21RDCI2.

HK 41.5 Wed 17:00 SCH/A118

Evolution of the first mixed-symmetry 2^+ state in the N=80 isotones — •T Stetz[1], R Zidarova[1], R Kern[1], V Werner[1], N Pietralla[1], T Abraham[2], U Ahmed[1], G Colucci[2], K Hadyńska-Klek[2], K E Ide[2], G Jaworski[2], M Kisieliński[2], M Komorowska[2], M Kowalczyk[1], M Liliana Cortes[2], P Napiorkowski[1], C Nickel[2], M Palacz[3], G Rainovski[2], J Samorajczyk-Pyśk[2], J Srebrny[3], M Stoyanova[2], A Trzcińska[2], K Wrzosek-Lipska[2], and B Zalewski[1] — [1]TU Darmstadt — [2]HIL Warsaw — [3]U Sofia

The evolution of the first mixed-symmetry 2^+ state in the N=80 isotones from ^{132}Te to ^{142}Sm has been of great interest for the past two decades [1,2,3,4,5]. A recent CoulEx experiment to investigate the M1 strength of the $2^+_{\mathrm{ms},1} \rightarrow 2_1^+$ transition of ^{142}Sm has been performed at HIE-ISOLDE [6]. A complementary experiment to determine the multipole mixing ratio of the aforementioned transition was conducted at the HIL in Warsaw in 2021. Combined, these experiments will expand the understanding of the first mixed-symmetry 2^+ state in this isotonic chain.

[1] M. Danchev *et al.*, Phys. Rev. C **84** (2011) 061306(R)
[2] T. Ahn *et al.*, Phys. Lett. B **679** (2009) 1
[3] N. Pietralla *et al.*, Phys. Rev. C **58** (1998) 796
[4] G. Rainovski *et al.*, Phys. Rev. Lett. **96** (2006) 122501
[5] R. Kern *et al.*, Phys. Rev. C **102** (2020) 041304(R)
[6] R. Kern *et al.*, J. Phys.: Conf. Ser. **1555** (2020) 012027
*Supported by BMBF 05P18RDCIA-TP1 and 05P21RDCI2-TP1

HK 42: Structure and Dynamics of Nuclei VIII

Time: Wednesday 15:45–17:15 Location: SCH/A215

Group Report HK 42.1 Wed 15:45 SCH/A215

Nuclear structure studies far from stability with the FRS Ion Catcher — •Christine Hornung for the FRS Ion Catcher-Collaboration — GSI, Darmstadt, Germany,

At the FRS Ion Catcher at GSI, projectile and fission fragments are produced at relativistic energies at the FRS, separated in-flight, range-focused, slowed-down and thermalized in a cryogenic stopping cell and transmitted to a Multiple-Reflection Time-of-Flight Mass Spectrometer (MR-TOF-MS) for high-accuracy (down to $\Delta m/m \sim 10^{-8}$) direct mass measurements. Mass measurements of projectile fragments in the vicinity of ^{100}Sn were performed, including the first direct mass measurement of the ^{98}Cd ground state and the discovery of isomeric states. The measured excitation energies are compared with large-scale shell model calculations; they indicate the importance of core excitation around ^{100}Sn. Light neutron-deficient lanthanides were investigated. In this measurement the potential to perform surveys covering a large region on the chart of nuclei using an MR-TOF-MS was shown. Additionally, mass measurements of neutron-rich nuclei revealed evidence for shape transitions in the $N \approx 90$, Z=56-63 region. These results, recent technical upgrades at the FRS-IC, news from the next-generation CSC for the Super-FRS at FAIR and an outlook to plans for future experiments will be presented.

HK 42.2 Wed 16:15 SCH/A215

Fragmentation cross-sections of 1 GeV/u ^{208}Pb on ^{9}Be measured at the FRS — •Suraj K. Singh for the S450-Collaboration — GSI, Darmstadt, Germany — Justus-Liebig-Universität Gießen, Germany

Studies of nuclei far from the valley of stability, where extreme proton-to-neutron ratios appear, are particularly interesting because they provide insight into the nuclear structure and astrophysical nucleosynthesis processes. The nuclei are important for studies of the nuclear-existence limit, and for the understanding of nuclear reaction mechanisms. For such studies of the exotic isotopes, production cross-section measurements are the basic step of any research. The knowledge of accurate production cross-sections is essential for further development of reaction models and every new experiment based on a certain reaction.

In this contribution, the evaluation of production cross-sections of exotic nuclei close to 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 42.3 Wed 16:30 SCH/A215

^{12}C(p,2p)^{11}B Quasi-Free-Scattering in Inverse Kinematics at R^{3}B — •Tobias Jenegger, Philipp Klenze, Lukas Ponnath, and Roman Gernhaeuser — Technische Universität München, Germany

The advanced R^{3}B setup at GSI allows to investigate proton-induced-quasi-free one-nucleon knockout reactions of exotic nuclei in inverse kinematics. This technique gives direct access to the momentum distributions of the scattered off protons in the nucleus before as well as the recoil momentum of the remaining spectator nucleus. In addition to the correlated gamma spectrum it is a powerful tool to unveil individual states populated in the reaction. The CALIFA calorimeter, with its 2528 CsI scintillation crystals in its final design, is a key detector in quasi-free-scattering experiments at R^{3}B. It allows to detect both the two coincident protons from the quasi-free-scattering process and emitted γ-rays from de-excitation of the remaining nucleus with high angular resolution and precise Doppler correction.
For the heavy residues unique particle identification was performed with multi-sampling ionisation chambers and a high resolution tracking system before and after the GLAD magnet, resulting in a relative mass resolution of less than 0.5 percent.
We present the analysis of the S444 experiment performed in the FAIR Phase-0 campaign with relativistic ^{12}C beams at various energies focusing on the quasi-free-scattering process, and the reconstruction of the associated gamma ray spectra.

HK 42.4 Wed 16:45 SCH/A215

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

In order to constrain the largely unknown multi-neutron interactions, it is necessary to measure the relevant observables sensitive to them. In the current work we plan to investigate multi-neutron resonances close to the corresponding neutron removal thresholds in neutron-rich light nuclei. The objective is to search for and characterize the systematic appearance of narrow resonances related to multi-neutron cluster structures and correlations near the respective cluster thresholds, similar to the popular alpha cluster resonant states. For this purpose an experiment has been recently concluded at the R^{3}B Setup in GSI. The $(p, 2p)$ reactions are studied in inverse kinematics where a radioactive ion "cocktail" beam is impinged on a 5cm LH_2 target. The resulting reaction products are measured using a large combination of detector systems providing information of the full reaction kinematics. Of particular interest is the neutron detector NeuLAND, which thanks to its high resolution and granularity provides access to the detailed study of multi-neutron resonances aimed for in this work.
Supported by HFHF, the GSI-TU Darmstadt cooperation and the BMBF project 05P21RDFN2

HK 42.5 Wed 17:00 SCH/A215

Correlation Experiments in Photofission* — •Vincent Wende[1], Dimiter Balabanski[4], Joachim Enders[1], Sean W. Finch[2], Alf Göök[3], Calvin R. Howell[2], Ronald C. Malone[6], Maximilian Meier[1], Andreas Oberstedt[4], Stephan Oberstedt[5], Marius Peck[1], Norbert Pietralla[1], Jack A. Silano[6], Gerhart Steinhilber[1], Anton P. Tonchev[6], and Werner Tornow[2] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [3]Uppsala Universitet, Uppsala, Sweden — [4]ELI-NP, IFIN-HH, Magurele, Romania — [5]EC-JRC Geel, Belgium — [6]Lawrence Livermore National Laboratory, Livermore, CA, USA

Mass, total kinetic energy and polar as well as azimuthal angular distributions of fission fragments were measured simultaneously using a position-sensitive twin Frisch-grid ionization chamber [1]. We present results of a pioneering ^{238}U(γ,f) experiment at the High-Intensity γ-Ray Source (HIγS) facility at Triangle Universities Nuclear Laboratory (TUNL) at an excitation energy of 11.2 MeV [2] as well as the first data from follow-up ^{234}U(γ,f) and ^{232}Th(γ,f) experiments with excitation energies near the fission barrier.
*Supported by HMWK (LOEWE Cluster Nuclear Photonics)
[1] A. Göök et al., Nucl. Instrum. Methods A 830, 366 (2016); M.Peck et al., EPJ Web of Conferences 239, 05011 (2020).
[2] M. Peck, PhD Dissertation, TU Darmstadt (2020).

HK 43: Fundamental Symmetries II

Time: Wednesday 15:45–17:15 Location: SCH/A252

Group Report HK 43.1 Wed 15:45 SCH/A252

The search for Charged Lepton Flavour Violation with the Mu2e experiment — •Anna Ferrari[1], Stefano Di Falco[2], Valerio Giusti[3], Stefan E. Müller[1], Oliver Knodel[1], Vitaly Pronskikh[4], and Reuven Rachamin[1] for the Mu2e-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]INFN Pisa, Pisa, Italy — [3]University of Pisa, Pisa, Italy — [4]Fermi National Accelerator Laboratory, Batavia, IL, USA

The Mu2e experiment, currently under construction at Fermilab (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 sensitivity four orders of magnitude better than previous experiments. To achieve such a goal, a reliable estimate of the relevant particle yields and a rigorous control of all backgrounds are mandatory, together with an accurate normalization of signal events.

An extensive campaign of Monte Carlo simulations has been therefore performed to investigate key yields and beam and cosmic rays-related backgrounds. In addition, at the Helmholtz-Zentrum Dresden-Rossendorf the pulsed Bremsstrahlung photon beam at the ELBE facility has been used to study the performance of the detector system that will monitor the rate of the stopped muons in the aluminum target.

The design and present status of the Mu2e experiment will be presented, together with the main results of the background and sensitivity studies, and a summary of the results of the ELBE campaign.

Group Report HK 43.2 Wed 16:15 SCH/A252

Status of the COMET experiment — •Andreas Jansen, Thomas Kormoll, Dominik Stöckinger, and Kai Zuber — TU Dresden, Institut für Kern- und Teilchenphysik, Germany

The COMET experiment, currently being built in Tokai, Japan, will search for the coherent neutrinoless transition of muons to electrons in the Coulomb field of atomic nuclei ($\mu^- + \mathrm{N} \to e^- + \mathrm{N}$). While the total lepton number L is conserved, with no out-going neutrinos the individual lepton flavors L_e and L_μ are violated by one unit.

This charged lepton flavor violation involving muons is one of the most promising Beyond Standard Model (BSM) fields currently under investigation. Not only do recent results regarding the muon anomalous magnetic moment (g-2) present a very strong motivation for muon BSM, but also current best experimental limits barely fall short of the predicted conversion rate in many widely acknowledged BSM theories (e.g. supersymmetric theories).

In order to realize stringent requirements on the detector system and muon beam, the COMET experiment will follow a staged approach. Phase-I aims to improve the current branching ratio limit of 7×10^{-13} by two orders of magnitude while also allowing data taking of beam dynamics and validation of Monte Carlo simulations. In Phase-II the branching ratio limit will be additionally improved by at least two orders of magnitude.

This talk will give an experimental overview of both phases, recent updates on the facility and the current detector development status.

HK 43.3 Wed 16:45 SCH/A252

Effect of magnet cycling on the magnetic field tracking uncertainties in the Fermilab g–2 experiment — •René Reimann,

Mohammad Ubaidullah Hassan Qureshi, and Martin Fertl for the Muon g–2-Collaboration — Institute of Physics and Excellence Cluster PRISMA+, Johannes Gutenberg University Mainz, 55099 Mainz, Germany

The Muon g–2 Collaboration has presented the most precise measurement of the anomalous magnetic moment a_μ with an uncertainty of 460 ppb. To achieve the goal of 140 ppb uncertainty, more than a factor of nine times the published data have been recorded, but systematic uncertainties must also be reduced. A key parameter in determining a_μ is the precise value of the homogeneous 1.45 T magnetic field in which the muons are stored. Two systems using nuclear magnetic resonance (NMR) techniques are used to track the magnetic field in the muon storage ring. One system measures the spatial magnetic field distribution every few days in the storage region itself, and the other system measures the magnetic field drift continuously with probes in the walls of the vacuum chambers of the storage ring. Cycling the storage ring magnet introduces additional field drifts which are challenging for the tracking of the averaged magnetic field. In this talk, I will present the effect of magnet cycling on the tracking of the magnetic field and its uncertainty.

HK 43.4 Wed 17:00 SCH/A252

Upgrading antihydrogen production in AEgIS — •Saiva Huck — CERN, Meyrin, Switzerland — University of Hamburg, Inst. f. Experimental Physics, Hamburg, Germany

The AEgIS (Antimatter Experiment: Gravity, Interferometry, Spectroscopy) collaboration, based at CERN's Antiproton Decelerator (AD) complex, produces antihydrogen atoms in the form of a pulsed, isotropic source with a precisely defined production time. $\bar{H}$ is formed by means of a charge exchange reaction: antiprotons are captured from the AD inside a Penning-Malmberg trap, further sympathetically cooled with electrons, and then combined with positronium atoms, which are previously laser-excited to Rydberg states.

The focus of research in AEgIS is on the formation of a pulsed horizontal beam of $\bar{H}$ atoms utilized to investigate their vertical deflection due to the influence of gravity, thereby probing the Weak Equivalence Principle for antimatter and providing a test of the CPT theorem.

Since the first $\bar{H}$ formation in 2018, AEgIS has undergone several significant upgrades aimed at improving the efficiency of antihydrogen production and fully benefiting from the newly added ELENA (Extra Low ENergy Antiproton) decelerator at the AD, which commenced operation in fall of 2021 and yields antiprotons in larger numbers at lower energies. Subsequently, work is being undertaken to re-establish $\bar{H}$ production, in larger numbers, and move towards beam formation.

This contribution gives an overview of the improvements to the AEgIS setup, results obtained during the first beam times with ELENA, and progress towards the formation of a pulsed $\bar{H}$ beam.

HK 44: Instrumentation XII

Time: Wednesday 17:30–19:00 Location: SCH/A251

Group Report HK 44.1 Wed 17:30 SCH/A251

Status of the CBM Silicon Tracking System — •Marcel Bajdel for the CBM-Collaboration — Goethe-Universität Frankfurt am Main — GSI Helmholtz Centre for Heavy Ion Research

The Compressed Baryonic Matter (CBM) is one of the core experiments at the future Facility for Anti-proton and Ion Research (FAIR), Darmstadt, Germany. The Silicon Tracking System (STS) is a central detector system of CBM, placed inside a 1 Tm magnet and with an operation temperature of about -10 $°C$ to keep low radiation-induced bulk current in the 300 μm double sided microstrip silicon sensors.

The STS comprises eight tracking stations with 876 modules. Each module is calibrated and tested in order to access its performance. Next steps involve mounting the module on a carbon ladder, and subsequently these objects are arranged horizontally on so-called C-frames.

The purpose of this contribution is to give an overview of the recent progress towards the STS detector. The first major milestone is the operation of the readout chain and detector control system of the miniaturized version of STS, which features 11 detector modules. The second accomplishment features the commissioning efforts of the thermal demonstrator which serves to validate the concept for crucial services of the STS (cooling, air drying, ambient conditions measurements). Lastly, the preproduction of the detector modules has started, and the first results collected.

HK 44.2 Wed 18:00 SCH/A251

Quantifying the Dual-Sided Silicon Strip Detectors at R3B — •Andrea Jedele[1,2], Dominic Rossi[1,2], and Thomas Aumann[1,2] for the R3B-Collaboration — [1]TU-Darmstadt, Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Dual-sided silicon strip detectors allow for accurate position and charge determination of in-beam fragments for heavy-ion collisions with minimal spatial restraints. The X5 Micron silicon detectors have been used in the R3B set-up at GSI. Improvements have been implemented to the hardware of the detector and a new calibration method has been developed and tested for beams of primary and secondary Sn isotope experiments.

Supported in part by BMBF (05P21RDFN2), Helmholtz Forschungsakademie Hessen für FAIR and GSI-TU Darmstadt cooperation agreement

HK 44.3 Wed 18:15 SCH/A251

HI-TREX: Compact, high resolution particle detection system for ISOLDE — Roman Gernhäuser, •Sergei Golenev, and Robert Neagu for the MINIBALL-Collaboration — Technische Universität München, Germany

HI-TREX is a particle detection setup, developed for the HIE-ISOLDE facility at CERN, optimized for transfer reactions using radioactive ion beams. HI-TREX is based on a very thin double-sided silicon strip detector (DSSSD), high-resolution front-end electronics based on SKIROC ASICs, and a newly developed, custom made, FPGA based GEneric Asic Readout board GEAR for the TRB data acquisition system.

A full system test with an array of four detectors in a two arm geometry was performed at the Bronowice Cyclotron Center in Krakow using proton beams with energies ranging from 80 to 200 MeV.

With ancillary CsI(Tl) scintillation detectors behind the setup and a plastic fiber target a full 4-momentum reconstruction of the 12C(p,2p) reactions is performed. We will present first results on calibrations, the energy resolution and the event correlations to determine absolute efficiencies of the new detector elements.

(supported by BMBF 05P21WOCI1)

HK 44.4 Wed 18:30 SCH/A251

A new concept for the geometry of the Silicon Tracking System in the CBM Experiment — •Mehulkumar Shiroya — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Compressed Baryonic Matter experiment is a fixed target experiment planned to be built at the Future Facility of Anti-Proton and Ion Research at the GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany. The Silicon Tracking System is the main detector for tracking and momentum determination of the CBM experiment. It is designed to measure up to 700 charged particles produced in nucleus-nucleus collisions up to an interaction rate of 10 MHz, and achieve a momentum resolution in 1 Tm dipole magnetic field better than 2%. It uses double-sided micro-strips silicon sensors with a thickness of 320 $\pm$ 15 μm arranged in 8 tracking stations. Since the CBM magnet cannot be realized as previously planned, the originally intended monolithic design which minimizes the detector dimensions can be replaced by a modular structure independently assembled, called STS-3 & STS-5, and a full separation of services (low/high voltage, front-end, cooling, etc). A ROOT based geometrical model for the new conceptual design of the STS, including a detailed description of the passive material, has been implemented. The performance for track reconstruction and momentum determination has been studied in comparison with the old design with Au+Au simulations at different colliding energies. Further detailed information will be presented during the conference.

HK 44.5 Wed 18:45 SCH/A251

Light-weight but dense: mechanics and integration of Silicon Tracking System of the CBM experiment — •Maksym Teklishyn[1,2] and Oleg Vasylyev[1] for the CBM-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung — [2]Kyiv Institute for Nuclear Research

Silicon Tracking System (STS) is a core tracking detector of the future heavy-ion CBM experiment at FAIR. Requirements to cope with unprecedentedly high beam-target interaction rate (up to 10 MHz), multiple low-momentum reaction products (up to 700 charge particles per central collision) challenge the detector technologies.

STS features fast light-weight detector modules of various form factors. They are made of the 300 μm thick 2×1024 channel double-sided double-metal silicon sensors connected to the dedicated read-out electronics by 32 thin aluminium-polyimide micro-cables of up to 500 mm length. The STS assembly features highly integrated unique components. The basic blocks of STS are 876 detector modules in 199 unique configurations. They are arranged on the light-weight carbon-fibre mechanical support structures forming ladders of 8 or 10 modules each. There are 106 ladders in 38 ladder types; they form 8 tracking layers on 18 aluminium supports. They also accommodate powering and back-end read-out electronics, and liquid cooling.

Recently, STS team altered the detector mechanical design: STS may be split in upstream and downstream parts with 3 and 5 tracking layers, respectively. This introduces flexibility for running scenarios ($2 - 11$ AGeV for Au ions) and facilitates upgrade.

HK 45: Instrumentation XIII

Time: Wednesday 17:30–19:00 Location: SCH/A.101

HK 45.1 Wed 17:30 SCH/A.101

Photon Detection with THGEMs — •Thomas Klemenz[1], Laura Fabbietti[1], Piotr Gasik[2], Roman Gernhäuser[1], and Berkin Ulukutlu[1] — [1]Techinsche Universität München, Garching, Germany — [2]FAIR/GSI GmbH, Darmstadt, Germany

Traditional devices for photon detection like the Photomultiplier Tube or more recent technologies such as Silicon Photomultipliers are not easily scalable and rather cost-intensive.. Therefore, especially with large area experiments in mind it is exciting to investigate new ways of detecting photons. In this project we are taking the approach of combining a photosensitive material with a Thick GEM (THGEM) to produce a gaseous photon detector. THGEMs are robust, low-cost devices, which can be easily implemented in large area applications. One side of the THGEM is coated with a photosensitive material and placed within an electrical field. Photons captured by the active surface lead to a release of electrons which drift into the THGEM hole where they undergo avalanche multiplication due to strong electric fields applied. Below the THGEM an anode is reading out the amplified electron signal. Depending on the gain of the THGEM this could enable single photon detection. We want to study the potential of this approach while trying different photosensitive materials. Ultimately, we aim to measure visible wavelength photons and to provide a low-cost, large area solution for neutrino observation in water and ice environments. In the talk the current status of the project is discussed.

This work is funded by the BMBF Verbundforschung (05P21WOCA1 ALICE) and the DFG Sachmittel FA 898/5-1.

HK 45.2 Wed 17:45 SCH/A.101

The novel XYU-Readout for ambiguity-reduced tracking — •Karl Jonathan Flöthner[1,2], Florian Brunbauer[1], Serge Ferry[1], Francisco García[3], Djunes Janssens[1], Bernhard Ketzer[2], Marta Lisowska[1], Hans Muller[1], Rui de Oliveira[1], 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], Antonija Utrobicic[1], and Rob Veenhof[1] — [1]CERN, Geneva, Switzerland — [2]University of Bonn, Germany — [3]HIP, Helsinki, Finland — [4]ESS, Lund, Sweden

Signals generated in gaseous detectors such as GEM-based detectors are often read out by strips providing one or two coordinates of a track. Such a strip-based readout (R/O) often suffers from ambiguities. For particle tracks, these are usually removed by pattern recognition. For the detection of photons, e.g. in a RICH detector, however, they have to be removed in a single detector. Solutions for this problem on the detector level are additional information about the signal amplitude, or a pixelated readout. The latter, however, results in a huge increase in the number of electronic channels and the material budget. Therefore, the XYU-R/O was proposed as a three-coordinate strip-readout. The fact that no vias are needed inside the active area is a novelty of the design and important for a reliable and simple production. The talk will cover results from X-ray measurements and will be complemented by test beam data from October 2022.

HK 45.3 Wed 18:00 SCH/A.101

Stabilized voltage divider for GEM detectors — •Oliver Adam, Philip Hauer, Christian Honisch, Dimitri Schaab, Dominik Schüchter, Marco Vogt, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

Multi-GEM detectors often use the simple principle of classic voltage dividers to supply their electrodes with high voltages. The problem with that kind of voltage supply (passive voltage divider) is that the voltages change when additional currents are produced inside the detector at high irradiation rates, which are taken up by the electrodes. In addition, the effect of occasional sparks inside the detector is traditionally minimized using high-ohmic bias resistors, which again modify the electrode potentials in case of non-negligible currents. Using active components (source follower) instead of passive resistors offers away to overcome these drawbacks. The resistor chain is stabilized with a transistor chain and has an active current limit. Simulations support these considerations. In measurements with X-ray and radioactive sources, we investigate the gain stability at high rates and the stability against discharges. This talk will cover the working principle of the stabilized voltage divider. Furthermore the results of simulations and measurements will be discussed.

HK 45.4 Wed 18:15 SCH/A.101

Studying the Impact of Humidity on the Performance of MPGDs — •Henrik Fribert[1], Piotr Gasik[2], Berkin Ulukutlu[1], and Laura Fabbietti[1] — [1]Technische Universität München, Garching, Germany — [2]FAIR/GSI GmbH, Darmstadt, Germany

MPGDs (Micro-Pattern Gaseous Detectors) are gaseous detectors used in high-energy physics experiments like ALICE or ATLAS at the LHC. Despite 30 years long experience in the production and successful operation of this type of detector, the effect of water contamination of the gas composition on their performance is still a subject of debate. We contribute to this topic with systematic studies using several MPGDs (GEMs, THGEMs, and Micromegas) operated with an Ar-CO2 mixture and introducing water content in a range of 0-5000 ppmV. Detector performance is evaluated while varying the humidity level for each type of MPGD under study. The water is introduced to the detector vessel by incorporating a water-filled bubbler into the gas system, through which gas can be flushed at different rates. It is observed that the presence of increased humidity does not degrade any of the studied performance criteria. On the contrary, our measurements suggest an improvement in discharge stability with increasing humidity levels, at the highest gains and fields. We conclude, that adding a small amount of water to the gas mixture may be beneficial for the stable operation of an MPGD. This work is funded by the BMBF Verbundforschung (05P21WOCA1 ALICE) and the DFG Sachmittel FA 898/5-1.

HK 45.5 Wed 18:30 SCH/A.101

Investigations on the Signal-to-Noise Ratio of the VMM Readout Chip with a GEM Detector — •Virginia Klapper[1], Karl Flöthner[1,3], Pascal Henkel[1], Michael Lupberger[1,2], and Bernhard Ketzer[1] — [1]Universität Bonn, Helmholtz- Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Universität Bonn, Physikalisches Institut, Bonn, Germany — [3]CERN, Geneva, Switzerland

Dedicated readout chips are required to collect, preamplify and further process the data generated by microstructured particle detectors. The VMM is an ASIC that was developed for the ATLAS New Small Wheel upgrade. It operates in a self-triggered mode, thus not requiring an

external trigger signal for data readout, which gives much more flexibility for complex selection criteria in the high-level software trigger. This chip is a candidate to read out novel high-rate GEM detectors at the AMBER experiment at the CERN SPS. We are in particular interested in the Signal-to-Noise Ratio (SNR) and how it compares to the APV25 chip that has been used for GEM readout at COMPASS.

This presentation focuses on a setup to measure the SNR with cosmic muons. A GEM detector read out by VMM chips is sandwiched between two scintillators with photomultipliers. The coincidence signal is injected into a trigger board connected to a separate VMM frontend board. This way, the triggers are timestamped as belonging to data from the detector.

This contribution presents the SNR measurements for a variety of parameters like different gas gains or VMM thresholds.

HK 45.6 Wed 18:45 SCH/A.101

Data analysis of a GEM detector with VMM3a readout at the AMBER pilot run — •Pascal Henkel[1], Karl Jonathan Flöthner[3,1], Virginia Klapper[1], Michael Lupberger[1,2], and Bernhard Ketzer[1] — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Universität Bonn, Physikalisches Institut, Bonn, Germany — [3]CERN, Geneva, Switzerland

In its first phase, the AMBER experiment at CERN SPS plans, among others, a measurement of the proton form factor at small Q2, using high-energy muon-proton elastic scattering. During a pilot run in October 2021 a GEM-based planar tracking prototype detector took data using the self-triggered VMM3a ASIC as readout chip. The purpose was a first test of the prototype detector in a high muon rate environment and in various configurations of the chip. The time-stamped VMM data has to be combined with the triggered data from the COMPASS spectrometer and other detectors in the pilot run setup. For synchronization, COMPASS trigger signals where injected into a dedicated VMM chip, such that they were timestamped.

In the ongoing analysis the obtained data is brought into temporal match with the external trigger which will make it possible to reconstruct particle tracks from the triggered detectors and correlate them with the signals measured by the prototype detector. The results should give insights that help optimizing the chip configurations in order to evaluate in future measurements how the VMM3a performs in comparison to the APV25 readout chip for COMPASS GEMs.

HK 46: Heavy-Ion Collisions and QCD Phases IX

Time: Wednesday 17:30–19:00 Location: SCH/A216

Group Report HK 46.1 Wed 17:30 SCH/A216

Open heavy-flavour hadron production from small to large collision systems at the LHC with ALICE in Run 2 and beyond — •Annalena Kalteyer for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

This talk will present the latest measurements performed by the group for heavy-flavour baryon production at midrapidity in pp, p–Pb and Pb–Pb collisions at the LHC. Small collision systems, like pp, allow for precision measurements of rare particle species, and they can serve as a reference for heavy-ion collisions. Proton-lead collisions are in particular useful to study cold nuclear matter effects, and with Pb–Pb systems we study heavy-flavour production in heavy-ion collisions and their interaction with the quark-gluon plasma.
We will show the measurement of Λ_c^+ down to $p_T = 0$ in pp and p–Pb collisions, together with the obtained nuclear modification factor, thanks to the recently measured Λ_c^+ also in Pb–Pb collisions. Furthermore, due to sophisticated machine learning techniques, it was possible to gain indirect information on beauty baryon production by measuring Λ_c^+ coming from the decay of beauty hadrons, both in pp and p–Pb collisions. Finally, results of heavy charm baryons, such as $\Xi_c^{0,+}$ and Ω_c^0, will be discussed. Since data taking in Run 3 at the LHC started in July 2022, we will show a first look on Run 3 data, plus some studies on vertex determination with the KFParticle package and heavy-flavour triggers for rare particles and beauty hadrons.

HK 46.2 Wed 18:00 SCH/A216

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

Recent measurements of the production of charm hadrons at midrapidity in pp collisions at $\sqrt{s} = 5.02$ TeV showed that the baryon-to-meson yield ratios are significantly higher than those measured in e^+e^- collisions for different charm-baryon species. These observations suggest that the charm fragmentation fractions are not universal and depend on the collision systems. In this talk, the new measurement of the p_T-differential cross section times branching ratio of the Ω_c^0 baryon measured in the decay channels $\Omega_c^0 \to e\Omega\nu$ and $\Omega_c^0 \to \pi\Omega$ in pp collisions at $\sqrt{s} = 13$ TeV will be reported. The measurement of the Ω_c^0 baryon, containing 2 strange quarks, gives further constraints on charm-quark hadronisation models. The final result will be compared with theoretical calculations.

HK 46.3 Wed 18:15 SCH/A216

Charm production in proton–proton collisions at $\sqrt{s} = 13$ TeV measured with the ALICE detector — •Carolina Reetz for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

Recent measurements of charm fragmentation fractions of single charm ground state hadrons at midrapidity in proton–proton (pp) collisions at $\sqrt{s} = 5.02$ TeV at the LHC significantly differ from the values obtained in e^+e^- and ep collisions. Therefore the assumption of universality of the charm-to-hadron fragmentation fractions across different collision systems might not be fully supported.
New p_T-integrated cross section measurements of prompt D^0, D^+, D_s^+, D^{*+}, Λ_c^+ and Ξ_c^+ in pp collisions at $\sqrt{s} = 13$ TeV are presented. The relative abundance of the different charm hadron species, which is sensitive to hadronization mechanisms, is shown and compared to model calculations. The presented charm hadron cross section measurements are used to evaluate the charm fragmentation fractions and the total charm production cross section at midrapidity in pp collisions at $\sqrt{s} = 13$ TeV. The new measurement of the Ξ_c^+ production cross section down to low transverse momenta is extrapolated to $p_T = 0$ for the first time. The Ξ_c^+ fragmentation fraction is calculated and the contribution is included in the total charm production cross section.

HK 46.4 Wed 18:30 SCH/A216

Reconstruction of displaced decay vertices in an inhomogeneous magnetic field with a Kalman Filter based tracking algorithm at HADES — •Mirco Parschau for the HADES-Collaboration — Goethe University Frankfurt am Main

The high interaction rate, fixed target experiment HADES at GSI, located in Darmstadt, Germany, investigates collisions of heavy-ion, proton and secondary pion beams with a target material. Hyperons are one of the key observables for both heavy-ion and elementary collisions. The challenge is to detect displaced vertices with good accuracy without having a dedicated vertex detector, by employing state-of-the-art techniques.

In this contribution we discuss a newly developed tracking algorithm that uses a Kalman Filter to further boost the track reconstruction performance and the reconstruction of displaced vertices from hyperons.

This work has been supported by BMBF (05P21RFFC2), GSI, HFHF, the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and HGS-HIRe.

HK 46.5 Wed 18:45 SCH/A216

Performance test of the KF Particle vertexing package for open heavy flavour baryon reconstruction with the ALICE detector — •Phil Stahlhut for the ALICE Germany-Collaboration — Physikalisches Institut, Universität Heidelberg

The study of charm baryon production is crucial to understand charm hadronisation processes in a parton-rich environment. In order to extract signal even in low transverse momentum (p_T) regions where the signal-to-background ratio is rapidly decreasing, a precise vertex reconstruction is of upmost importance.

The Kalman Filter Particle package gives a fast reconstruction of

complex decay topologies providing a full description of the decay particle both at its production and decay vertex. It is suitable even for high-density track environments. In addition to that, the KF Particle package supports the use of geometrical, mass and topological constraints in the reconstruction process and includes the complete treatment of tracking and vertexing uncertainties.

In this work, the KF Particle package was used to reconstruct the Ξ_c^+ baryon from its decay to $\Xi^-\pi^+\pi^+$ in simulated proton–proton collisions at a center-of-mass energy of $\sqrt{s} = 13$ TeV. This contribution will demonstrate the effect of geometrical, mass and topological constraints on the secondary vertex, p_T and mass resolution of the reconstructed Ξ_c^+ baryon.

HK 47: Heavy-Ion Collisions and QCD Phases X

Time: Wednesday 17:30–18:45 Location: SCH/A315

HK 47.1 Wed 17:30 SCH/A315

Light Nuclei Emission in Ag+Ag Collisions — •Marvin Nabroth for the HADES-Collaboration — Institut fuer Kernphysik, Frankfurt, Deutschland

This contribution gives an overview of data on protons, deuterons and He3, emitted in Ag+Ag collisions at $\sqrt{s_{NN}} = 2.55$ GeV measured at HADES. Covered is the procedure of particle identification based on a Bayesian ansatz as well as the process of acceptance and efficiency correction and extrapolation into uncovered phase space regions. The reconstructed transverse mass spectra and resulting rapidity density distributions as a function of the collision centrality are presented and a comparison of the 4π yield to the world data in the low energy regime, as a function of collision energy, is discussed.
Detailed knowledge of the production yields and phase space spectra is of special interest when it comes to test to what extent thermal models can describe the nature of a heavy-ion collision in the low-energy regime and to understand the mechanisms under which light nuclei are formed during a heavy-ion collision.
This work has been supported by BMBF (05P21RFFC2), GSI F&E and HGS-HIRe.

HK 47.2 Wed 17:45 SCH/A315

Testing coalescence by studying (anti)nuclei production in and out of jets in ALICE — •Chiara Pinto for the ALICE Germany-Collaboration — Technische Universität München, München, Deutschland

The production mechanism of (anti)nuclei in ultrarelativistic hadronic collisions is under intense debate in the scientific community. The description of the experimental measurements is currently based on two competing phenomenological models: the statistical hadronisation model and the coalescence approach. For the first time, the deuteron production in pp collisions at \sqrt{s}= 13 TeV is measured both in jets and in the underlying event. Due to the collimated emission of nucleons in a jet, the nuclear production by coalescence is expected to be enhanced. In this contribution, the results for the coalescence parameter B2 in and out of the jet are presented in comparison with predictions from the coalescence model and a recently developed reaction-based production mechanism implemented in PYTHIA 8.3.

This work is funded by DFG SFB1258 and by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 47.3 Wed 18:00 SCH/A315

Measurement of proton-deuteron correlations in Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV — •Michael Jung for the ALICE Germany-Collaboration — Institut für Kernphysik Frankfurt

The first measurement of p–d two-particle correlations measured with ALICE in central and semi-central Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV will be presented. This measurement enables the possibility to study three particle interactions as well as the formation mechanism of light nuclei in heavy-ion collisions. The particle identification, the procedure to obtain the correlation functions and a study of the source size will be shown. The measured correlations are then compared with theoretical predictions using the Lednický-Lyuboshitz approach. For these calculations measured scattering lengths of proton-deuteron pairs from scattering experiments are taken.

HK 47.4 Wed 18:15 SCH/A315

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

For many years, WIMPs have been the leading candidate for the phenomenon of dark matter in astronomy. However, despite extensive experimental research, no WIMP signal has been detected, leading to the exploration of other dark matter candidates. In 2017, G. Farrar proposed the sexaquark as a new 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 dark matter relic abundance. 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 presentation, we will discuss an overview of the sexaquark, some preliminary studies with specialized simulations, and the challenges and prospects of this search analysis.

HK 47.5 Wed 18:30 SCH/A315

Net-Proton Fluctuations in Pb-Pb Collisions with the ALICE Experiment — •Ilya Fokin for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg

Fluctuations of conserved charges – such as the electric charge, baryon number or strangeness – in ultrarelativistic heavy-ion collisions provide insight into the QCD phase diagram. They are quantified using moments or cumulants of the distribution of the respective charge in a collision, which can be related to susceptibilities from lattice QCD calculations. These numerical calculations predict a second order phase transition from the quark-gluon plasma to the hadron gas close to the chemical freeze-out temperature for vanishing quark masses and baryon chemical potential, which is expected to turn into a continuous crossover for physical masses. Since the LHC provides heavy-ion collisions with almost vanishing baryon chemical potential, using the proton number as a proxy for the baryon number makes the lattice QCD results accessible in the experiment.

In this contribution, recent measurements of higher-order cumulants of the net-proton number in Pb-Pb collisions recorded with the ALICE detector are presented. Their dependence on the pseudorapidity acceptance and centrality and comparisons to models are discussed. Moments of the proton number distributions are measured probabilistically using the Identity Method, treating contamination of the proton sample in a natural way.

HK 48: Hadron Structure and Spectroscopy V

Time: Wednesday 17:30–19:00 Location: SCH/A316

HK 48.1 Wed 17:30 SCH/A316

Status report of the PANDA FAIR Phase-0 detector development and installation at MAMI — Nicolo Baldicchi[1], Luigi Capozza[1], Samet Katilmis[1], Dong Liu[1], Frank Maas[1,2,3], Julian Moik[1], Oliver Noll[1,2], David Rodriguez Piñeiro[1], •Christoph Rosner[1], Paul Schöner[1], and Sarah Wolf[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.

In this contribution, the current status of the detector assembly for the PANDA Fair Phase-0 version of the backward EMC will be summarised. In addition, the first efforts to install the experiment at MAMI will be discussed.

HK 48.2 Wed 17:45 SCH/A316

Search for $J/\psi \to p\bar{p}e^+e^-$ decays at the BESIII experiment — •Saskia Plura, Achim Denig, and Christoph Florian Redmer for the BESIII-Collaboration — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

In 2016, the ATOMKI collaboration proposed the existence of a new neutral boson with a mass of 17 MeV to explain their observation of a significant enhancement in the angular correlations of e^+e^- pairs in nuclear transitions of ^{8}Be and ^{4}He. This new particle, referred to as the X17 boson, sparked interest in the particle physics community.

As the X17 should couple to nucleons, the decay $J/\psi \to p\bar{p}e^+e^-$ has been selected as a potential channel for X17 searches, where the (anti-)proton radiates off an X17, which subsequently decays to an e^+e^- pair. The concurrent QED process offers the possibility to measure the timelike proton form factor in the unphysical region. However, the decay has not yet been measured. The BESIII experiment, located at the BEPCII collider in Beijing, China, has collected a data sample of $10^{10} J/\psi$ events.

In this talk, the current status of the search for the decay of $J/\psi \to p\bar{p}e^+e^-$ at the BESIII experiment is presented.

Supported by PRISMA$^+$ Cluster of Excellence.

HK 48.3 Wed 18:00 SCH/A316

Luminosity Determination for the FAIR Phase-0 Beamtime to Study Hyperon Production with HADES — •Gabriela Perez Andrade[1,2], James Ritman[1,2], and Peter Wintz[2] for the HADES-Collaboration — [1]GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany — [2]Wilhelm-Johnen-Straße, 52428 Jülich

New data on hyperon production have been measured with the upgraded HADES Spectrometer, including the new Forward Detector components (FD). These measurements used a proton beam of 4.5 GeV kinetic energy impinging onto a fixed liquid hydrogen target. Proton-proton elastic scattering with one proton going in the FD ($3° < \theta_{FD} < 6°$) and the other proton in the main HADES acceptance ($70° < \theta_H < 79°$) has a high differential cross-section. This reaction is used to calibrate the FD and determine the integrated luminosity. Event selection is based on the kinematic observables, and the integrated luminosity is calculated considering the elastics yield, the elastic scattering cross-section interpolated from measurements in other experiments, and a correction factor that accounts for the reconstruction efficiency in the FD. Preliminary results of the integrated luminosity for the beamtime will be presented in this talk.

HK 48.4 Wed 18:15 SCH/A316

Study of Elastic Muon-Electron Scattering as Energy Calibration Process for the Proton Radius Measurement at AMBER* — Christian Dreisbach, Karl Eichhorn, Jan Friedrich, •Simon Helbing, Igor Konorov, Martin Losekamm, Stephan Paul, and Thomas Pöschl — Technische Universität München, Physik-Department E18, Garching, Germany

The proton radius can be determined by measuring the slope of the electric form factor G_E at small squared four-momentum transfer Q^2. Numerous elastic scattering and laser spectroscopy measurements of the proton radius have been performed with contradicting results – the so-called proton radius puzzle. We propose to measure the proton radius in high-energy elastic muon-proton scattering at the M2 beam line of CERN's Super Proton Synchrotron in the year 2023. A high-precision measurement at low Q^2 implemented using a high-pressure hydrogen TPC can contribute to a solution of the puzzle, especially in view of the systematics of this approach compared to electron scattering. The kinematic relation in elastic muon-electron scattering is foreseen as calibration process for the momentum of the incoming muon. Data collected in a pilot run in 2021 is used to study the resolutions and methods under comparable conditions to the proposed setup. We present results of the ongoing analysis and developments towards a possible application in the final setup.

*funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311

HK 48.5 Wed 18:30 SCH/A316

Study of η and η' Production in Double-Tagged Two-Photon Scattering — •Maurice Anderson, Achim Denig, Christoph Florian Redmer, and Max Lellmann for the BESIII-Collaboration — JGU Mainz

The g-2 puzzle describes a 4.2 σ discrepancy between the experimental measurements of the muon's magnetic moment and the Standard Model prediction. In order to determine whether this observed deviation is a significant discovery of possible Beyond the Standard Model physics, the measurement uncertainty must be reduced. The primary source of systematic error stems from the hadronic quantum fluctuations affecting the muon, specifically the hadronic vacuum polarization (HVP) and the hadronic light-by-light (HLbL) scattering contributions. The HLbL term is dominated by the exchange of pseudoscalar mesons.

In this talk, the production of η and η' mesons via two virtual spacelike photons will be studied. Double-tagged measurements are conducted at the BESIII experiment in Beijing, China, in which both virtual photons possess nonzero momentum transfers (Q^2). The transition form factor needed for the calculation of the HLbL contribution is determined in dependence of both Q^2-values.

HK 48.6 Wed 18:45 SCH/A316

Study of neutral-pion pair production in two-photon scattering at BESIII — •Max Lellmann, Achim Denig, and Christoph Florian Redmer — Johannes Gutenberg-Universität Mainz

The anomalous magnetic moment of the muon, a_μ, is one of the most precisely measured observables of the Standard Model, yet it shows a discrepancy of about 4.2σ between Standard Model prediction and measurement. It is still under discussion whether this discrepancy is a hint for New Physics or a proof for the poor understanding of strong interaction at low energies. To get a better understanding of this discrepancy, one needs to reduce the uncertainty of both, the Standard Model prediction and the direct measurement. Since the uncertainty of the Standard model prediction is dominated by hadronic contributions, it is crucial to gather more information about the contributing hadronic processes.

Information on the production of pion pairs in two-photon fusion processes plays an important role in the calculation of the hadronic light-by-light scattering contribution to a_μ. The BESIII experiment, located at the institute of high energy physics in Beijing/China, offers a perfect testbed for the investigation of two-photon processes at small momentum transfers. The process $e^+e^- \to e^+e^-\pi^0\pi^0$ is measured at the BESIII experiment at centre-of-mass energies between 3.77 and 4.6 GeV with a total integrated luminosity of more than 10 fb^{-1}. This presentation will discuss the current status of the analysis.

HK 49: Structure and Dynamics of Nuclei IX

Time: Wednesday 17:30–19:00 Location: SCH/A118

HK 49.1 Wed 17:30 SCH/A118

Measurements of the reaction cross sections of neutron-rich Sn isotopes at R^{3}B setup. — •Eleonora Kudaibergenova[1], Thomas Aumann[1,2,4], Martina Feijoo Fontan[5], Andrea Horvat[1,3], Ivana Lihtar[3], Valerii Panin[2], and Dominic Rossi[1,2] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]Rudjer Boskovic Institute, Zagreb, Croatia — [4]Helmholtz Forschungsakademie HFHF — [5]IGFAE, Universidad de Santiago de Compostela, Spain

The equation of state (EoS) is fundamental for understanding the structure of nuclear matter.The study of asymmetric nuclear matter via properties of neutron-rich nuclei became a current focus of investigation.The asymmetry term of the nuclear EoS is expressed by the

symmetry energy at saturation J and its slope L, which has not yet been constrained well experimentally. It has been identified that a precise determination of the neutron removal cross section of neutron-rich nuclei, which is directly related to the neutron skin, would provide a much better constraint on L. To this end, an experiment was performed with the neutron-rich tin isotopes in the mass range A=124-134 on ^{12}C targets at the R^{3}B setup at the GSI/FAIR facility in inverse kinematics with very large acceptance. In this report, the current detector calibration, analysis status is presented.

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

HK 49.2 Wed 17:45 SCH/A118

Investigation of γ-softness: Lifetime measurements in ^{104,106}Ru — •Arwin Esmaylzadeh[1], Andrey Blazhev[1], Kosuke Nomura[2], Jan Jolie[1], Marcel Beckers[1], Christoph Fransen[1], Rosa-Belle Gerst[1], Andreas Harter[1], Vasil Karayonchev[1,3], Lukas Knafla[1], Mario Ley[1], and Franziskus von Spee[1] — [1]Insitute for Nuclear Physics, University of Cologne — [2]Department of Physics, University of Zagreb — [3]TRIUMF, Canada

Lifetimes of the 2_1^+, 4_1^+, 6_1^+, 2_γ^+ and 3_γ^+ states in ^{104,106}Ru were measured using the recoil distance Doppler shift technique and the Cologne Plunger device. Low-lying excited states in both nuclei were populated in a ^{104}Ru(^{18}O, ^{18}O)^{104}Ru* inelastic scattering and in a ^{104}Ru(^{18}O, ^{16}O)^{106}Ru two-neutron transfer reaction using the Cologne FN Tandem accelerator. The experimental energy levels and deduced electromagnetic transition probabilities are compared in the context of γ-softness and the mapped interacting boson model with input from the microscopic self-consistent mean-field calculation using a Gogny interaction [1]. The newly obtained results for the γ band, give a more detailed insight about the triaxial behavior of ^{104,106}Ru. The results will be discussed in the context of γ soft and rigid triaxial behavior which is present in the neutron-rich Ru isotopes [2]. This work supported by BMBF erbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21PKFN1.

[1] K. Nomura et al., Phys. Rev. C 94, 044314 (2016)
[2] A. Esmaylzadeh et al., Phys. Rev. C (accepted in PRC) (2022)

HK 49.3 Wed 18:00 SCH/A118

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

^{142}Xe is a neutron rich even-even isotope which lies between the double shell closure N = 82 and Z = 50 and a region in which an increased quadrupole and octupole collectivity is expected [1,2]. The lifetimes of excited states of ^{142}Xe are located in the range of some picoseconds. In this time range the Fast-Timing method is suited to determine the lifetime of exited states. Since there are different results for the lifetimes of excited states of the Xe-isotopes in experiments using the Fast-Timing method [1] and Coulomb exitation [2]. Therefore, we are going to analyse the data taken following the fission of ^{238}U induced by a pulsed neutron beam of 1.7 MeV energy from the LICORNE neutron source. The nu-Ball2 multidetector array consisted of 24 HPGe Clover detectors and 20 $LaBr_3$(Ce) detectors which promise excellent energy and time resolution, respectively. The campaign was performed at IJCLab in Orsay, France. Preliminary results will be presented. Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21RDFN1 and ARIEL

[1] S. Ilieva et al., PRC 94, 034302 (2016).
[2] C. Henrich, Dissertation TU Darmstadt (2020)

HK 49.4 Wed 18:15 SCH/A118

Gamma-ray spectroscopy of neutron-rich ^{55,57,59}Sc isotopes — •Radostina Zidarova[1], Martha Liliana Cortés[2], Volker Werner[1], Pavlos Koseoglou[1], Norbert Pietralla[1], Pieter Doornenbal[2], and Alexandre Obertelli[1] — [1]TU Darmstadt, Germany — [2]RIKEN-RIBF, 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 gamma-ray spectroscopy and mass measurements. 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 new γ-rays from ^{57,59}Sc identified for the first time. Observed γ spectra from ^{55,57,59}Sc will be presented together with preliminary level schemes. They will be discussed in the framework of the tensor-driven shell evolution.

Supported by BMBF under Grant Nos. 05P19/21RDFN1.

HK 49.5 Wed 18:30 SCH/A118

Lifetime measurements of excited states in ^{57}Mn — •Hannah Kleis, Peter Reiter, Konrad Arnswald, Maximilian Droste, Andrey Blazhev, Ramona Burggraf, and Cristoph Fransen — Institut für Kernphysik, Universität zu Köln

Previously, the $N = 32$ subshell closure was observed in the even-even Ca-, Ti-, and Cr-isotopes [1]. Adding more valence protons to the $\pi(f_{7/2})$ orbital reduces the shell gap at $N = 32$ which vanishes completely at $^{58}_{26}$Fe. Lifetime measurements in the odd-even ^{57}Mn nucleus were performed in order to close the gap between $Z = 24$ and $Z = 26$. Excited states of ^{57}Mn were populated via ^{55}Mn(^{18}O, ^{16}O)^{57}Mn two-neutron transfer reactions at a beam energy of 38 MeV employing the FN tandem accelerator at the University of Cologne. The Doppler-shift attenuation method is utilized to determine new lifetimes for the $11/2_1^-$ and $9/2_1^-$ states. The experimentally determined transition probabilities are confronted with results from the GXPF1A shell-model interaction along the Mn-isotopes. The experimental findings in ^{57}Mn are well reproduced by this interaction. The comparison of excitation energies and $B(E2)$ strengths is extended to all odd-even nuclei between Ca and Ni with neutron numbers $N = 26$ and $N = 36$ in order to discuss the nature of the $N = 32$ subshell closure.

[1] D. Steppenbeck *et al.*, Nature 502, 7470 (2013)

HK 49.6 Wed 18:45 SCH/A118

Lifetime measurements of neutron-rich Kr isotopes within the nu-Ball2 fission campaign — •J. Fischer[1], A. Blazhev[1], C. Hiver[2], J. Jolie[1], A. Messingschlager[3], S. Pascu[4], M. von Tresckow[3], N. Warr[1], and J. N. Wilson[2] for the nu-Ball2 N-SI-120-Collaboration — [1]U 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. In recent years, neutron-rich krypton isotopes have been studied as part of various campaigns. New gamma-transitions and levels were discovered in the first nu-Ball and SEASTAR-2015 campaigns [1,2] which compared to theory indicated oblate-prolate shape coexistence already in ^{96}Kr [2]. However, the limited information on transition strengths did not allow for firm conclusions. Therefore lifetime measurements were performed at the IJCLab Orsay as part of the nu-Ball2 fission campaign. The nuclei of interest were produced with a fast-neutron-induced fission reaction ^{238}U(n,f). The improved multidetector-array (nu-Ball2), a novel hybrid γ-spectrometer consisting of HPGe and LaBr3(Ce) detectors provided excellent energy and timing information, respectively. The fast-timing method allows for lifetime determination down to about 10 ps and thus a possibility to determine transition strengths in the nuclei of interest. 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 50: Structure and Dynamics of Nuclei X

Time: Wednesday 17:30–19:00 Location: SCH/A215

Group Report HK 50.1 Wed 17:30 SCH/A215

Measuring Photo-Absorption Cross Sections with Tagged Photons at NEPTUN — •Martin Baumann[1], Thomas Aumann[1,2], Maike Beuschlein[1], Isabelle Brandherm[1], Meytal Duer[1], Amrita Gupta[1], Phillip Imgram[1], Andrea Jedele[1], Liancheng Ji[1], Igor Jurosevic[1], Marco Knösel[1], Nikolina Lalic[1], Enis Lorenz[1], Hannes Mayr[1], Leandro Milhomens da Fonseca[1], Nikhil Mozumdar[1], Ann Rochele Netto[1], Oliver Papst[1], Thomas Pohl[1], Heiko Scheit[1], Gerhart Steinhilber[1], Sonja Storck-Dutine[1], Dmytro Symochko[1], Iyabo Usman[3], and Patrick van Beek[1] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]GSI Helmholtzzentrum, Darmstadt, Germany — [3]University of the Witwatersrand, Johannesburg, South Africa

The photon tagger NEPTUN at the superconducting linear electron accelerator S-DALINAC has been upgraded to enable high precision measurements of nuclear photo-absorption cross sections in the energy region up to 35 MeV, covering the giant dipole resonance region using tagged bremsstrahlung with a single configuration. For this purpose a new focal plane detector LARISSA and a rapid target changer PROTEUS have been commissioned. This setup has recently been used to measure the photo-absorption cross sections of the isotopes Sn-112,116,120,124,Ca-40 and Ca-48. In this talk the method will be outlined and performance characteristics of the setup will be shown as well as preliminary data from the recent beam time.

This work was supported by the Deutsche Forschungsgemeinschaft under Contract No. SFB 1245 (Project ID No. 279384907)

HK 50.2 Wed 18:00 SCH/A215

Self-absorption experiments with quasi-monochromatic photon beams: Model-independent level widths with high precision — •D. Savran[1], J. Isaak[2], A.D. Ayangeakaa[3,4], M. Beuschlein[2], S.W. Finch[4,5], D. Gribble[2], A. Gupta[2], J. Hauf[2], R.V.F. Janssens[3,4], S.R. Johnson[3,4], P. Koseoglou[2], T. Kowalewski[3,4], B. Löher[1], O. Papst[2], N. Pietralla[2], A. Saracino[3,4], N. Sensharma[3,4], and V. Werner[2] — [1]GSI, Darmstadt — [2]IKP, TU Darmstadt — [3]UNC, Chapel Hill, NC, USA — [4]TUNL, Durham, NC, USA — [5]Duke U., Durham, NC, USA

We have developed a novel variation of the relative self-absorption (RSA) technique in order to adapt this method to quasi-monochromatic photon beams produced via Laser-Compton Backscattering (LCB) [1]. The approach combines the advantages of LCB beams with the model-independent determination of level widths via the RSA method. In this contribution the method itself as well as preliminary results of its pioneering application to measure the B(E2, $0_1^+ \rightarrow 2_1^+$) transition strength of the first excited state in ^{12}C to a precision of better than 2% will be presented.

Supported by the State of Hesse, grant "Nuclear Photonics" (LOEWE program) and the Research Cluster ELEMENTS (Project-ID 500/10.006), the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) - Project-ID 279384907 - SFB 1245 and the U. S. DOE Grant No. DE-FG02-97ER41041 and No. DE-FG02-97ER41033.

[1] D. Savran and J. Isaak, Nucl. Inst. and Meth. A 899, 28 (2018).

HK 50.3 Wed 18:15 SCH/A215

Self-absorption experiments with quasi-monochromatic photon beams: A new approach to nuclear level densities — •J. Isaak[1], D. Savran[2], A.D. Ayangeakaa[3,4], M. Beuschlein[1], S.W. Finch[4,5], A. Gupta[1], D. Gribble[3,4], J. Hauf[1], R.V.F. Janssens[3,4], S.R. Johnson[3,4], P. Koseoglou[1], T. Kowalewski[3,4], B. Löher[2], O. Papst[1], N. Pietralla[1], A. Saracino[3,4], N. Sensharma[3,4], and V. Werner[1] — [1]IKP, TU Darmstadt — [2]GSI, Darmstadt — [3]UNC, Chapel Hill, NC, USA — [4]TUNL, Durham, NC, USA — [5]Duke U., Durham, NC, USA

The modeling of the elemental abundances in the universe requires, among others, information on the nuclear level density (NLD) of isotopes across the nuclear chart from stable to unstable nuclides. While it can be determined at the lowest excitation energies and from neutron resonances, it is a difficult quantity to access at intermediate excitation energies. In fall 2022, a pioneering experiment with ^{88}Sr was performed at HIγS exploiting the combination of the self-absorption technique with quasi-monoenergetic photon beams. A novel approach is introduced enabling the extraction of the NLD of dipole-excited states with photonuclear reactions and first results for the case of ^{88}Sr are presented.

Supported by the State of Hesse, grant "Nuclear Photonics" (LOEWE program) and the Research Cluster ELEMENTS (Project-ID 500/10.006), the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation - Project-ID 279384907 - SFB 1245 and the U. S. DOE Grant No. DE-FG02-97ER41041 and No. DE-FG02-97ER41033.

HK 50.4 Wed 18:30 SCH/A215

Lifetime measurements of excited states in ^{59}Ni and ^{57}Fe — •Ramona Burggraf, Erik Gassmus, Peter Reiter, Konrad Arnswald, Andrey Blazhev, Maximilian Droste, Christoph Fransen, and Hannah Kleis — IKP, Universität zu Köln

Lifetime measurements of excited states in nuclei along the $N = 31$ chain were used to corroborate the $N = 32$ sub-shell closure [1], as done previously in ^{55}Cr [2]. Systematic studies including the neighboring $N = 31$ isotones suffer from imprecise experimental values. Excited states in ^{59}Ni and ^{57}Fe have been 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 employed to determine lifetimes with the recoil-distance Doppler-shift method and the differential decay-curve method. Lifetimes and reduced transition strengths for several excited states in ^{59}Ni and ^{57}Fe were determined. Considerable deviations from previous experimental findings were observed. Comparison with results from new shell-model calculations employing the GXPF1A interaction show remarkable agreement with the present values.

[1] D. Steppenbeck et al., Nature 502, 7470 (2013)
[2] H.Kleis et al., Phys. Rev. C 104, 034310 (2021)

HK 50.5 Wed 18:45 SCH/A215

Lifetime Measurement of the 2_1^+ and 4_1^+ states in ^{60}Ni using the RDDS method — •Marcel Beckers[1], Claus Müller-Gatermann[2], Konrad Arnswald[1], Alfred Dewald[1], Felix Dunkel[1], Christoph Fransen[1], Lisa Kornwebel[1], Casper-David Lakenbrink[1], and Franziskus von Spee[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Argonne National Lab, USA

At ^{60}Ni and surrounding Ni isotopes one can find a quite confusing situation regarding the existing experimental results. There are several data sets giving quadrupole transition strengths for the $2_1^+ \rightarrow 0_1^+$ and the $4_1^+ \rightarrow 2_1^+$ transitions that are in disagreement with each other and would lead to different physical interpretations.

Therefore, a high-precision γ-γ coincidence Recoil Distance Doppler-Shift measurement has been carried out on ^{60}Ni to re-measure the lifetime of the 2_1^+ and 4_1^+ states. The new lifetime of the 2_1^+ state supports the adopted NNDC value but disagrees with the results of two more recent Doppler-Shift Attenuation Method measurements, which suggested a longer lifetime. The new result for the 4_1^+ state's lifetime is significantly shorter than the one recommended in the latest NNDC compilation while also reducing its uncertainty. It therefore resolves an unclear situation, where an unexpected drop in transition strength appeared from ^{58}Ni to ^{60}Ni. Both values match very well with recently applied shell model calculations using the GXPF1A interaction.

Supported by the DFG, grant Nos. FR 3276/2-1 and DE 1516/5-1.

HK 51: Fundamental Symmetries III

Time: Wednesday 17:30–19:15 Location: SCH/A252

Group Report HK 51.1 Wed 17:30 SCH/A252
Recent results of NA64 for Dark Matter searches at CERN — •Michael Hösgen and Bernhard Ketzer for the NA64-Collaboration — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany

We report on the recent activity of the NA64 experiment at the SPS of CERN. The NA64 experiment uses an active beam-dump setup to conduct missing energy searches with high-intensity lepton beams (e or mu).

Since 2016 several dedicated searches for new mediators between standard model and dark sector were performed, most notably a light vector boson A' and a short-lived neutral boson X(17). The A' was proposed as a possible explanation for magnetic-moment anomalies of muons. At NA64 it could be created in electron-on-target reactions $e^-Z \to e^-ZA'$ and supposedly decay invisibly into lighter dark-sector particles ($A' \to \chi\bar{\chi}$). The X is motivated by an excess of e^+e^--pairs in ^{8}Be* excited state nuclear transitions. At NA64 it could be produced in bremsstrahlung interactions $e^-Z \to e^-ZX$ and decay into standard model leptons ($X \to e^+e^-$).

Starting in 2021, the search for a dark portal was expanded with a dedicated setup using a muon beam at the M2 beamline at the SPS of CERN. In 2022, a pilot run using an e^+ beam for resonant A' production in our active target was performed.

We present an overview over the experimental setups and analysis strategies, as well as the updated results until 2022.

Group Report HK 51.2 Wed 18:00 SCH/A252
The P2 experiment — Sebastian Baunack[1], Maarten Boonekamp[4], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,2,3], 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 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 will be built at the future MESA accelerator in Mainz. In this talk, the motivation and challenges for this measurement will be discussed together with ideas for measurements at lower beam energies, which will be available at the start of MESA.

Group Report HK 51.3 Wed 18:30 SCH/A252
Light Dark Matter Searches at DarkMESA — •Maik Biroth for the MAGIX-Collaboration — Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany

The DarkMESA beam dump experiment will search for light dark matter particles. It will be placed behind the P2 experiment at the future MESA electron accelerator, where an unprecedented amount of electrons-on-target can result in the radiative production of dark photons. In various models, such a dark photon decays predominantly into a pair of dark matter particles in the sub-GeV range. These will be detected by a sophisticated setup based on a solid and reliable detection technology.

In this talk, the development status of the detector system and the estimated exclusion limits will be presented.

HK 51.4 Wed 19:00 SCH/A252
Search for axion-like particles from Higgs boson decays in the 4 electron final state using the ATLAS detector — •Georgios Lamprinoudis, Matthias Schott, and Kristof Schmeiden for the ATLAS-Collaboration — Johannes Gutenberg Universitat Mainz

Axion-like particles (ALPs) are motivated by numerous theoretical models, including the two-Higgs-doublet model (2HDM). ALPs can also couple to the Higgs boson and may decay to leptons. The coupling of ALPs to leptons defines their life-time and hence might lead to displaced decay vertices in the detector. While previous analyses assumed a negligible axion lifetime, a finite lifetime with displaced vertex signatures is studied in the present analysis of the h->aa->4e channel. The analysis covers a mass range of the axions from 0.5 GeV to 60 GeV. In the case that no signal is observed, the analysis will establish upper limits on the axion-Higgs coupling.

HK 52: AI Topical Day – Invited Talks (joint session AKPIK/HK/ST/T/AKBP)

Time: Thursday 11:00–12:30 Location: HSZ/AUDI

Invited Talk HK 52.1 Thu 11:00 HSZ/AUDI
AI Techniques for Event Reconstruction — •Ivan Kisel — Goethe University, Frankfurt, Germany

Why can we relatively easily recognize the trajectory of a particle in a detector visually, and why does it become so difficult when it comes to developing a computer algorithm for the same task? Physicists and computer scientists have been puzzling over the answer to this question for more than 30 years, since the days of bubble chambers. And it seems that we are steadily approaching the answer in our attempts to develop and apply artificial neural networks both for finding particle trajectories and for physics analysis of events in general.

This talk will present the basics of artificial neural networks in a simple form, and provide illustrations of their successful application in event reconstruction in high energy physics and heavy ion physics experiments. You will get an insight into the application of traditional neural network models, such as deep neural network, convolutional neural network, graph neural network, as well as those standing a little aside from traditional approaches, but close in idea of elastic network and even cellular automata.

Invited Talk HK 52.2 Thu 11:30 HSZ/AUDI
Accelerator operation optimisation using machine learning — •Pierre Schnizer — Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany

Accelerators are complex machines whose many components need to be accurately tuned to achive design performance. Reliable operation requires frequent recalibration and tuning. Especially for large machines tools have been developed that facilitating this task.

Machine learning allows building such tools using simulations, archiver data or interaction with the real machine, thus making many tools now also available for smaller machines.

This talk will give an overview of different machine learning projects targeted to accelerators, which simplifies accelerator operation or even enable applications not been possible before.

Invited Talk HK 52.3 Thu 12:00 HSZ/AUDI
Is this even physics? – Progress on AI in particle physics — •Gregor Kasieczka — Universität Hamburg

Motivated by the large volume and high complexity of experimental data and mathematical structures, particle physics has a long tradition of employing state of the art computing and analysis techniques. Recent progress in machine learning and artificial intelligence have further pushed this trend, and these approaches are now ubiquitous in our field. This overview attempts to capture key developments such as the rise of unsupervised approaches and the quest for suitable neural network architectures for physics tasks; challenges like ultra-low latency inference and robust predictions; as well as promising new ideas looking forward.

HK 53: AI Topical Day – Computing II (joint session HK/AKPIK)

Time: Thursday 14:00–15:30 Location: HSZ/0103

HK 53.1 Thu 14:00 HSZ/0103

Exploiting Differentiable Programming for the End-to-end Optimization of Detectors — The MODE Collaboration[1] and •Anastasios Belias[2] — [1]mode-collaboration.github.io — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

Machine-learning Optimized Design of Experiments, the MODE Collaboration, targets the end-to-end optimization of experimental apparatus, by using techniques developed in modern computer science to fully explore the multi-dimensional space of experiment design solutions. Differentiable Programming is employed to create models of detectors that include stochastic data-generation processes, the full modeling of the reconstruction and inference procedures, and a suitably defined objective function, along with the cost of any given detector configuration, geometry and materials.

The MODE Collaboration considers the end-to-end optimization challenges in its generality, providing software architectures for machine learning to explore experiment design strategies, information on the relative merit of different configurations, with the potential to identify and investigate novel, possibly revolutionary solutions. In this contribution we present use cases, and highlight the potential for on-going and future experiment design studies in fundamental physics research.

HK 53.2 Thu 14:15 HSZ/0103

Klassifikation von Pulsdaten mit neuronalen Netzwerken auf einer FPGA Accelerator Card — •Robert Ufer, Bastian Auer, Helene Hoffmann, Oliver Knodel, Mani Lokamani und Stefan Müller — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

Zur Analyse der entstehenden Detektordaten bei dem Mu2e Experiment am Fermilab soll die Datenauswertung mit Field Programmable Gate Array (FPGA) erfolgen. Diese übernehmen die notwendige Vorverarbeitung und Reduktion der Messdaten, noch während der Durchführung der Messung. Die dabei ausgeführten Anwendungen werden standardmäßig durch Algorithmen realisiert. Eine dieser Anwendungen führt die Klassifikation der ermittelten Pulsdaten durch. Mit den Testläufen an der gELBE Bremstrahlungs-Beamline am Helmholtz-Zentrum Dresden-Rossendorf (HZDR) konnte für das zukünftige Experiment eine große Menge dieser Datensätze erfasst werden. Diese dienen zur Charakterisierung des Detektorsystems und wurden mit einem Lanthanbromid (LaBr) Detektor gemessen. Für die Pulsdatenklassifikation wird auf der Basis des Algorithmus und der erfassten Datensätze, ein neuronales Netzwerk erstellt, trainiert und validiert. Um bei diesen Schritten etablierte Machine Learning Frameworks zu verwenden, wird für die Portierung des Netzwerks in eine High-Level Synthese (HLS) Sprache die Software hls4ml verwendet. Dabei werden verschiedene Konfigurationen genutzt, um unterschiedlich optimierte Implementierungen zu generieren. Zum Evaluieren erfolgt die Ausführung der Implementierungen auf einer Xilinx Alveo Accelerator Card.

HK 53.3 Thu 14:30 HSZ/0103

Pattern recognition using machine learning for the mCBM mRICH detector — •Martin Beyer for the CBM-Collaboration — Justus-Liebig-Universität Gießen

The Compressed Baryonic Matter experiment (CBM) is designed to explore the QCD phase diagram at high baryon densities using high-energy heavy ion collisions at high interaction rates. The Ring Imaging Cherenkov detector (RICH) contributes to the overall particle identification by reconstruction of rings from electrons with their respective radius, position and time. The miniCBM (mCBM) detector is the test setup for the CBM experiment, with the purpose of testing both hardware and software including the triggerless free-streaming data acquisition and data reconstruction algorithms. The miniRICH (mRICH) detector in the mCBM setup is a proximity focussing RICH detector with a photon detection plane consisting of 36 MultiAnode Photo Multipliers (MAPMTs). This setup results in charged particles passing directly through the MAPMTs resulting in quite some additional signals typically inside ring structures and reducing the overall ring finding efficiency based on the Hough Transformation.

In this talk a machine learning approach is presented to classify those signals in ring centers and thus improving the overall ring finding efficiency and precision.

HK 53.4 Thu 14:45 HSZ/0103

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] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

Precise and fast hadronic particle identification (PID) is crucial to reach the physics goals 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. In search for the best performance, different network architectures are currently under investigation.

HK 53.5 Thu 15:00 HSZ/0103

Optimization of the specific energy loss measurement for the upgraded ALICE TPC using machine learning — •Tuba Gündem for the ALICE Germany-Collaboration — Institut fuer Kernphysik, Frankfurt, Germany

The Time Projection Chamber (TPC) is the primary detector used in the ALICE experiment for tracking and particle identification (PID). PID is accomplished by reconstructing the momentum and the specific energy loss ($\mathrm{d}E/\mathrm{d}x$) of a particle. The $\mathrm{d}E/\mathrm{d}x$ for a given track is calculated using a truncated mean on the charge signals associated to the track. The readout plane, on which the signals are measured, is radially subdivided into four regions with different pad sizes. Since the measured signals depend on the pad size, an optimization of the $\mathrm{d}E/\mathrm{d}x$ calculation based on the pad size can be performed.

In this talk, a method for optimizing the $\mathrm{d}E/\mathrm{d}x$ calculation using machine learning (ML) algorithms will be presented. By performing realistic simulations of the generated signals on the pads, various effects such as the different pad sizes and track geometry are modeled. These simulations are used as inputs for the training of the ML model and are investigated using RootInteractive.

Supported by BMBF and the Helmholtz Association.

HK 53.6 Thu 15:15 HSZ/0103

Deep Leaning Based PID with the HADES detector — •Waleed Esmail[1] and James Ritman[1,2,3] for the HADES-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [2]Forschungszentrum Jülich, 52428 Jülich, Germany — [3]Ruhr-Universität Bochum, 44801 Bochum, Germany

The main purpose of a particle identification (PID) algorithm is to provide a clean sample of particle species needed to conduct a physics analysis. The conventional approach used in the HADES experiment is to apply the so-called "graphical cuts" around the theoretical Bethe-Bloch curves of the energy loss as a function of the particle momentum. However, this approach is not optimal, since the distributions resulting from the different particle species overlap. A better approach is based on deep learning algorithms. In our preliminary studies done with the p(4.5 GeV)+p data recently collected by HADES, we were able to improve the separation power of the particle species. The algorithm is based on Domain Adversarial Neural Networks (DANN) trained in a semi-supervised way to simultaneously look at simulated and real data to learn the discrepancies between the two data domains. In this talk we will present our preliminary results, which show that this technique significantly improves the classification of particle species in the experimental data.

HK 54: AI Topical Day – Heavy-Ion Collisions and QCD Phases XI (joint session HK/AKPIK)

Time: Thursday 14:00–15:30 Location: HSZ/0105

HK 54.1 Thu 14:00 HSZ/0105

Modelling charged-particle production at LHC energies with deep neural networks — •Maria Calmon Behling for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt, Germany

Particle production at the Large Hadron Collider (LHC) is driven by a complex interplay of soft and hard QCD processes. Modelling these interactions across center-of-mass energies and collision systems is still challenging for Monte Carlo event generators. Concise experimental data is indispensable to characterize the final state of a collision. The ALICE experiment with its unique tracking capabilities down to low transverse momenta is perfectly suited to study the bulk particle production in high-energy collisions. During the data taking campaigns of LHC Run 1 and Run 2 (2009 - 2018), a large amount of data were collected of a variety of collision systems at different center-of-mass energies. A recent measurement of charged-particle production covering all of these collision systems provides a comprehensive set of fundamental observables like the charged-particle multiplicity distributions and transverse momentum spectra as well as their correlation.

In this talk, we discuss the possibility of extending this set of discrete experimental data points into unmeasured regions by means of machine learning techniques. Training deep neural networks with ALICE data gives the unique opportunity to measure the evolution of multiplicity dependent charged-particle production across collision system sizes and energies.

Supported by BMBF and the Helmholtz Association.

HK 54.2 Thu 14:15 HSZ/0105

Measurement of the Λ separation energy in hypertriton with ALICE using machine learning techniques — •Regina Michel for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung — Technische Universität Darmstadt

Hypertriton ${}^{3}_{\Lambda}$H is the lightest hypernucleus, consisting of a Λ hyperon, a proton and a neutron. It is structured as a halo nucleus, where the Λ hyperon is very loosely bound to a "deuteron core". Measurements of the Λ separation energy can be used as a test for QCD, for some models of neutron stars and to constrain the possible difference of the lifetimes of ${}^{3}_{\Lambda}$H and Λ. The Λ separation energy can be measured via the invariant mass of the hypertriton decay products. The two-body-decay ${}^{3}_{\Lambda}\mathrm{H} \rightarrow {}^{3}\mathrm{He}+\pi$ is considered. Monte Carlo simulations are conducted to simulate the hypertriton interactions and decays while propagating through the detector. A data sample from Pb-Pb collisions at a center-of-mass energy of $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV recorded with ALICE at the LHC is analyzed using machine learning techniques.

HK 54.3 Thu 14:30 HSZ/0105

Physics performance studies on Ξ^- Baryon at CBM — •Lisa-Katrin Kümmerer[1,2], Andrea Dubla[2], and Ilya Selyuzhenkov[2] for the CBM-Collaboration — [1]Physikalisches Institut, Universität Heidelberg — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

The Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram in the region of high net-baryon densities ($\mu_B > 500$ MeV) in the collision energy range of $\sqrt{s_{NN}} = 2.7 - 4.9$ GeV with high interaction rate, up to 10 MHz, provided by the SIS100 accelerator. The (multi)strange baryons are crucial in determining the chemical freeze-out and its connection to hadronization from deconfined QCD matter.

In this contribution the performance for Ξ^- selection in Au-Au collisions at $\sqrt{s_{NN}} = 4.93$ GeV in the CBM experiment will be presented. The Ξ^- hyperon is reconstructed via the weak decay channel $\Xi^- \rightarrow (\Lambda \rightarrow p\pi^-)\pi^-$ using the Particle-Finder Simple package.

For the reduction of the data size, which is driven by the large combinatorial background, specific skimming pre-selection criteria are optimized in this work. To obtain an optimal and stable separation between signal and background candidates the machine learning tool XGBoost is used. Machine learning allows for efficient, non-linear and multi-dimensional selection criteria to be implemented in a heavy-ion collision environment, enabling to extract and correct the Ξ^- raw yield in different rapidity and transverse momentum intervals.

HK 54.4 Thu 14:45 HSZ/0105

Multi-differential Λ Yield Measurement in the CBM Experiment using Machine Learning Techniques — •Axel Puntke[1] and Shahid Khan[2] for the CBM-Collaboration — [1]Institut für Kernphysik, WWU Münster — [2]Eberhard Karls University of Tübingen

The Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram at high net-baryon densities (μB > 500 MeV) with heavy-ion collisions in the energy range of $\sqrt{s_{\mathrm{NN}}} = 2.9$-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.

The strange 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 needs to be suppressed by applying selection criteria according to the topology of the decay. This selection is optimized by training a boosted decision tree-based machine learning model with simulated data from two event generators, UrQMD and DCM-QGSM-SMM. After the signal has been selected, the yield of the strange hadron is computed.

In this talk, the analysis procedure for the most abundant Λ baryon is presented and the performance of the non-linear multi-parameter selection method is evaluated. A fitting routine is implemented to extract the Λ yield, on which the performance gain of training a separate model for each p_{T}-y interval will be discussed.

HK 54.5 Thu 15:00 HSZ/0105

Full beauty-hadron reconstruction with J/ψ: feasibility study for Run 3 with ALICE — •Guillaume Taillepied for the ALICE Germany-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The study of the production of hidden and open heavy-flavour hadrons in proton-proton (pp) collisions provides an essential test of quantum chromodynamics, involving both the perturbative and non-perturbative regimes. The J/ψ meson allows to study both the charm sector, via the measurement of prompt J/ψ, and the beauty sector through the measurement of the non-prompt component, coming from the decay of beauty hadrons. With the recent upgrades of the ALICE apparatus, the full reconstruction of beauty hadrons in exclusive decay channels containing non-prompt J/ψ mesons is now possible, providing a new way to study beauty physics in hadronic collisions.

In this talk, a feasibility study of the $\mathrm{B}^+ \rightarrow \mathrm{J}/\psi\ \mathrm{K}^+$, $\mathrm{J}/\psi \rightarrow \mathrm{e}^+\mathrm{e}^-$ process in pp collisions at $\sqrt{s} = 13.6$ TeV with ALICE will be presented. The analysis makes use of the KFParticle package for a precise reconstruction of the B^+ and non-prompt J/ψ decay chain. The package also provides important information for the training of a machine learning model, increasing the signal selection efficiency and signal-over-background ratio. Discussions on the perspectives in lead-lead collisions for Run 3, based on the results of this feasibility study, will be shown.

HK 54.6 Thu 15:15 HSZ/0105

Photon reconstruction in the Transition Radiation Detector of ALICE — •Peter Stratmann for the ALICE Germany-Collaboration — Institut für Kernphysik, Wilhelm-Klemm-Str. 9, 48149 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 DFG as part of the GRK 2149.

HK 55: Instrumentation XIV

Time: Thursday 14:00–15:30 Location: SCH/A251

Group Report HK 55.1 Thu 14:00 SCH/A251

Different applications of Low Gain Avalanche Detectors — •Felix Ulrich-Pur[1], Tetyana Galatyuk[1,2], Wilhelm Krüger[2], Sergey Linev[1], Jan Michel[3], Jerzy Pietraszko[1], Adrian Rost[4], Michael Traeger[1], Michael Traxler[1], and Christian Joachim Schmidt[1] — [1]GSI GmbH, Darmstadt, Germany — [2]Technische Universität Darmstadt, Darmstadt, Germany — [3]Goethe-Universität, Frankfurt, Germany — [4]FAIR GmbH, Darmstadt, Germany

Low Gain Avalanche Detectors (LGADs) are fast silicon detectors especially designed for high-rate environments. Due to their high spatial granularity ($\leq 100\mu$m) and excellent intrinsic time resolution ($\leq$ 100ps), LGADs allow the reconstruction of single particle tracks even at very high track densities.
Within this contribution, we will present several applications of LGAD strip sensors, which were produced at Fondazione Bruno Kessler (FBK). This includes the reaction time (T0) detector for the High Acceptance Di-Electron Spectrometer (HADES) at GSI in Darmstadt, Germany, a beam-structure monitor for the Superconducting Darmstadt LINear Accelerator (S-DLINAC) at the Technische Universität Darmstadt and an ion imaging experiment conducted at the MedAustron cancer therapy and research centre in Wiener Neustadt, Austria. After discussing first results, we will outline planned upgrades of the current systems and possible future projects at the GSI and FAIR facilities.

HK 55.2 Thu 14:30 SCH/A251

LGAD based Start Detector in HADES — Tetyana Galatyuk[1,2], Vadym Kedych[1], •Wilhelm Krüger[1], Sergey Linev[2], Jan Michel[3], Jerzy Pietraszko[2], Adrian Rost[4], Christian Joachim Schmidt[2], Michael Träger[2], Michael Traxler[2], and Felix Ulrich-Pur[2] — [1]Technische Universität Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [3]Goethe Universität Frankfurt — [4]FAIR GmbH

The High Acceptance Di-Electron Spectrometer (HADES) experiment has designed and used a Low Gain Avalanche Detector (LGAD) based in-beam detector for its high rate 4.5 GeV pp production beam time in February 2022. As LGADs offer high-precision timing measurements with high spatial granularity and high radiation hardness, they were the sensors of choice for the in-beam detector.
The detector consisted of two FBK LGADs with a form factor of 2 x 2 cm^2 and 96 half-strips each. It was used for beam monitoring purposes during the beam time and will assist in particle identification by providing a precise reaction time (T0).
This contribution will present the calibration procedure of the detector as well as its performance with respect to the reached timing precision.

HK 55.3 Thu 14:45 SCH/A251

Beam monitoring and T0 system for the CBM experiment at FAIR — •Adrian Rost for the CBM-Collaboration — Facility for Antiproton and Ion Research in Europe GmbH, Darmstadt, Germany

A beam detector system for the CBM experiment at the FAIR accelerator complex has been developed. The system will be used for T0 measurements with a precision in the order of 50 ps and for beam monitoring purposes i.e. beam halo particle measurements. The concept has been prepared and will consist of two detector stations, one used for beam monitoring and the second for the T0 measurement. Both detector stations are planned to utilize poly-crystal CVD diamond technology. But also new technologies like the Low Gain Avalanche Detectors (LGADs) are under investigation in collaboration with the HADES experiment at GSI. The sensors will be mounted on dedicated printed circuit boards, equipped with amplifier and shaping circuits. The detector stations are located in standard vacuum elements which are integrated into the CBM beamline. Two pcCVD diamond based prototype sensors have been prepared for tests at the mCBM experiment at the SIS18 accelerator. The read-out system will utilize the PADI discriminator and the GET4 TDC ASICs. In this contribution the BMON concept and the current status of the project will be presented.

*This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 87072.

HK 55.4 Thu 15:00 SCH/A251

Studies of the Unified Tracking Station for the Proton Radius Measurement in High-Energy Elastic Muon-Proton Scattering at AMBER* — •Christian Dreisbach, Karl Eichhorn, Jan Friedrich, Igor Konorov, Martin Losekamm, Stephan Paul, and Thomas Pöschl for the AMBER-Collaboration — Technische Universität München, Physik-Department E18, Garching, Germany

The proton radius can be determined by measuring the slope of the electric form factor G_E at small squared four-momentum transfer Q^2. Numerous elastic scattering and laser spectroscopy measurements of the proton radius have been performed with contradicting results – the so-called proton radius puzzle. We propose to measure the proton radius in high-energy elastic muon-proton scattering at the M2 beam line of CERN's Super Proton Synchrotron in the year 2023. A high-precision measurement at low Q^2 realized with a high-pressure hydrogen TPC can contribute to a solution of the puzzle, especially in view of the systematics of this approach compared to electron scattering. In addition to the precise measurement of the recoil proton provided by the TPC, novel unified tracking stations (UTS) are foreseen for an accurate measurement of the muon trajectory. Scintillating Fiber Hodoscopes joint with monolithic silicon-pixel detectors will be combined in this UTS. A first prototype was built and a beam test was performed in 2022. We present ongoing studies and results on the tracking capability of the UTS.

*funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311

HK 55.5 Thu 15:15 SCH/A251

Scintillating Fiber Hodoscopes for the Proton Radius Measurement at AMBER — Christian Dreisbach, •Karl Eichhorn, Jan Friedrich, Igor Konorov, Martin Losekamm, Stephan Paul, and Thomas Poeschl for the AMBER-Collaboration — Technische Universität München, Physik-Department, Garching, Germany

The AMBER collaboration aims to measure the proton charge radius in an elastic scattering experiment using high energy muons provided by the M2 secondary beamline at CERN's Super Proton Synchrotron using an active hydrogen target. For muon tracking, novel Unified Tracking Stations equipped with monolithic active pixel silicon detectors in combination with a Scintillating Fiber Hodoscope (SFH) will be used. The SFH consists of 500 μm thin scintillating plastic fibers read out with SiPMs, covering an active area of (9x9) cm^2. We present ongoing studies and results from a test beam experiment performed in 2022 with a detector prototype.
Funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 56: Instrumentation XV

Time: Thursday 14:00–15:30 Location: SCH/A.101

Group Report HK 56.1 Thu 14:00 SCH/A.101

Performance of the upgraded HADES RICH in heavy ion collisions* — •Jörg Förtsch for the HADES-Collaboration — Bergische Universität Wuppertal

The 1.58A GeV Ag+Ag beamtime of the High Acceptance DiElectron Spectrometer (HADES) at GSI Darmstadt, Germany, in March 2019 marked the first use of the upgraded HADES RICH. At triggered event rates of up to 18 kHz the HADES RICH detector is the key component for efficient identification of electrons and positrons in hadronically dominated collision products.

The HADES RICH detector is a gaseous ring imaging Cherenkov detector with C_4H_{10} (isobutane) being used as radiator hence making the detector hadron blind for momenta up to approximately 2 GeV/c. A spherical mirror reflects Cherenkov photons on a staggered photon detection plane comprised of 428 MultiAnode Photo electron Multipliers (MAPMTs) of type Hamamatsu H12700. All 27392 different MAPMT channels are read out by the DIRICH readout electronic scheme measuring leading edge and time over threshold of each pulse down to sub-nanosecond precision.

In this talk we will present key features of our upgrade and lay out quantitatively how well the RICH performed throughout the full measurement campaign.

* Work supported by GSI and BMBF (05P19RGFCA, 05P21RGFC1, 05P19PXFCA, 05P21PXFC1), Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Gießen

HK 56.2 Thu 14:30 SCH/A.101

Design of a luminosity monitor for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,2,3], •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

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

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

HK 56.3 Thu 14:45 SCH/A.101

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

In the PANDA detector at FAIR two DIRC detectors will be used for particle identification using Cherenkov light. Since the focal planes of both DIRCs are located inside magnetic fields of $\gtrapprox 1$ Tesla, Microcannel-Plate Photomultipliers (MCP-PMTs) will be used to detect the few Cherenkov photons. The Barrel DIRC, which will surround the beam line and the interaction point, will be equipped with 128 MCP-PMTs of the type XP85112-S-BA by PHOTONIS with an active area of 2x2 inch^2, 8x8 anode pixels and a pore diameter of 10 μm of the MCPs. As part of the quality controll process Erlangen will measure performance parameters like the efficiency, both quantum and collection efficiency, the gain distribution, the time resolution, the afterpulse probability and the rate capability of these sensors.

The quantum efficiency of former MCP-PMTs dropped after only a few hundred mC/cm^2 integrated anode charge due to feedback ions produced in the residual gas. These ions are accelerated back to the photo cathode and may damage it. This aging problem was significantly reduced by applying an ALD coating (atomic-layer deposition) to the MCP pores. Both the lifetime performance of the latest tubes and the performance of the first Barrel DIRC MCP-PMTs will be shown in this talk. - Funded by BMBF and GSI -

HK 56.4 Thu 15:00 SCH/A.101

New "escalation" effect observed in recent MCP-PMTs — •Steffen Krauss, Merlin Boehm, Katja Gumbert, Albert Lehmann, and Daniel Miehling — Physikalisches Institut, Universität Erlangen-Nürnberg

Two DIRC-type Cherenkov detectors will be employed in the PANDA experiment at FAIR for pion/kaon separation. Since the focal planes of both DIRC detectors are located in a $\gtrsim 1$ Tesla magnetic field, Microchannel-Plate Photomultipliers (MCP-PMTs) are the only viable option to detect the few generated Cherenkov photons. To distinguish these single photons safely from the thermally emitted photo electrons a low darkcount rate is required in combination with a high gain of $> 10^6$. In some of the latest MCP-PMTs a new and completely unexpected effect was observed recently. At high gains and sometimes in combination with high illumination levels the MCP-resistance drops significantly, the gain drops, and a high amount of photons are created inside the tube, which causes a drastic increase of count rate. Inside a magnetic field this behavior seems to be significantly suppressed.

To study this effect in more detail several measurements of current, gain, and count rate were performed and compared for different MCP-PMTs. The rate of the produced photons were measured in an oppositely placed additional MCP-PMT. The results of these measurements are presented in this talk for older and the most recent MCP-PMT generations of different manufacturers.

- Funded by BMBF and GSI -

HK 56.5 Thu 15:15 SCH/A.101

Prototype studies towards the CBM RICH air cooling system* — •Gianluca Boccarella, Christian Pauly, Dennis Pfeifer, and Karl-Heinz Kampert for the CBM-Collaboration — Bergische Universität Wuppertal, Gaußstraße 20, 42119 Wuppertal

The Compressed Baryonic Matter (CBM) RICH detector is a CO_2 based gaseous Ring Imaging Cherenkov detector using MultiAnode PhotoMultipliers (MAPMT) for Cherenkov photon detection. It is placed beam downstream directly behind the CBM superconducting magnet and serves the precise electron identification and pion suppression. The photon detector is split into two separate cameras each including 30k channels DIRICH frontend readout electronics. Both cameras are enclosed by an iron shielding box in order to protect the MAPMT sensors from the magnetic stray field of the nearby CBM magnet. This shielding enclosure poses a major challenge for the cooling of the electronics dissipating approximately 3 kW heat inside each camera module. In order to achieve reliable cooling of all ∼1000 readout modules per camera we plan to use a closed-cycle enforced air cooling system.

In the talk, we present the cooling concept of the CBM RICH detector together with first measurements obtained using a full scale prototype of one of the camera modules.

* supported by BMBF (05P19PXFCA, 05P21PXFC1) and GSI.

HK 57: Hadron Structure and Spectroscopy VI

Time: Thursday 14:00–15:30 Location: SCH/A316

Group Report HK 57.1 Thu 14:00 SCH/A316
Multi-meson photoproduction off the proton - recent results from the CBELSA/TAPS experiment — •Philipp Mahlberg for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Deutschland

The nucleon excitation spectrum is dominated by mostly broad resonances, so partial wave analyses (PWA) are needed to extract the overlapping resonances from the experimental data. In order to find an unambiguous solution, the measurement of polarization observables is indispensable.

Meson photoproduction experiments have provided an extensive database which in turn let different partial wave analyses converge to similar results. The findings fit surprisingly well in an ordering scheme imposed by a non-relativistic quark model. Within the higher mass regime, the PWA solutions are less constrained and not all model-predicted states have been confirmed by experiments. Here, multi-meson decay channels gain importance and sequential decay chains can be studied.

The Crystal Barrel/TAPS experiment is, due to its good energy resolution, high photon detection efficiency and its almost complete solid angle coverage, ideally suited to measure such multi-meson final states in which neutral mesons decay into photons.

For the $p\pi^0\pi^0$ and $p\pi^0\eta$ final states, recent results – obtained with a linearly polarized photon beam at different coherent edge positions (up to 1850 MeV), impinging on an either transversely polarized or unpolarized target – will be presented.

HK 57.2 Thu 14:30 SCH/A316
Sensitivity study for baryon resonances searches in pion-proton collisions with HADES — •Jan Gollub[1], Ahmed Foda[2], Johan Messchendorp[2], and James Ritman[2] for the HADES-Collaboration — [1]Ruhr-Universität Bochum, 44801 Bochum, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

Pion-induced reactions provide unique opportunities for a description of baryonic resonances and their coupling channels. The two-pion production in $\pi^- - p$ reactions at pion beam momenta between 0.650 GeV/c and 0.786 GeV/c was already analysed. The next step is to investigate these reactions at center of mass energies up to $\sqrt{s}$ = 1.76 GeV with the HADES detector in 2024.

In this work, a sensitivity study of the expected results using the Bonn-Gatchina partial wave analysis framework has been performed. In this talk MC simulated invariant mass spectra and angular distributions will be presented.

HK 57.3 Thu 14:45 SCH/A316
Study of the Δ++ baryon at BESIII — •Dong Liu[1,2], Christoph Rosner[1], and Frank Maas[1,3,4] for the BESIII-Collaboration — [1]Helmholtz Institute Mainz, Mainz, Germany — [2]University of Science and Technology of China, Hefei, China — [3]Institute of Nuclear Physics, Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Mainz, Germany

The common baryons are the baryon octet and the baryon decuplet states. The wave functions of baryons in the octet are antisymmetric under quark exchange, and they have been extensively studied in electron-positron collision experiments, including proton, neutron, Λ, Σ, Ξ, etc. The wave functions of decuplet baryons are symmetric under quark exchange and there are few studies on them, including Δ, Σ*, Ξ*, Ω, etc. Among them, Δ particles are the lightest ones and have the highest cross section in electron-positron collisions. The measurement of the Δ production cross section at the BESIII experiment is a complement to the study of baryons and provides an experimental basis for theoretical studies of the intrinsic structure of baryons. The analysis of the Δ++ baryon pair production process is carried out at the BESIII experiment, giving the upper limit of the cross section for the process in the energy range from the threshold up to 2.645 GeV, which constrain the theoretical prediction for the decuplet pair production process. Meanwhile, the cross section and error for the Δ++p-π- process at a centre-of-mass energy of 2.645 GeV is also reported.

HK 57.4 Thu 15:00 SCH/A316
Determination of the polarization observables T,P and H in the reaction $\gamma p \to p\pi^0$ — •Sebastian Ciupka for the CBELSA/TAPS-Collaboration — HISKP, Uni Bonn

It is experimentally and theoretically challenging to determine the exact number of exited nucleon states and their properties, since the short lifetime of these exited states leads to strongly overlapping resonances. Using a polarized beam, a polarized target or using the polarization of the recoil nucleon helps to measure single or double polarization observables, that are needed for an unambiguous partial wave analysis solution.

The CBELSA/TAPS experiment in Bonn provides a polarized photon beam as well as a longitudinally or transversely polarized target, allowing for the determination of single and double polarization observables. The Crystal Barrel (CB) calorimeter, together with the MiniTAPS calorimeter in forward direction, give the opportunity for close to 4π coverage for the measurements.

This talk will present preliminary results of the determination of the polarization observables T, P and H, for energies between 600MeV and 3200MeV, using data collected after the recent upgrade of the CB calorimeters readout electronics and these results are compared to previous data and model predictions.

HK 57.5 Thu 15:15 SCH/A316
Resonance Regions: Partial Wave Analysis in the HADES Experiment — •Ahmed Marwan Foda — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

The High Acceptance Di-lepton Spectrometer (HADES) collaboration uses a pion beam to study features of baryonic resonances and their decay channels. This allows the production of baryonic resonances at a fixed center of mass energy, i.e. in the s-channel, thus giving these beams a significant advantage relative to proton proton reactions. Partial Wave Analysis (PWA) techniques are used to study the coupling of the resonances to different final states. Analysis of the baryonic resonances decays to ρN and ωN final states will provide insight into baryon-vector meson couplings essential for the understanding of the melting of the ρN meson in a dense baryonic matter and description of dilepton emissions from Heavy Ion collisions.

A new implementation of the Bonn-Gatchina framework is being developed in preparation for a more detailed mapping of the resonance regions in pion-proton collisions. Example fits will be presented showing current status and the potential of the new framework.

HK 58: Hadron Structure and Spectroscopy VII

Time: Thursday 14:00–15:30 Location: SCH/A419

Group Report HK 58.1 Thu 14:00 SCH/A419
Understanding the dynamics of three-body systems using femtoscopy at the LHC — •Raffaele Del Grande for the ALICE Germany-Collaboration — Technical University of Munich, Garching, Germany

Three-body forces among hadrons are necessary for the theoretical description of nuclear bound objects and for modeling the equation of state of neutron stars. Direct measurements of three-body interactions are currently missing and represent one of the current challenges for experimental nuclear physics. The ALICE Collaboration has recently extended the femtoscopy technique to explore the strong interaction in three-particle systems, exploiting both three-hadron and hadron-nucleus correlation studies. The present contribution provides an overview of the milestones reached by ALICE in the study of three-body systems, using the femtoscopy technique in pp collisions at $\sqrt{s} = 13$ TeV. The main highlights are the first experimental mea-

surements of three-baryon correlations, p–p–p and p–p–Λ, and the first study of three-body systems with kaons, p–p–K^+ and p–p–K^-. The contribution of genuine three-body effects in the measured correlation functions has been isolated using Kubo's cumulant expansion method. The interpretation of such measurement and the possible implications on the equation of state of neutron stars and bound state formation will be discussed.

This research was funded by DFG SFB1258 and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 58.2 Thu 14:30 SCH/A419

Understanding the particle emitting source of π–π correlations from measurements in MB pp of ALICE at 13 TeV — •Maximilian Korwieser for the ALICE Germany-Collaboration — TU München, Physik Department E62, Excellence Cluster 'Universe', Garching

The ALICE collaboration recently published a plethora of results obtained from femtoscopic measurements, studying the interaction between many exotic combinations of particles, most notably Ω–p. In general these studies depend on a precise understanding of the particle emitting source, which is constructed employing the resonance source model (RSM). In the RSM, deviations of a Gaussians source distribution, due to the effects of short lived resonances, are modeled via a Monte Carlo procedure. For two particle correlations between baryons (p–p and Λ–p) the RSM was already validated with great success. The goal of this work is to validate whether the RSM can also be applied to constrain the source in the mesonic sector. A differential study of the source functions spatial extension is presented, in bins of m_{T} and multiplicity classes, by analysing MB pp collisions at $\sqrt{s}$ = 13 TeV obtained by ALICE. An m_{T} scaling behaviour of the source is observed and found to be compatible with previous results in the baryonic sector. This measurement supports the scenario of a common source for mesons and baryons in small colliding systems, allowing to employ the RSM to constrain the source for meson–baryon and meson–meson.

This research was supported by the BmBf.

HK 58.3 Thu 14:45 SCH/A419

Investigating p–π^+ and p–π^- femtoscopic correlations with ALICE at the LHC — •Marcel Lesch for the ALICE Germany-Collaboration — TUM, James-Franck-Straße 1, 85748 Garching bei München

The modelling of neutron stars is deeply linked to the understanding of the nuclear equation of state (EoS). It was recently proposed that the QCD axion might impact the EoS of neutron stars and that its properties at large baryonic densities can be related to the in-medium properties of pions. Constraining the latter is thus crucial for the study of the QCD axion and its impact on the description of neutron stars. By employing recently developed three-body femtoscopic techniques, the in-medium properties of pions can be inferred from correlation measurements between pions and many nucleons in pp collisions at the LHC. These small systems produce particles at distances of ∼ 1 fm, mimicking a large-density environment. However, to understand the experimental three-body correlations, the lower-order two-body correlations between p–π^+ and p–π^- must be constrained. In this talk, we present the first measurement of p–π^+ and p–π^- correlations using two-body femtoscopy. The results have been obtained by analysing high-multiplicity pp collisions at $\sqrt{s}$ = 13 TeV measured by ALICE.

This research was funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and the BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 58.4 Thu 15:00 SCH/A419

ALICE determines the scattering parameters of open charm mesons with light-flavor hadrons — •Daniel Battistini for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

The strong interaction among D mesons and light-flavor hadrons was completely out of experimental reach until recently. The lack of experimental constraints on the scattering parameters of D-proton/pion/kaon poses strong limitations not only to the search of molecular states composed of charm and non-charm hadrons, but also to the study of the rescattering of charm mesons in the hadronic phase of ultrarelativistic heavy-ion collisions. The knowledge of the scattering parameters of charm hadrons with non-charm hadrons would be a crucial ingredient for models based on charm-quark transport in a hydrodynamically expanding QGP to describe the typical observables of heavy-ion collisions.

In this talk, we will report on the first measurement of the scattering parameters of open charm mesons with light-flavor hadrons. The study is carried out by the ALICE Collaboration, in high-multiplicity proton-proton collisions at $\sqrt{s}$ = 13 TeV. The scattering parameters are measured employing correlation techniques and the final-state strong interaction is found to be shallow in all the channels under study.

* Funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 58.5 Thu 15:15 SCH/A419

Studying the pΛ interaction in small collision systems using a common emission source — •Jaime Gonzalez and Dimitar Mihaylov — Technical Unverisity of Munich

This work introduces a new framework (CECA) to model the source function that represents the spatial and kinematic properties of a particle emission in small collision systems. The properties of the source have been fixed within CECA by using an existing ALICE measurement of the pp source size in pp collisions. Under the assumption of a common source, a simulation of the kinematic properties of the pΛ system is performed and compared to existing measurements. Utilizing several parameterizations of the chiral effective field theory, used to model the pΛ interaction, allowed to study the properties of the hyperon-nucleon interaction, which is an important ingredient for the nuclear Equation of State and the modeling of the structure of neutron stars. Funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 59: Structure and Dynamics of Nuclei XI

Time: Thursday 14:00–15:30 Location: SCH/A118

Group Report HK 59.1 Thu 14:00 SCH/A118

Commissioning of Miniball@HIE-ISOLDE and first results from Coulomb excitation of ^{130}Sn — •Maximilian Droste[1], Peter Reiter[1], and Thorsten Kröll[2] for the MINIBALL IS702-Collaboration — [1]IKP, Universität zu Köln, Germany — [2]Institut für Kernphysik, TU Darmstadt, Germany

The high-resolution Miniball germanium array has been recommissioned at the HIE-ISOLDE facility at CERN in 2022. After successful campaigns at RIKEN, Japan and PSI, Switzerland the cryostats and capsules of the HPGe crystals have been redesigned and rebuilt. A new data acquisition system, based on FEBEX digitizers, was used for the commissioning of the array. Coulomb excitation of ^{130}Sn was the first experiment after LS2 at CERN. A beam of 4.4 $\frac{\mathrm{MeV}}{\mathrm{u}}$ was delivered onto a ^{206}Pd target. Dexciting γ-rays from target and projectile nuclei were recorded in coincidence with scattered particles. The experiment aims to investigate the evolution of nuclear structure around the magic-shell closure at N=82 tin isotopes by determining the $B(E2; 0^+_{\mathrm{g.s.}} \rightarrow 2^+_1)$ value. Most advanced SM calculations using realistic interactions 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] needs 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 BMBF Projects 05P18PKCI1, 05P21PKCI1 and European Unions Horizon Europe Framework research programm (Grant Agreement No. 101057511)

HK 59.2 Thu 14:30 SCH/A118

Investigation of SRC in exotic nuclei at R3B/GSI — •Enis Lorenz[1,2], Thomas Aumann[1,2], Meytal Duer[1,2], Anna Corsi[3], Or Hen[4], Julian Kahlbow[4], Aldric Revel[3], Andrea Jedele[1,2], Andrea Lagni[3], Manuel Xarepe[5,1], Hang Qi[4], Nikhil Mozumdar[1,2], and Antoine Barriere[6] for the R3B-Collaboration — [1]Technische Universität Darmstadt — [2]GSI Helmholtz Zentrum — [3]CEA Saclay — [4]Massachusetts Institute of Technology — [5]University

of Lisbon — [6]Grand Accélérateur National d'Ions Lourds

Short-Range Correlations (SRC) are two-body components of the nuclear wave function with high relative momentum and low center-of-mass momentum relative to the Fermi momentum. These high-momentum states are overpopulated relative to a simple free-Fermi gas. During the nuclear reaction, SRC pairs are temporarily formed due to the presence of high-density fluctuations between 2-5 times the saturation density. The formation of the SRC pairs gives an unique opportunity to explore the interaction of cold nuclear matter at extreme densities. The first measurement of SRCs in inverse kinematics with radioactive ion beams has been performed at R3B as part of the FAIR Phase-0 experimental program in Spring 2022. In this talk I will give an overview on the status of the analysis. This work is funded and supported by the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006), by the German Federal Ministry for Education and Research (BMBF) under contract number 05P21RDFN2 and the GSI-TU Darmstadt cooperation.

HK 59.3 Thu 14:45 SCH/A118

Overview of CALIFA in FAIR-Phase-0 Experiments at R^3B — •Leyla Atar[1], Christian Sürder[1], Thorsten Kröll[1], Roman Gernhäuser[2], and Philipp Klenze[2] for the R3B-Collaboration — [1]Institut für Kernphysik, Technische Universität Darmstadt, Germany — [2]Technische Universität München, Germany

CALIFA (the CALorimeter for In Flight detection of γ-rays and light charged pArticles) is one of the key detectors of the R^3B experiment at the GSI/FAIR facility. CALIFA is highly segmented and currently consists of 1528 scintillation CsI(Tl) crystals surrounding the reaction target area to facilitate measurement of the emission angle and energy of reaction products. CALIFA covers a large dynamic range to allow a simultaneous measurement of γ-rays down to 100 keV and scattered protons up to 300 MeV. A special feature of CALIFA is the digital Quick Particle Identification (QPID) enabling γ-rays and charged particle identification through Pulse Shape Analysis (PSA) of the scintillation light output.

I will shortly introduce the CALIFA calorimeter and its auxiliary detector systems and give an overview of the performance of CALIFA in the frame of FAIR-Phase-0 experiments performed at the R^3B/FAIR setup. First results from specific reaction channels will be presented.

This work is supported by BMBF contracts (05P19RDFN1) and (05P21RDFN2).

HK 59.4 Thu 15:00 SCH/A118

Lifetime measurements of excited states of ^{132}Te after 2n transfer — •H. Mayr[1], T. Stetz[1], V. Werner[1], T. Beck[5], M. Beckers[2], A. Blazhev[2], R. Borcea[4], S. Calinescu[4], C. Costache[4], I. Dinescu[4], A. Esmaylzadeh[2], B. Falk[2], J. Fischer[2], R.-B. Gerst[2], K. Gladnishki[3], A. Ionescu[4], V. Karayonchev[6], E. Kleis[2], H. Kleis[2], L. Klöckner[2], P. Koch[2], D. Kocheva[3], P. Koseoglou[1], R. Mayer[1], R.-E. Mihai[4], C. M. Nickel[1], C.-R. Nita[4], A. Pfeil[2], N. Pietralla[1], G. Rainovski[3], F. Spee[2], L. Stan[4], M. Stoyanova[3], S. Toma[7], and R. Zidarova[1] — [1]TU Darmstadt — [2]U Cologne — [3]U Sofia — [4]IFIN-HH Bucharest — [5]MSU — [6]TRIUMF Canada — [7]UP Bucharest

The proton-neutron symmetry of low-lying nuclear states is characterized by the mixing of respective configurations to their wave functions, dominated by few two-nucleon configurations near shell closures. Located closely to the doubly-magic ^{132}Sn, ^{132}Te is therefore well suited to study mixed-symmetric configurations and their fragmentation. By applying the Doppler Shift Attenuation Method, following a two-neutron transfer reaction to ^{132}Te, the location and fragmentation of mixed-symmetric states has been studied through the measurement of excited-state lifetimes. Results for the 2^+ mixed-symmetric states will be presented. A complementary experiment has been performed using the Recoil Distance Doppler Shift method, in order to access lifetimes of longer-lived states. With the resulting lifetimes, transition strengths to lower lying states have been determined and compared to theoretical approaches. *Supported by the BMBF 05P21RDCI2-TP1.

HK 59.5 Thu 15:15 SCH/A118

Development of a new γ-γ angular correlation analysis method using asymmetric ring of clover detectors — •Lukas Knafla[1], Arwin Esmaylzadeh[1], Andreas Harter[1], Jan Jolie[1], Ulli Köster[2], Mario Ley[1], Caterina Michelagnoli[2], and Jean-Marc Régis[1] — [1]Institut für Kernphysik, Universität zu Köln — [2]Institut Laue-Langevin, Grenoble, Frankreich

A new method for γ-γ angular correlation analysis using a symmetric ring of HPGe clover detectors is presented. Pairwise combinations of individual crystals are grouped based on the geometric properties of the spectrometer, constrained by a single variable parameterization. The corresponding effective interaction angles between crystal pairs, as well as the attenuation coefficients are extracted directly from the measured experimental data. Angular correlation coefficients, parameter uncertainties and parameter co-variances are derived using a Monte-Carlo approach, considering all sources of statistical uncertainty. The general applicability of this approach is demonstrated by reproducing known multipole mixing ratios in ^{177}Hf, ^{152}Gd and ^{116}Sn, populated by either β-decay or (n, γ)-reactions, measured at the Institut Laue-Langevin, using the EXILL&FATIMA spectrometer and different configurations of the FIPPS instrument. The derived mixing ratios are in excellent agreement with adopted literature values with comparable or better precision [1].

[1] L. Knafla et al., Nucl. Instrum. Methods Phys. Res. A 1042 (2022)

HK 60: Structure and Dynamics of Nuclei XII

Time: Thursday 14:00–15:30 Location: SCH/A215

HK 60.1 Thu 14:00 SCH/A215

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

Electron scattering experiments under 180° are an excellent tool to study transversal form factors of magnetic excitations due to 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. A measurement was performed with the 180° system [1] at the S-DALINAC, in order to investigate the M3 transition of the 3^+ ground state to the excited 0^+ state at 1.74 MeV in ^{10}B which is the analogue to the second-forbidden beta-decay of ^{10}Be. The measurement will extend existing data towards lower momentum transfer allowing to improve 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. First results of the new ^{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 60.2 Thu 14:15 SCH/A215

^{16}O(n,α_0)^{13}C Cross Section Normalization based on a new Time-of-Flight measurement using a Frisch Grid Ionisation Chamber — Sebastian Urlass[1], •Arnd Junghans[1], Roland Beyer[1], and Arjan Plompen[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Bautzner Landstraße 400, 01328 Dresden, Germany — [2]European Commission, Joint Research Center (JRC), Retieseweg 111 2440 Geel, Belgium

The ^{16}O(n,α)^{13}C reaction plays an important role in nuclear technology. Oxygen is a major component of the fuel and in the water coolant of nuclear power reactors. This reaction influences criticality through the removal of neutrons and produces helium in the fuel which may lead to swelling. A new reaction cross section measurement was carried out at the time-of-flight facility GELINA using a Frisch-gridded ionization chamber. Between the reaction threshold and a neutron energy of 9 MeV, ^{16}O(n,α_0)^{13}C events on the CO_2 admixture in the counting gas could be well identified. The cross sections were determined relative to relative to the neutron-induced fission cross section standard of ^{235}U

using the H19 fission chamber of PTB and compared to recent evaluations. Special care was taken to quantify all sources of systematic uncertainties based on measurements. The integral over the data from 4 to 5.3 MeV allows the normalization of evaluated ^{16}O(n,α_0)^{13}C reaction cross sections and data in the literature to about 6% uncertainty. The new cross section normalization is compared with results deduced from thin target measurements of the inverse reaction ^{13}C(α,n)^{16}O and thick target yields.

HK 60.3 Thu 14:30 SCH/A215

Energy-dependence of the γ-decay branching ratio of the Giant Dipole Resonances of ^{154}Sm and ^{140}Ce — •K. Prifti[1], J. Kleemann[1], V. Werner[1], N. Pietralla[1], P. Koseoglou[1], M. Beuschlein[1], U. Friman-Gayer[1,2,4], S. W Finch[2,3], T. Beck[1], K. Ide[1], J. Isaak[1], O. Papst[1], M.L. Cortes[1], D. Gribble[2,3], D. Savran[5], and W. Tornow[2,4] — [1]IKP, TU Darmstadt — [2]TUNL, Durham, NC, USA — [3]UNC, Chapel Hill, USA — [4]Duke University, Durham, NC, USA — [5]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. Simultaneously to a nuclear resonance fluorescence (NRF) measurements an activation measurement has been performed at the HIγS facility. The targets used for the activation measurements were comprised of natural samarium, natural cerium and gold foils. By determining the activation of these targets and then comparing to the GDR-NRF events that are observed, we will determine the γ- to neutron-decay branching ratio. The data, their analysis and first results will be presented and discussed.

This work is supported by the LOEWE program under grant *Nuclear Photonics* and within the Hessian cluster project *ELEMENTS*.

HK 60.4 Thu 14:45 SCH/A215

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], 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], 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, 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. 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' intense, linearly-polarized and quasi-monochromatic γ-ray beam. The regions were chosen to highlight distinct features of the double-humped GDR of ^{154}Sm. The obtained data allow for a first experimental test of the commonly accepted K-quantum-number assignments to the GDR of ^{154}Sm. First results of the analysis will be presented and discussed with respect to the textbook interpretation of the GDR in deformed nuclei.

This work is supported by the State of Hesse under the LOEWE research grant *Nuclear Photonics* and the cluster project *ELEMENTS*, and by the U.S. Department of Energy, Office of Nuclear Physics.

HK 60.5 Thu 15:00 SCH/A215

Status report on the progress on the analysis of the NewSUBARU data — •Nikolina Lalic[1], Thomas Aumann[1,2], Takashi Ariizumi[3], Martin Baumann[1], Patrick van Beek[1], Ioana Gheorghe[4], Heiko Scheit[1], Dmytro Symochko[1], and Hiroaki Utsunomiya[3] for the NewSUBARU-Collaboration — [1]Technische Unitversität Darmstadt, Germany — [2]GSI Helmholtzzentrum, Germany — [3]Department of Physics, Konan University, Japan — [4]"Horia Hulubei" National Institute for R & D in Physics and Nuclear Engineering (IFIN HH), Romania

The photoneutron cross sections of ^{112}Sn, ^{116}Sn, ^{120}Sn and ^{124}Sn were measured in (γ, xn) reactions, where $x \in [1, 4]$, using a quasi-monochromatic laser Compton-scattering γ-ray beam at the NewSUBARU facility. The goal of the experiment is to resolve the long-standing discrepancy of the total and partial cross sections measured by the Livermore and the Saclay groups. Measurements were done with γ energies from 8 MeV to 38 MeV. As a neutron counter a detector with a flat efficiency was used to take advantage of the direct neutron-multiplicity sorting technique. The (γ, xn) cross sections $x \in [1, 4]$ will be determined as well as the total photo absorption cross sections.
In this report the experiment and the current state of the ongoing analysis will be presented.
Suported by HMWK (LOEWE centre "Nuclear Photonics") and DFG (SFB 1245).

HK 60.6 Thu 15:15 SCH/A215

Systematic investigation of the low-energy electric dipole response in ^{116,118}Sn using the $(d, p\gamma)$ reaction — •Markus Müllenmeister, Michael Weinert, Florian Kluwig, Miriam Müscher, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

The so-called Pygmy Dipole Resonance (PDR) has been a research topic of great interest in recent decades. While the general properties of this excitation is well known [1], there are still questions about its structure. For the study of this underlying structure, experiments sensitive to different aspects of the nucleus are vital [2]. The $(d, p\gamma)$ reaction has been shown to be a selective probe for the microscopic character of certain states. The tin isotopic chain in particular is an interesting subject for this kind of investigation, as its magic proton number ($Z = 50$) provides several isotopes accessible for this reaction. As the $(d, p\gamma)$ reaction was already studied in depth for ^{119}Sn$(d, p\gamma)^{120}$Sn [3], similar experiments were performed at the SONIC@HORUS setup [4] in Cologne on the other two available isotopes ^{115,117}Sn to study excitations in ^{116,118}Sn. The results of these experiments will be shown.
Supported by the DFG (ZI 510/10-1).
[1] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360
[2] D. Savran *et al.*, Phys. Lett. B **786** (2018) 16
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021) 242501
[4] S. G. Pickstone *et al.*, Nucl. Instr. and Meth. **875** (2017) 104

HK 61: Structure and Dynamics of Nuclei XIII

Time: Thursday 14:00–15:15 Location: SCH/A117

HK 61.1 Thu 14:00 SCH/A117

Reconstructed gamma-ray spectra by CALIFA after proton knockout reactions (experiment s467) — •Christian Sürder[1], Ryo Taniuchi[2], Luke Rose[2], Leyla Atar[1], Marina Petri[2], Stefanos Paschalis[2], and Thorsten Kröll[1] for the R3B-Collaboration — [1]Institut für Kernphysik, TU Darmstadt, Darmstadt, Germany — [2]School of Physics, Engineering and Technology, University of York, York, United Kingdom

An experiment to study single-particle properties of isotopes around the Ca isotopic chain was performed with the R^{3}B setup at GSI, Darmstadt, Germany. This experiment was part of the Phase 0 program at FAIR. A cocktail beam was produced via fragmentation of a ^{86}Kr primary beam impinging on a ^{9}Be target at a beam energy of 580MeV/A. One goal is to extract exclusive reaction cross sections in proton knockout (p,2p) reactions. Therefore it is essential to detect the knocked out protons and the coincident gammas from a de-excitation of the residual nucleus. CALIFA is a highly segmented CsI(Tl) detector which is capable of this task. To show the performance of CALIFA a strongly populated isotope is selected as a benchmark and the corresponding protons and gammas are reconstructed. The status of the analysis will be presented.

This work is supported by BMBF under contract 05P19RDFN1 and 05P21RDFN2 and the Helmholtz Research Academy Hesse for FAIR - HFHF.

HK 61.2 Thu 14:15 SCH/A117

"Comparison of the probability of Bi-209 (γ, p5n) Pb-203 reaction at 60 MeV and 80 MeV " — •Jelena Bardak[1], Miodrag Krmar[2], and NIkola Jovančević[2] — [1]GSI Helmholtz Centre for

Heavy Ion Research, Darmstadt, Germany and Faculty of Sciences, University of Novi Sad, Serbia — [2]Faculty of Sciences, University of Novi Sad, Serbia

In several recently published papers, photonuclear reactions with a target of natural bismuth were studied. Irradiation of some heavy elements by the photons having energies up to 80 MeV, will give several products of (γ,xn) reactions. The emission of protons or other charged particles is less probable due to the Coulomb barrier. In this paper, an attempt was made to gain experimental evidence of Bi-209(γ,p5n)Pb-203 nuclear reaction by comparison of intensities of gamma lines following EC decay of Bi-203 and Pb-203. Pb-203 can be formed by (γ,p5n) nuclear reaction, but it is certainly created after the decay of Bi-203, obtained in Bi-209(γ,6n)Bi-203 reaction. After activation of the target from natural bismuth in photon beams of maximum energies of 60 MeV and 80 MeV, several gamma spectra were successively measured. Based on selected gamma lines from the measured spectra, the activities of Pb-203 and Bi-203 were monitored to assess the probability ratio for the occurrence of (γ,6n) and (γ,p5n) nuclear reactions. Furthermore, quantitative data concerning the probability of the mentioned reactions is extracted and compared to theoretical predictions.

HK 61.3 Thu 14:30 SCH/A117

Investigation of the internal conversion lifetime of ^{229m}Th in a solid — •Lilli Löbell[1], Sandro Kraemer[1], Daniel Moritz[1], Kevin Scharl[1], Benedict Seiferle[1], Lars von der Wense[2], Florian Zacherl[1], and Peter Thirolf[1] — [1]LMU München — [2]Max-Planck-Institut für Quantenoptik, Garching

The first excited nuclear state of ^{229}Th has an exceptionally low excitation energy of 8.338 ± 0.024 eV ($\lambda = 148.71 \pm 0.42$ nm), allowing potentially a laser excitation of the nuclear transition. Consequently, ^{229}Th is the so far only candidate for a nuclear clock, which can possibly outperform optical atomic clocks and be used amongst a manifold of other applications to investigate variations of fundamental constants. For the decay of the thorium isomer to the ground state, the dominant decay channel in neutral ^{229m}Th atoms is internal conversion (IC), in which the nuclear transition energy is transferred to an electron of the atomic shell. The lifetime of the IC decay was measured on a metallic surface as 7 ± 1 μs, but there are indications of a dependence on the electronic environment surrounding the thorium atom. A possible way to investigate the IC lifetime within a solid state environment is the implantation of ^{229m}Th atoms into the depletion region of a semiconductor detector, where the IC electrons can be detected. This could be a scenario for a solid-state nuclear clock where the clock transition would occur via IC in an active detector medium. The talk will present ongoing experiments using VUV-sensitive silicon photomultipliers for the IC electron detection. This work was supported by the European Research Council (ERC): ERC Synergy Grant 'ThoriumNuclearClock'.

HK 61.4 Thu 14:45 SCH/A117

Investigations of the internal conversion lifetime of ^{229m}Th on various metal surfaces — •Daniel Moritz[1], Sandro Kraemer[1], Lilli Löbell[1], Kevin Scharl[1], Benedict Seiferle[1], Lars von der Wense[2], Florian Zacherl[1], and Peter G. Thirolf[1] — [1]LMU München — [2]Max-Plank-Institut für Quantenoptik

With its exceptionally low energy of the isomeric first excited nuclear state, which has most recently been constrained to 8.338(24) eV (i.e. λ=148.71(42) nm) [1], ^{229m}Th is in the focus of current research as the only suitable candidate to build a nuclear clock based on it. One of the isomer's properties to be further investigated is its internal conversion (IC) lifetime when IC is triggered by neutralization of ^{229m}Th on a metallic catcher surface. After first hints on its dependence on the electronic environment of ^{229m}Th [2], the IC lifetime of ^{229m}Th$^{2+,3+}$ ions will now be evaluated systematically for various metal surfaces with different work functions. This talk presents the current status of these investigations at LMU.

This work was supported by the ERC Synergy Grant "ThoriumNuclearClock", Grant agreement No. 856415.

[1] S. Kraemer et al., arXiv:2209.10276 (2022)
[2] B. Seiferle, Diss., LMU (2019)

HK 61.5 Thu 15:00 SCH/A117

Benchmark of proton detection using CALIFA at R3B — •Luke Rose[1], Stefanos Paschalis[1], Ryo Taniuchi[1], Valerii Panin[2], Leyla Atar[2,3], Christian Suerder[3], and Marina Petri[1] for the R3B-Collaboration — [1]University of York, York, United Kingdom — [2]GSI, Darmstadt, Germany — [3]TU-Da, Darmstadt, Germany

Quasi-free scattering (p,2p) experiment of the Calcium isotopic chain $^{38-50}Ca$ at 450 MeV/u were performed by the R3B collaboration as part of FAIR phase 0. We performed a systematic study on the dependency of the quenching of spectroscopic factors to the isospin asymmetry by employing quasi-free scattering reactions in inverse kinematics, extending our previous investigation [Atar et al.] towards this medium-mass region. CALIFA has been used to measure the momentum of both the recoil and the knocked-out proton. In this contribution, we will discuss the simulations that were performed to study (p,2p) reactions using the CALIFA detector to quantify the detector efficiency for protons. This is a critical step in extracting the measured cross sections for the quasi-free scattering (p,2p) process.

HK 62: Astroparticle Physics I

Time: Thursday 14:00–15:15 Location: SCH/A252

Group Report HK 62.1 Thu 14:00 SCH/A252

Probing the Standard Model in Free Neutron Decay — •Karina Bernert, Max Lamparth, and Bastian Märkisch — Technische Universität München, Germany

(For the PERKEO and PERC consortia) Measurements of free neutron decay enable a variety of tests of the Standard Model of particle physics. Among the observables are the parity-violationg beta asymmetry A, and the Fierz interference term b. From precision measurements of A and the neutron lifetime, the CKM matrix element V_{ud} is determined without nuclear corrections. It serves as input for the first-row unitarity test of the CKM matrix and the current Cabibbo-angle anomaly. A non-zero Fierz term b would signal the existence of novel scalar and tensor interactions.

With its unique measurement technique, PERKEO III delivers the currently most precise values of A and b using a polarized neutron beam. We present the status of the data analysis of the most recent campaign at the ILL PF1b beam line in Grenoble, France, with the aim to extract an improved limit for the Fierz term b from the electron spectrum.

Meanwhile, the new PERC (Proton Electron Radiation Channel) facility is 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.

HK 62.2 Thu 14:30 SCH/A252

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

The KATRIN experiment aims to measure or exclude the effective electron neutrino mass m_ν down to 0.2 eV/c^2 (90 % C.L.) by measuring the tritium beta spectrum near its endpoint E_0, and performing a fit including the parameters E_0 and m_ν^2. Since these are highly correlated, a systematic shift influencing the obtained neutrino mass would be visible in the endpoint and thus the tritium Q value. The KATRIN Q value can be determined by absolute calibration with ^{83m}Kr conversion electron lines. This is however limited by the nuclear gamma transition energy uncertainties of ^{83m}Kr to $0.5-0.6$ eV accuracy. The excited nucleus of ^{83m}Kr decays in a two-step cascade of 32.2 eV and 9.4 eV highly converted gamma transitions. In a new four weeks measurement campaign performed at KATRIN, a large set of conversion electron lines including a new line was measured extensively with a condensed krypton source. Following the method described in ref. EPJ C 82 (2022) 700, the ^{83m}Kr nuclear transition energies can be determined, which can allow for a reduction of the Q value uncertainty to below 100 meV. In this talk the principle, measurements, and analyses for improving the ^{83m}Kr transition energy uncertainties are presented. This work is supported by BMBF under contract number 05A20PMA.

HK 62.3 Thu 14:45 SCH/A252

Towards the biggest germanium detectors ever grown — •Tommaso Comellato and Stefan Schönert — Technical University of Munich, Garching bei München, Germany

The Legend experiment searches for the neutrinoless double-beta decay of ^{76}Ge, a second order weak process which, if observed, would provide evidence of beyond the standard model physics. It is presently being commissioned in the upgraded Gerda infrastructure at LNGS (Italy) and in its first stage it will operate 200 kg of High Purity Germanium (HPGe) detectors. The baseline detector geometry is the inverted coaxial, which combines the excellent pulse shape discrimination performance of previous generation experiments with a up to a factor 4 larger mass per detector. This yields as a result a reduction of a similar factor of backgrounds from close-by parts as cables and holders. In this talk, detailed field modeling of big detectors will be given, and preliminary results on the experimental characterization of one of them will be presented. This work has been supported in part by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement No. 786430 - GemX)

HK 62.4 Thu 15:00 SCH/A252

Development of a cosmic muon and neutron veto system for IAXO and BabyIAXO — •Dhruv Chouhan, Elisa Ruiz-Chóliz, and Matthias Schott — Johannes Gutenberg University of Mainz, Germany

The International Axion Observatory (IAXO) experiment is a large-scale helioscope aimed at searching for axions and axion-like particles (ALPs) produced in the Sun. As a first step, the BabyIAXO was proposed as a smaller scale helioscope that will reach a sensitivity on the axion-photon coupling of 1.5*10-11 GeV-1 for masses up to 0.25 eV, covering a very interesting region of the parameter space. To detect the axion signal, a very low background x-ray detector design is required. This talk will focus on the development of the BabyIAXO veto system for cosmic rays based on light-guided organic plastic scintillators with Silicon Photo Mutiplier sensors.

HK 63: Instrumentation XVI

Time: Thursday 15:45–17:00 Location: SCH/A251

Group Report HK 63.1 Thu 15:45 SCH/A251

Der PANDA-Luminositätsdetektor — •Heinrich Leithoff[1], Achim Denig[1], Christof Motzko[2], Jannik Petersen[2], Florian Feldbauer[3], Gerhard Reicherz[3], Roman Klasen[3], Stephan Maldaner[3], Niels Boelger[3], Stephan Bökelmann[3], René Hagdorn[3] und Miriam Fritsch[3] — [1]Johannes-Gutenberg Universität Mainz — [2]Helmholtz Institut Mainz — [3]Ruhr-Universität Bochum

Das zukünftige PANDA-Experiment, welches im Antiprotonenring HESR als Teil der im Bau befindlichen FAIR Beschleunigeranlage bei Darmstadt entsteht, ist optimiert, um Fragen der Hadronenphysik zu untersuchen. Es bietet herausragende Voraussetzungen zur Suche nach neuen Zuständen sowie der präzisen Vermessung bekannter Zustände. In der dafür verwendeten Energie-Scan-Methode ist die exakte Kenntnis der Luminosität zur Normierung essentiell. Diese wird bei PANDA aus der Winkelverteilung der elastisch gestreuten Antiprotonen extrahiert. Für die geforderte absolute Messgenauigkeit von besser als 5% werden die Spuren der elastisch gestreuten Antiprotonen mit 4 Ebenen gedünnter Siliziumpixelsensoren (HV-MAPS) gemessen. Diese Sensoren mit integrierter Ausleseelektronik werden auf CVD-Diamantscheiben aufgeklebt in zwei verfahrbaren Halbdetektoren montiert und zur Reduktion der Vielfachstreuung im Vakuum betrieben. Präsentiert werden das Konzept des Luminositätsdetektors mit technischen Aspekten wie Vakuumsystem, Kühlung und Elektronik sowie Einblicken in die Datenanalyse.

HK 63.2 Thu 16:15 SCH/A251

Performance on the STS detector in Ni+Ni collisions at 1.93 AGeV with the mCBM setup at SIS18 — •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. CBM focuses on the search for a signal of the phase transition between hadronic and quark-gluon matter, the QCD critical endpoint, new forms of strange-matter, in-medium modifications of hadrons, and the onset of chiral symmetry restoration. The Silicon Tracking System is the central detector for momentum measurement and charged-particle identification. It is designed to measure Au+Au collisions at interaction rates up to 10 MHz. It comprises approximately 900 double-sided silicon strip sensors arranged in 8 tracking stations, resulting in 1.8 million channels, having the most demanding requirements in terms of bandwidth and density of all CBM detectors. The mini-CBM (mCBM) project is a small-scale precursor of the full CBM detector, consisting of sub-units of all major CBM systems which aims to verify CBM's concepts of free-streaming readout electronics, data transport, and online reconstruction. In the 2022 beam campaign at SIS18 (GSI) Ni+Ni collisions at 1.93 AGeV were measured with an average collision rate of 400 kHz. The mini-STS (mSTS) setup for the campaign consists of 2 stations with 11 sensors. The results from data taken in the 2022 beam campaign will be presented focusing on the hit reconstruction and mSTS performance studies.

HK 63.3 Thu 16:30 SCH/A251

Characterization and test of STS modules for the E16 experiment — •Dairon Rodriguez Garces for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 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 di-electron detection from slowly moving vector mesons, particularly the phi meson, produced in proton-nucleus collisions. 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 at the Detector Lab in GSI. This is the first time a series of modules is produced with final components, and systematically tested. Each module has a double-sided silicon sensor, connected via a stack of microcables to a pair front-end boards (FEBs) with 8 ASICs (STS-XYTERv2) each. The characterization of the E16 modules was carried out through the STS testing procedure that includes the determination of the set of the operational parameters for each module (ADC calibration, etc.), testing the performance (ENC noise, the linearity of the ADC and the homogeneity of the channels response), and also the identification of the broken channels.

This work will show the results of testing and characterizing the E16 modules and the insights that we have gained from it for the upcoming series production of STS modules.

HK 63.4 Thu 16:45 SCH/A251

Dosimetry with test structures of the PANDA Micro-Vertex-Detector — •Nils Tröll — II. Physikalisches Institut, Giessen

Electrical characterization and radiation damage is carried out on double-sided silicon strip detectors and pin diodes representing a test structure with electrical properties for the Micro-Vertex-Detector (MVD), which will be the innermost tracking detector of the PANDA experiment.

Therefore, the silicon diodes of the MVD are used in a dosimeter con- cept for measurements of ionizing radiation dose. The energy calibra- tion is carried out at the Marburg Ion Beam Therapy Centre (MIT) and by various laboratory radiation sources. Signal generation by the sensors is observed to determine performance parameters for the MVD. Additionally, static electrical properties, like the depletion voltage, al- low a characterization of radiation tolerance of the silicon diodes. The work is supported by the BMBF.

HK 64: Instrumentation XVII

Time: Thursday 15:45–16:45 Location: SCH/A.101

Group Report HK 64.1 Thu 15:45 SCH/A.101

Status and production of the CBM Transition Radiation Detector — •Philipp Kähler for the CBM-Collaboration — Institut für Kernphysik, WWU Münster

The upcoming Compressed Baryonic Matter (CBM) experiment at FAIR will investigate the QCD phase diagram at high net-baryon densities and moderate temperatures. In these measurements, the CBM Transition Radiation Detector (TRD) will contribute to the excellent electron identification, enabling to study the hot and dense medium via di-electron analyses at intermediate masses. Furthermore, the TRD will serve as an intermediate tracking station as well as provide the identification of light nuclei in the hypernuclei programme of CBM.

This talk summarises the status of the CBM-TRD project. A report on the detector module (MWPC) production will be given, which has been started. Design details of the new intrinsically gas-tight cathode pad-plane are included. Moreover, the current plans for the periphery are covered as well as the participation in the FAIR phase 0 programme mCBM at the SIS18 accelerator. This work is supported by BMBF grants 05P21RFFC1 and 05P21PMFC1.

HK 64.2 Thu 16:15 SCH/A.101

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

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment which is currently under construction at FAIR in Darmstadt. It will explore the QCD phase diagram at high net-baryon densities. The Transition Radiation Detector (TRD) of the CBM experiment will be based on Multi Wire Proportional Chambers (MWPCs) filled with Xe/CO_2 85:15 as detector gas. This talk reports on the commissioning of the first regulated line of the future 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 and the PLC controls, 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 work is supported by BMBF grants 05P19PMFC1 and 05P21PMFC1.

HK 64.3 Thu 16:30 SCH/A.101

New planar GEM detectors for AMBER — •Jan Paschek[1], Karl Flöthner[1,3], Dimitri Schaab[1], Christian Honisch[1], Michael Lupberger[1,2], Igor Konorov[4], Christian Honisch[1], Michael Hösgen[1], and Bernhard Ketzer[1] — [1]Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik, Bonn, Germany — [2]Universität Bonn, Physikalisches Institut, Bonn, Germany — [3]CERN, Geneva, Switzerland — [4]Technische Universität München, Physik-Department, Garching, Germany

As a follow-up experiment to COMPASS at the M2 beamline of the CERN SPS, AMBER (NA66) is expected to make important contributions to unresolved questions related to the structure and spectroscopy of light mesons. In addition, a precision measurement of the proton formfactor by elastic muon-proton scattering at very low 4-momentum transfer will be performed over the next two years.

New large-format triple GEM detectors have been designed and built for tracking charged particles in close proximity to the primary beam. They have shorter strips split in the middle to handle higher particle rates without having to disable the central region. We also eliminated the use of spacer grids to minimize dead zones. The first new detectors were installed and operated during the COMPASS beam period in 2022. For AMBER, the APV-based readout electronics will be replaced by a self-triggering front-end chip. In addition, a stabilized voltage divider will provide constant gain independent of particle rate.

The talk will give an overview of the construction and commissioning of the new detectors and show first results from their operation.

HK 65: Heavy-Ion Collisions and QCD Phases XII

Time: Thursday 15:45–17:15 Location: SCH/A216

HK 65.1 Thu 15:45 SCH/A216

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

The High Acceptance DiElectron Spectrometer (HADES) situated at GSI Darmstadt, Germany, aims to measure nuclear matter at high densities and medium temperatures by means of heavy ion collisions. As leptons do not interact strongly with the formed medium in all stages of such collisions, electrons and positrons can provide information about the full fireball evolution. Hence, the study of virtual photons and their decay into electron pairs $\left(e^- + e^+\right)$ are one of the main goals in the HADES physics program.

The major background in the di-electron spectrum at low invariant masses are Dalitz-decays of light neutral mesons. Hence, precisely extracting the yields of neutral mesons produced in the collisions is necessary for proper background subtraction in all di-electron analyses.

In this talk we will present preliminary results on the transverse mass and rapidity resolved π^0- and η-production yields in Ag-Ag collisions measured with HADES via the photon conversion method at 1.58A GeV incident beam energy.

* Work supported by BMBF (05P19PXFCA, 05P21PXFC1), and GSI.

HK 65.2 Thu 16:00 SCH/A216

Measurement of neutral meson production with ALICE — •Nicolas Strangmann for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at CERN-LHC investigates the properties of hot and dense nuclear matter created in heavy-ion collisions. Measurements of identified particle production in pp collisions not only serve as reference for larger collision systems, but also help to study different aspects of hadronisation. This contribution will focus on the production of neutral mesons in different collision systems. A precise determination of the neutral meson production can help constrain theoretical models and provide vital input for direct photon analyses.

In ALICE, different detectors and detector combinations are used to reconstruct neutral mesons (π^0 and η) via their two photon decay channel. These photons can be detected in the calorimeters or via their conversion-electron tracks in ALICE tracking detectors. ω mesons can be reconstructed via their three pion decay $\omega \to \pi^+\pi^-\pi^0$.

In this talk, an overview of the π^0, η and ω measurements with ALICE will be presented. This includes a multiplicity dependent measurement of π^0 and η in pp collisions at $\sqrt{s}$=13 TeV as well as ω measurements in pp and p–Pb collisions.

Supported by BMBF and the Helmholtz Association.

HK 65.3 Thu 16:15 SCH/A216

Characterising the hot and dense fireball with virtual photons at HADES — •Niklas Schild für die HADES-Kollaboration — Technische Universität Darmstadt, 64289 Darmstadt, Germany

Electromagnetic probes (γ, γ^*) offer a unique opportunity to study the conditions in heavy-ion collisions throughout their whole evolution. Since they can escape the strongly interacting medium, they may bring direct information from their origins to a detector.

In this contribution, we present measurements of such dileptons from Ag+Ag collisions, collected at the High-Acceptance-DiElectron-Spectrometer (HADES), at $\sqrt{s_{NN}}$ = 2.55 GeV. A particular focus is set on the multidifferential analysis of the anisotropic flow in

terms of centrality, rapidity, transverse momentum and invariant mass. Through the isolation of the in-medium contribution, this will allow insights into the flow at early stages of the collision, and therefore into the time evolution of the system's collectivity as a whole.

HK 65.4 Thu 16:30 SCH/A216

Measurement of photon and light neutral meson production in p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV — •Stefanie Mrozinski for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment at CERN-LHC is designed to study the characteristics of the hot and dense nuclear matter created in heavy ion collisions, the quark-gluon plasma (QGP). Since direct photons escape the medium unaffected during all collision states, they offer unique analysis opportunities. A necessary prerequisite for the direct photon measurement is the precise determination of the inclusive photon as well as the neutral meson production.
In ALICE, the measurements of photons is realized using electromagnetic calorimeters (EMCal or PHOS) and a photon conversion method (PCM). For the reconstruction of the mesons via their two-photon decay channel, photons from the same calorimeters or method as well as photons from a calorimeter and the PCM method can be used.
This talk will focus on the reconstruction of π^0 and η meson spectra as well as the measurement of the inclusive photon yield in p–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV using the PCM-PHOS reconstruction method. The current status of the analyses will be presented.
Supported by BMBF and the Helmholtz Association.

HK 65.5 Thu 16:45 SCH/A216

Topological separation of dielectron signals in Pb–Pb collisions with ALICE — •Jerome Jung for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Dielectrons are an exceptional tool to study the evolution of the medium created in heavy-ion collisions. In central collisions, the energy densities are sufficient to create a quark-gluon plasma (QGP). Thermal e^+e^- pairs with invariant mass around 1.5 GeV/c^2 can be used to estimate the temperature of the QGP.

At LHC energies, correlated HF hadron decays dominate the dielectron yield for invariant masses above 1.1 GeV/c^2. 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. The proper decay length of HF hadrons is of the order of $c\tau \approx 100 - 500$ μm, hence their reconstructed decay electrons do not point to the primary vertex of the collision. Therefore, a topological separation based on the distance-of-closest approach (DCA) to the primary vertex is a promising alternative approach to disentangle them from the prompt contribution of thermal dielectrons.

In this talk, the newest results on the DCA_{ee} spectra of dielectrons produced in Pb–Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE will be presented. The measurements are compared to reference distributions from simulations and expectations from theory. The presentation will conclude with a discussion of novel developments of the dielectron analysis.

HK 65.6 Thu 17:00 SCH/A216

Measurement of neutral pions in PbPb collisions in ALICE at sqrt(s_NN) = 5TeV — •Stephan Stiefelmaier for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg

Neutral pion and eta mesons are responsible for a large fraction of secondary photons in the measurement of direct photons what makes their measurement important. I present the current state of the measurement of neutral mesons with the photon conversion method with the 2018 PbPb data sample using the latest reconstruction and calibration methods.

HK 66: Heavy-Ion Collisions and QCD Phases XIII

Time: Thursday 15:45–17:15 Location: SCH/A315

HK 66.1 Thu 15:45 SCH/A315

Measurement of light neutral meson production inside jets in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE — •Joshua König for the ALICE Germany-Collaboration — IKF, Goethe-Universität Frankfurt

Particle production in ultra-relativistic pp collisions can be factorized into the parton density function (PDF), the partonic cross-section and the fragmentation function (FF). While PDFs, accessible via deep inelastic scattering experiments, and the partonic cross section, calculable using perturbative QCD, are independent of the final state particle species, FFs need to be constrained by experimental data for each particle species. Measurements of the momentum fraction $z = p_{\rm part}/p_{\rm jet}$ of a particle species contained in a high energetic jet gives direct access to the FF of the species.
In this talk, the measurement of the $p_{\rm T}$ spectra of π^0 and η mesons inside jets as well as the measurement of the meson momentum fraction z in pp collisions at $\sqrt{s}$ = 13 TeV with ALICE will be presented. The measurement combines results from several partial independent meson reconstruction techniques available in ALICE, including calorimeter based photon detection as well as utilizing photon conversions in the central tracking detectors. Particle jets are reconstructed using charged tracks from the central tracking detectors as well as neutral clusters from the electromagnetic calorimeter. The results will be compared to theoretical model predictions.
Supported by BMBF and the Helmholtz Association

HK 66.2 Thu 16:00 SCH/A315

Jet-hadron correlations in PbPb collisions at $\sqrt{s_{\rm NN}}$=5.02 TeV with ALICE — •Luisa Bergmann for the ALICE Germany-Collaboration — Physikalisches Institut, Im Neuenheimer Feld 226, 69120 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, first studies of event plane dependent jet-hadron correlations for data collected by the ALICE experiment in PbPb collisions at $\sqrt{s_{\rm NN}}$=5.02 TeV are presented.

HK 66.3 Thu 16:15 SCH/A315

Studies of jets in heavy-ion collisions at ALICE with a novel mixed-event approach — •Nadine Grünwald for the ALICE Germany-Collaboration — Physikalisches Institut Heidelberg, Im Neuenheimer Feld 226, 69120 Heidelberg

With heavy-ion collisions QCD matter is studied at very high temperatures and densities. 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 in various ways. A major difficulty in heavy-ion jet measurements is the huge amount of uncorrelated particles which distorted the jet measurements, especially at lower $p_{\rm T}$. In order to perform low $p_{\rm T}$ 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 for the first time inclusive charged jet measurements down to low $p_{\rm T}$ at collision energies of $\sqrt{s_{\rm NN}}$ = 5.02 TeV. In particular no cuts on the reconstructed jet energies are necessary.

HK 66.4 Thu 16:30 SCH/A315

Direct photon and χ_c performance studies for the ALICE 3 experiment — •Abhishek Nath for the ALICE Germany-

Collaboration — Ruprecht Karl University of Heidelberg, Germany

Direct photons are one of the critical tools for studying hot QCD medium as their mean free path is much larger than the size of the system and they leave the medium without further interaction. As the ALICE 3 LOI received the LHCC recommendation to proceed with R&D, we try to perform more critical studies regarding photons. With much larger rapidity coverage and usage of bent Monolithic Active Pixel Sensors (MAPS), the ALICE 3 experiment aims to go much lower in p_{T} to explore the direct photons originating majorly from thermal contribution. Along with that, with the measurement of χ_c, χ_b, and other $L = 1$ states in the extended rapidity range in ALICE 3, a more accurate description of the dynamics of quarkonium interactions with the medium will be possible.

In this talk, we present performance studies and uncertainty projections in key direct photon measurements like R_γ, direct photon spectrum and corresponding inverse slope parameter, direct photon v_2 and possibly also HBT anticipated for Run 5 and 6. Along with this, the performance of χ_c measured through the radiative decay channel $\chi_c \to J/\psi + \gamma$ in Pb–Pb collisions is also presented.

HK 66.5 Thu 16:45 SCH/A315

Low p_{T} ω measurements in pp collisions at $\sqrt{s}$ = 5.02 TeV with ALICE — •Merle Luisa Wälde for the ALICE Germany-Collaboration — Goethe University, Frankfurt, Germany

Measurements of hadron production cross sections in proton-proton (pp) collisions at high energies are important to test our understanding of QCD and as reference for heavy-ion studies. While the hard production of particles can be calculated in a perturbative approach, the production via soft scattering processes relies on phenomenological model approaches that require experimental input and suffer from sizeable uncertainties in their predictions. Therefore, the spectra of the ω meson needs to be measured down to the lowest transverse momentum (p_{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 $p_{\mathrm{T}} = 0$ in pp collisions at $\sqrt{s} = 5.02$ TeV at midrapidity will be presented. The ω meson is reconstructed in the decay into e^+e^- pairs with ALICE. We will discuss the estimation of the combinatorial background as well as uncertainties related to the extraction of the signals. The final results will be compared to model calculations.

HK 66.6 Thu 17:00 SCH/A315

Charged Kaon and ϕ Production in Ag+Ag Collisions at 1.58A GeV with HADES — •Marvin Kohls for the HADES-Collaboration — Goethe-Universität Frankfurt

The investigation of strangeness production and propagation in heavy-ion collisions in the few GeV energy regime is a sensitive tool to study the microscopic structure of nuclear matter at high baryo-chemical potential [1]. For respective studies presented in this talk, a total of 6×10^9 central Ag(1.58 A GeV)+Ag events recorded with HADES in 2019 have been used. We focus on results concerning K^+, K^- and $\phi(1020)$.
The multiplicities of strange particles are compared with results obtained from statistical hadronization models. Special attention will be put on the non-strange $\phi(1020)$ meson and the double-strange Ξ^- hyperon. Furthermore, the centrality ($\langle A_{\mathrm{part}} \rangle$) dependence of strange-hadron multiplicities will be discussed, which was found to follow a universal scaling for the collision system Au(1.23 A GeV)+Au.

This work has been supported by BMBF (05P21RFFC2), GSI, HFHF, the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and HGS-HIRe.

[1] Che Ming Ko et al.; Ann.Rev.Nucl.Part.Sci. 47 (1997) 505-539

HK 67: Hadron Structure and Spectroscopy VIII

Time: Thursday 15:45–17:00 Location: SCH/A316

Group Report HK 67.1 Thu 15:45 SCH/A316

Recent and ongoing studies from the A2 Collaboration at MAMI — •Edoardo Mornacchi for the A2-Collaboration — Johannes Gutenberg-Universität, Mainz, Germany

The A2 Collaboration at the Mainz Microtron (MAMI) performs photoproduction experiments to investigate the internal structure of nucleons and mesons, gaining a better understanding of non-perturbative QCD.

It uses a circularly or linearly polarized Bremsstrahlung photon beam with energies up to 1.6 GeV, together with a variety of unpolarized and polarized targets. The resulting particles are then detected using the large acceptance Crystal Ball-TAPS detector system, which is perfectly suited for the detection of multi-photon final states.

An overview of the ongoing studies as well as recent results from the A2 Collaboration will be given, along with an outlook on current and future measurements.

HK 67.2 Thu 16:15 SCH/A316

Studies of Coherent Photoproduction off the Deuteron at the BGOOD Experiment — •Antonio Joao Clara Figueiredo for the BGOOD-Collaboration — Physikalisches Institut der Universität Bonn

The BGOOD photo production experiment [1] at the ELSA facility [2] 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. Typically used to study strangeness photoproduction at low t, the setup also enables studies of coherent reactions off the deuteron where the deuteron takes the majority of the beam momentum.

Following a BGOOD publication on the $\pi^0\pi^0 d$ [3] photoproduction supporting the three isoscalar dibaryon candidates reported by the ELPH collaboration [4], the presented work uses an improved method of momentum reconstruction in the forward spectrometer and uses a kinematic fit to improve invariant mass resolutions. Preliminary results are presented of the analysis of the $pi^0\pi^0 d$ and $\pi^0\eta d$ final states.

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

[1] S. Alex et al., Eur. Phys. J. A 57 (2021) 80. [2] W. Hiller, Eur. Phys. J. A 28 (2006) 139. [3] T.C. Jude et al., Phys. Lett. B (2022) 137277. [4] T. Ishikawa et al., Phys. Lett. B 789 (2019) 413.

HK 67.3 Thu 16:30 SCH/A316

Evidence for a phi-N bound state — •Emma Chizzali for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

The possible existence of phi-mesic nuclei is widely discussed in the literature, however, experimental evidence so far is missing. The main ingredient for the study of such systems is the phi-N strong interaction, which is characterised by the two spin states S=1/2 and S=3/2 and can be accessed experimentally via momentum correlations. In this talk, a re-analysis of the p-phi correlation function, measured by the ALICE Collaboration in high-multiplicity pp collisions at sqrt(s)=13 TeV, is presented. The S=3/2 channel is constrained using the recently published lattice QCD potential. This makes it possible to study the unknown interaction in the S=1/2, which is modelled by an advanced phenomenological potential. The results of this study show evidence of a bound state in the S=1/2 channel, with sizeable binding energy, which is characterised by a potential strong enough that it results in negative scattering length.

Funded by BMBF Verbundforschung (05P21WOCA1 ALICE) and MPP IMPRS

HK 67.4 Thu 16:45 SCH/A316

Separation of protons and neutrons with the CBELSA/TAPS experiment — •Nadia Reinartz for the CBELSA/TAPS-Collaboration — HISKP, Uni Bonn

The ELSA accelerator can provide a polarised electron beam that together with the polarised target of the CBELSA/TAPS experiment makes it possible to determine single or double polarisation observables for various final states. The Crystal Barrel (CB) calorimeter in combination with the MiniTAPS calorimeter in forward direction, allows measurements in a full 4π coverage. In the past it was difficult to efficiently measure reactions with a neutron in the final state.

In the last years the CBELSA/TAPS experiment in Bonn has been

improved in order to significantly boost the efficiency for detecting neutrons in the main calorimeter. The data taken after the upgrade was used to determine methods for identifying protons and neutrons with beam energies between 600 MeV and 3200 MeV. In this talk an overview about those results is presented.

HK 68: Hadron Structure and Spectroscopy IX

Time: Thursday 15:45–17:00 Location: SCH/A419

Group Report HK 68.1 Thu 15:45 SCH/A419

Exclusive Hyperon Reconstruction in pp Data at HADES — •Jenny Regina — GSI, Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, 64291 Darmstadt, Germany

Hyperons are expected to play an important role in describing the dynamics of high-dense baryonic matter such as present in the interior of neutron stars. HADES (High Acceptance Di-Electron Spectrometer) offers excellent opportunities for studying hyperon production in pp and heavy ion collisions. In February 2022 HADES collected high statistics data of the reaction p(4.5 GeV)p. With this data set, the production and decay of single and double strange hyperons in inclusive and exclusive channels will be possible. In particular rare dielectron Dalitz decays of Σ^0 and Λ hyperons will investigated for the first time.

For this purpose, HADES was upgraded with straw tube trackers, which are a FAIR-Phase0 contribution from PANDA, and a timing detector, both of which cover polar angles below 7 degrees; a region where many hyperon decay products are emitted. As a result, they increase the efficiency of the hyperon reconstruction. A kinematic fitting library has been developed to improve the overall resolution. It is based on Lagrange multipliers and utilizes kinematic and geometric constraints.

This talk will address the exclusive hyperon reconstruction, for example of $pp \to pK^+\Lambda$, in the recent data, focusing on the new hyperon reconstruction tools; the straw tube tracker, the kinematic fitting, and how these are used in the analyses.

HK 68.2 Thu 16:15 SCH/A419

Hyperon-production studies in proton-proton collisions at 4.5 GeV with HADES — •Snehankit Pattnaik, Johan Messchendorp, and James Ritman for the HADES-Collaboration — GSI, Darmstadt, Germany

This work presents a preliminary analysis of the $\Lambda + K^0_S + \mathrm{p} + \pi^+$ final state in recently collected proton-proton scattering data taken at 4.5 GeV using HADES at GSI Helmholtzzentrum für Schwerionenforschung 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-dense matter such as that located at the core of neutron stars.

This talk will present some of the data-driven analysis procedures that have been used to select the final-state of interest. In particular, a particle identification method exploiting the relative time-of-flights and utilizing several vertex and kinematical observables have been used to obtain a strong signal for this exclusive state.

HK 68.3 Thu 16:30 SCH/A419

Photoproduction of $\Lambda(1520)$ at forward angles with BGOOD — •Emil Rosanowski for the BGOOD-Collaboration — Physikalisches Institut der Universität Bonn

The BGOOD experiment at the ELSA facility is used for photoproduction in the *uds* sector. It is uniquely designed to explore reactions where a meson is detected at forward angles, leaving a recoiling hadronic system at low momentum transfer, which could enable the observation of molecular structure.

Studies of the reaction $\gamma p \to K^+\Lambda(1520)$ at forward angles will be presented. The analysis required K^+ identification and the $\Lambda(1520)$ via the decay $\Lambda(1520) \to \pi^0\Sigma^0$. Progress in measuring preliminary differential cross sections at forward K^+ angles will be presented.

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

HK 68.4 Thu 16:45 SCH/A419

Hyperon Reconstruction with Realistic Track Finding for PANDA — •Anna Alicke[1], Tobias Stockmanns[3], and James Ritman[2,1,3] — [1]Ruhr-Universität Bochum, Experimentalphysik, Lehrstuhl I — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Forschungszentrum Jülich, Institut für Kernphysik

One main research topic of the PANDA experiment is the spectroscopy of excited hyperon states. Hyperons, such as Ξ, have a large decay length of several cm and further decay into Λ particles, which have a similarly long lifetime. Consequently, hyperons have a distinctive decay pattern consisting of final state particles that have a displaced secondary vertex. These tracks, which do not originate from the primary interaction point (IP), make track reconstruction and the subsequent event reconstruction challenging. In contrast to primary track finders, which use the IP, secondary track finders have to deal with a much higher combination of hits and are lacking this additional constraint to the IP. Consequently, the track finding efficiency and the momentum resolution for secondary tracks is worse than for primary tracks and usually require more computational power. Up to now, the PANDA experiment was lacking a dedicated track finder for secondary particles. Therefore, hyperon reactions have only been investigated using ideal track finding in PANDA. This work presents the new secondary track finder and its application on the reaction $p\bar{p} \to \Xi(1820)^-\Xi^+$. The expected reconstruction rate to observe the $\Xi(1820)^-$ resonance will be shown.

HK 69: Structure and Dynamics of Nuclei XIV

Time: Thursday 15:45–17:15 Location: SCH/A118

HK 69.1 Thu 15:45 SCH/A118

Investigation of neutron-induced γ rays from Ge-nuclides in the region of interest of GERDA/LEGEND — •Marie Pichotta[1], Toralf Döring[1,2], Hans F. R. Hoffmann[1], Konrad Schmidt[2], Ronald Schwengner[2], Steffen Turkat[1], Birgit Zatschler[1,3], and Kai Zuber[1] — [1]Technische Universität Dresden (IKTP), Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [3]University of Toronto, Canada

GERDA has been a pioneering experiment in the search for the still undetected neutrinoless double beta ($0\nu\beta\beta$)-decay of ^{76}Ge and this will also hold for the successor experiment LEGEND. The discovery of this extremely rare process would prove the Majorana character of neutrinos and consequently physics beyond the Standard Model. For an explicit identification of a signal caused by the $0\nu\beta\beta$-decay, which correspond to an energy of 2039 keV for ^{76}Ge, a precise understanding of all background contributions in the ROI is crucial.

However, previous experiments indicated γ lines produced by neutron activation (n,p) and neutron scattering (n,n') processes on ^{76}Ge and ^{74}Ge but until now, their existence could not be confirmed adequately. In this experiment an enriched Ge-sample was alternately irradiated by 14 MeV neutrons from a DT generator and measured by an optimized HPGe detection setup. The γ spectrum of 51 irradiation cycles shows three peaks in the energy region around 2039 keV which means that germanium itself can contribute to potential background in all ^{76}Ge $0\nu\beta\beta$-decay experiments such as LEGEND and GERDA. The experimental procedure and the results will be presented.

HK 69.2 Thu 16:00 SCH/A118

Simulation of ordinary muon capture for nuclear matrix elements of $0\nu\beta\beta$ research — •Xianke He, Andreas Jansen, and Kai Zuber — Institute of Nuclear and Particle Physics, TU Dresden, Germany

The search for beyond the Standard Model neutrinoless double beta decay ($0\nu\beta\beta$) is currently one method of determining the Majorana nature of the neutrino. The decay requires a non-zero neutrino mass. The connection between any possibly measured half-life and the neutrino mass is provided by the nuclear matrix elements (NMEs).

Nuclear models aiming at the description of the NMEs of $0\nu\beta\beta$ decays at high-momentum-exchange could be tested with Ordinary Muon Capture. OMC is a semi-leptonic weak interaction process quite like electron capture but with 200 times the electron rest mass. This leads to a remarkably larger momentum exchange. The OMC process taking place in the mother nuclei produces multipolarities J^π states of daughter nuclei with large angular momenta and high excitation energies.

From an experimental point of view, the corresponding muon capture rates can be obtained by measuring the intensity of gamma rays emitted during the de-excitation of these excited state nuclei over time, which can be used to test the correctness of the model describing the NMEs.

This talk will show the proposed experimental design to measure gamma spectrum of OMC using cosmic muons.

HK 69.3 Thu 16:15 SCH/A118

Neutrinoless double-β decay in an effective field theory — •Catharina Brase[1,2,3], Javier Menéndez[4,5], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]Max-Planck-Institut für Kernphysik, Heidelberg — [3]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [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

We study neutrinoless double-β decay in an effective field theory (EFT) for heavy nuclei, which are treated as a spherical core coupled to additional neutrons and/or protons. The low-energy constants for this unobserved decay are constrained through a correlation with double Gamow-Teller transitions. This correlation was recently found to hold for shell-model calculations, energy-density functionals, and other nuclear structure models. We therefore first calculate the nuclear matrix elements for double Gamow-Teller transitions in the EFT for heavy nuclei. The combination of the EFT uncertainty with the correlation uncertainty enables predictions of nuclear matrix elements for neutrinoless double-β decay for a broad range of isotopes with quantified uncertainties. Generally the EFT predicts smaller nuclear matrix elements compared to other approaches, but our EFT results are consistent with recent ab initio calculations.

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

HK 69.4 Thu 16:30 SCH/A118

Lifetime measurements in ^{116,118}Sn — •Sarah Prill, Anna Bohn, Felix Heim, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics

The Doppler-shift attenuation method (DSAM) using particle-γ coincidences is a reliable technique to determine sub-picosecond lifetimes of excited nuclear levels without feeding contributions [1,2]. In recent years, it was used to determine level lifetimes of stable nuclei along isotopic chains around the Z=50 and N=50 and N=82 shell closures to study changes of nuclear structure phenomena along these chains.

For ^{112,114}Sn, lifetimes have already been determined with this method [3]. To continue the study across the semi-magic tin isotopic chain, inelastic proton and alpha particle scattering experiments have been performed on ^{116}Sn and ^{118}Sn at the SONIC@HORUS detector array [4] at the University of Cologne. The combined detector array can measure the backscattered projectiles in coincidence with the produced γ radiation. This enables the reconstruction of the reaction kinematics as well as the elimination of feeding by selecting the direct excitation of the level of interest from the particle energy.

From these experiments, numerous level lifetimes in ^{116,118}Sn could be determined.

Supported by the DFG (ZI 510/9-1).

[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 69.5 Thu 16:45 SCH/A118

Lifetime determination in ^{99}Y, ^{99}Zr and ^{99}Nb via delayed γ-γ fast-timing spectroscopy — •Aaron Pfeil[1], Jean-Marc Régis[1], Jan Jolie[1], Arwin Esmaylzadeh[1], Mario Ley[1], Lukas Knafla[1], Ulli Köster[2] und Yung Hee Kim[2] — [1]Institute for Nuclear Physics, University of Cologne — [2]Institut Laue-Langevin, Grenoble, France

The experiment was performed in 2020 at the mass spectrometer Lohengrin at the Institut Laue-Langevin in Grenoble, France [1]. Lifetimes of the low-lying excited states in the nuclei ^{99}Y, ^{99}Zr and ^{99}Nb were determined using the fast-timing technique [2]. This region is of special interest because of a rapid shape transition, which occurs by going from $N = 58$ to $N = 60$ and is especially pronounced in the Zr isotopes, where ^{98}Zr is spherical and ^{100}Zr is strongly deformed [3]. Therefore, the results from ^{99}Zr provide crucial information about the spherical-deformed border at $N = 59$. Experimental values are compared to predictions calculated in the framework of the interacting boson-fermion model [4,5]. Work supported by DFG grant JO391/18.1 and the Institut Laue Langevin.

[1] P. Armbruster et al., Nucl. Instrum. Methods 139 (1976)
[2] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. 726 (2013)
[3] K.L.G. Heyde and J. L. Wood, Rev. Mod. Phys. 83, 1467 (2011)
[4] N. Gavrielov et al., Phys. Rev. C 106, L051304 (2022)
[5] K. Nomura et al., Phys. Rev. C 102, 034315 (2020)

HK 69.6 Thu 17:00 SCH/A118

Investigation of the Nuclear Structure of ^{76}Ge Using Nuclear Resonance Fluorescence — •M. Heumüller, V. Werner, S. Bassauer, T. Beck, M. Berger, M. Beuschlein, I. Brandherm, K. 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 heaviest stable of the Germanium isotopes, which have been discussed in terms of shape coexistence and triaxiality [1]. In addition, ^{76}Ge is the baseline isotope for experiments searching for neutrino-less double-beta decay, hence, especially its low-energy dipole response is of interest. The nuclear structure of ^{76}Ge was investigated previously by using the method of nuclear resonance fluorescence [2,3]. For minimizing systematic uncertainties for cross section measurements below 5 MeV, the energy region of the low lying scissors mode, a bremsstrahlung measurement with an endpoint energy of 5.5 MeV was performed. The photons were provided by the superconducting electron accelerator S-DALINAC, impinging the enriched target in the Darmstadt High Intensity Photon Setup (DHIPS) with three HPGe detectors for γ-ray detection. The data analysis and results will be presented in the talk.

[1]Y. Toh *et al.*, Phys. Rev. C **87**, 041304(R) (2013)
[2]A. Jung *et al.*, Nucl. Phys. A **584**, 103-132 (1995)
[3]R. Schwengner *et al.*, Phys. Rev. C **105**, 024303 (2022)

HK 70: Structure and Dynamics of Nuclei XV

Time: Thursday 15:45–17:15 Location: SCH/A215

Group Report HK 70.1 Thu 15:45 SCH/A215

Evolution of low-lying M1 modes in germanium isotopes — Stefan Frauendorf[1] and •Ronald Schwengner[2] — [1]University of Notre Dame, Indiana 46556, USA — [2]Helmholtz-Zentrum Dresden-Rossendorf, Germany

Magnetic dipole strength functions are determined for the series of germanium isotopes from $N = Z = 32$ to $N = 48$ on the basis of a large number of transition strengths calculated within the shell model. The evolution of the strength with increasing neutron number in the $1g_{9/2}$ orbital is analyzed. A bimodal structure comprising an enhancement toward low transition energy and a resonance in the region of the scissors mode is identified. The low-energy enhancement is strongest near closed shells, in particular at the almost completely filled $1g_{9/2}$ orbital, while the scissorslike resonance is most pronounced in the middle of the open shell, which correlates with the magnitude of the also

deduced electric quadrupole transition strengths. The results are consistent with previous findings for the shorter series of iron isotopes [1] and prove the occurrence and correlation of the two low-lying magnetic dipole modes as a global structural feature [2].

[1] R. Schwengner, S. Frauendorf, B.A. Brown, Phys. Rev. Lett. **118**, 092502 (2017).

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HK 70.2 Thu 16:15 SCH/A215

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], 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. First steps of the analysis will be presented, namely the particle identification for the incoming particles from the BigRIPS fragment separator and the outgoing particles in the ZeroDegree spectrometer. Additionally, Doppler-corrected gamma-ray spectra based on the reconstructed velocity of incoming ions will be presented.

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

HK 70.3 Thu 16:30 SCH/A215

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], and D. Savran[6] — [1]IKP, TU Darmstadt — [2]UNC, Chapel Hill, NC, USA — [3]TUNL, Durham, NC, USA — [4]Duke U., Durham, NC, USA — [5]ESS, Lund, SE — [6]GSI, Darmstadt

For the $N = 50$ isotones ^{90}Zr and ^{92}Mo, additional isovector spin-flip M1 (IVSM1) strength is expected for ^{92}Mo in comparison to ^{90}Zr because of the two additional protons in the proton $g_{9/2}$ orbital above the closed pf shell. In addition, the IVSM1 resonance is closely related to Gamow-Teller strengths and can serve to constrain the calculation of electron-capture rates in core-collapse supernova scenarios[1]. Using the newly available hybrid array of HPGe Clover and $LaBr_3$ detectors at the High Intensity γ-ray source (HIγS), we probed the dipole response of both isotopes in an integral-spectroscopy approach below neutron separation thresholds.The $E1$ and $M1$ strengths will be determined up to about 9 MeV by measuring the asymmetries resulting from the excitation of the target nuclei by the fully-polarized γ-ray beam. The experimental method and first results will be discussed.

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

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

HK 70.4 Thu 16:45 SCH/A215

Lifetime measurement of low-lying states in ^{92}Mo via γ-γ fast-timing spectroscopy — •Mario Ley[1], Lukas Knafla[1], Andreas Harter[1], Arwin Esmaylzadeh[1], Jan Jolie[1], and Piet Van Isacker[2] — [1]Institut für Kernphysik, Universität zu Köln — [2]Grand Accélérateur National d'Ions Lourds, Caen

Lifetimes of the first excited states in ^{92}Mo were measured using the digital γ-γ fast-timing technique with a detector array consisting of $LaBr_3$(Ce) and HPGe detectors. States were populated in a ^{90}Zr(α,2nγ)^{92}Mo reaction using the FN-Tandem accelerator of the institute for nuclear physics at the university of Cologne. The symmetrised centroid shift method [1], which is suitable for the determination of lifetimes in the pico- to nanosecond regime, was used to determine the lifetimes. The experimental results are used in a semiempirical approach which uses a single shell ($1g_{9/2}$) orbit to predict the B(E2) values in the N = 50 isotones from ^{93}Tc up to ^{98}Cd.

Work supported by DFG grant JO391/18.1

[1] J.-M. Régis et al., Nucl. Instrum. Methods Phys. Res. A 897 (2018)

HK 70.5 Thu 17:00 SCH/A215

Electron-Gamma Coincidence Measurements at S-DALINAC — •Gerhart Steinhilber, Jonny Birkhan, Isabelle Brandherm, Juliane Buschinger, Bastian Hesbacher, Johann Isaak, Igor Jurosevic, Peter von Neumann Cosel, Norbert Pietralla, Maxim Singer, and Maximilian Spall — IKP, Technische Universität Darmstadt

Inclusive (e,e') electron scattering is an established tool in nuclear physics that provides insights in nuclear structure with high accuracy because of its pure electromagnetic nature. (e,e'γ) coincidence experiments preserve this strength of inclusive electron scattering while additional information, for example, γ-decay branchings of PDR/GDR and the interference of longitudinal and transversal components of low-lying electric dipole excitations are accessible. The existing (e,e') setup at S-DALINAC was extended by a detector array consisting of 6 $LaBr_3$:Ce detectors. In 2021 a successful (e,e'γ) measurement was conducted on a mid-heavy nucleus, ^{96}Ru, for the first time. The main goal of this measurement was to study the B(M1,$2^+_{ms}\rightarrow 2^+_1$) and B(E2,$2^+_{ms}\rightarrow 0^+_1$) decay transition strengths of the 2^+_{ms} state of ^{96}Ru. Data were taken at excitation energies below and above the neutron separation threshold allowing a variety of physics cases to be studied. This talk will present the (e,e'γ) coincidence setup and preliminary results of the ^{96}Ru measurement.

This work is supported by the Research Training Group GRK 2128 and the Hessian cluster project ELEMENTS.

HK 71: Structure and Dynamics of Nuclei XVI

Time: Thursday 15:45–17:15 Location: SCH/A117

Group Report HK 71.1 Thu 15:45 SCH/A117

Broken axial symmetry as essential feature for a consistent modelling of various observables in heavy nuclei — •Eckart Grosse[1] and Arnd R. Junghans[2] — [1]IKTP, Techn. Universität Dresden — [2]Helmholtz-Zentrum Dresden-Rossendorf, 01314 Dresden

Although most experimental data do not deliver accurate information on nuclear axiality the ad-hoc assumption of symmetry about one axis found widespread use in nuclear model calculations. In the theoretical interpretation of nuclear properties as well as in the analysis of experimental data triaxiality was considered - if at all - only for some, often exotic, nuclides. Allowing breaking of axial symmetry combined to a spin-independent moment of inertia results in a surprisingly simple heuristic triaxial parametrization of the yrast sequence in all heavy nuclei, including well deformed ones. No additional fit parameters are needed in detailed studies of the mass and charge dependence of the electric dipole strength in the range of and outside of giant dipole resonances. Allowing triaxiality also avoids the introduction of an arbitrary level density parameter ã to fit the accurate values observed in n-capture experiments. Predictions for radiative neutron capture yields as derived on the basis of non-axiality are improved as well. The broken axial symmetry experimentally favoured apparently is in accord to HFB and MC-shell model calculations already for nuclei in the valley of stability.

HK 71.2 Thu 16:15 SCH/A117

Eigenvector continuation for the pairing Hamiltonian — •Margarida Companys Franzke[1], Alexander Tichai[1,2,3], Kai Hebeler[1,2,3], and Achim Schwenk[1,2,3] — [1]Technische Universität Darmstadt, Department of Physics — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung GmbH — [3]Max-Plank 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 if the Hamiltonian admits for a parametric dependence. By training the emulator on a set of training data the many-body solution for arbitrary parameter values can be robustly predicted in many cases. Furthermore, it can be used to resum perturbative expansions. In this work, we apply EC to the pairing Hamiltonian and show that i) EC-resummed perturbation theory is in qualitative agreement with the exact solution and ii) EC-based emulators robustly predict the ground-state energy once the training data are chosen appropriately. In particular the phase transition from a normal to a superfluid regime is quantitatively predicted from a very low number of training points. Finally the use of approximate training data is discussed and how many-body truncations may affect the emulator's performance.

Funded by the ERC Grant Agreement No. 101020842.

HK 71.3 Thu 16:30 SCH/A117

Improved coalescence model for (anti)nuclei formation — •Maximilian Horst — Technical University Munich

In accelerator experiments, the production of light (anti)nuclei such as (anti)deuterons and (anti)helium-3 can be studied in a wide range of collision systems, from small (pp) to large (A–A) emission source sizes. However, the microscopic mechanism through which they are produced and how they survive such hot and turbulent conditions, are still unknown. The most commonly used models to describe this process are the statistical hadronization model and the coalescence approach. In this talk, a state-of-the-art coalescence model based on the Wigner function formalism to describe (anti)nuclear production on an event-by-event basis is presented. The model developed in this work is parameter-free and tuned on experimental measurements of nucleon production spectra and of the emitting source size measured with ALICE. Such a model would find application in astroparticle physics to predict (anti)nuclear fluxes in cosmic rays, which are a crucial ingredient for indirect Dark Matter searches. This work was supported by DFG SFB1258 and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 71.4 Thu 16:45 SCH/A117

Electromagnetic interactions as the source of all known four forces. — •Osvaldo Domann — Stephanstr. 42, 85077 Manching

The SM represents the space as empty with the subatomic particles moving in it. The proposed focal-point approach models the space as filled with Fundamental Particles (FPs) with longitudinal and transversal angular momenta that move from infinite to infinite. The different types of subatomic particles are formed by different configurations of FPs. Fermions are focal-points of rays of FPs with aligned angular momenta, photons are rays of FPs with alternating opposed angular momenta, and neutrinos are pairs of FPs with opposed angular momenta. Forces between subatomic particles are the result of the interactions (scalar and vector product) of the angular momenta of their FPs. No fictitious force carriers are required. All four forces are due to electromagnetic interactions and described by QED. An important finding of the approach is that the interaction between two charged SPs tends to zero for the distance between them tending to zero. Atomic nuclei can thus be represented as swarms of electrons and positrons that neither attract nor repel each other. As atomic nuclei are composed of nucleons which are composed of quarks, the quarks can also be seen as swarms of electrons and positrons. The charge quantum number Q of a quark is now interpreted as the relative charge of electrons and positrons. No fractional charges Q are required and the charge of an electron or positron is thus the unit charge of nature. More at: www.odomann.com

HK 71.5 Thu 17:00 SCH/A117

Simulations for the ASY-EOS II experiment — •Leandro Milhomens da Fonseca[1,3] and Igor Gašparić[2,3] for the R3B-Collaboration — [1]Technische Universität Darmstadt, Fachbereich Physik, Institut für Kernphysik, 64289 Darmstadt, Germany — [2]Ruđer Bošković Institute, 10000 Zagreb, Croatia — [3]GSI Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt, Germany

The ASY-EOS II experiment aims to place new and more stringent constraints on the density dependence of the symmetry energy at supra-saturation densities. The system proposed for the study is Au+Au at 250, 400, 600 and 1000 AMeV, which can only be performed nowadays at the GSI/FAIR facilities. The experiment is based on the NeuLAND detector to measure neutrons, protons and light-charged clusters emitted from mid-rapidity. To discriminate between neutrons and charged particles, it is the intention to use a VETO detector in front of the NeuLAND detector. It is a proposal to use a double plane of the R3B TOFD detector in front of the NeuLAND due to its ability to detect charged particles efficiently and let neutrons pass through without leaving any signal. As a proof of concept for this apparatus, this work aims to show simulations performed to determine detection efficiencies for the particles of interest and to assess the possibility of distinguishing the differently charged light particles coming from the reaction. This project was supported by the BMBF project No. 05P21RDFN2, and the GSI-TU Darmstadt cooperation.

HK 72: Astroparticle Physics II

Time: Thursday 15:45–17:00 Location: SCH/A252

HK 72.1 Thu 15:45 SCH/A252

Measurement of Pion-Carbon Interactions with NA61/SHINE — •Johannes Bennemann for the NA61/SHINE-Collaboration — Karlsruhe Institute of Technology, Institute for Astroparticle Physics, Karlsruhe, Germany

For the measurement of ultrahigh-energy cosmic-rays it is crucial to understand the evolution of air showers in the atmosphere. Air showers initiated by cosmic ray particle consist mostly of pions, thus studying the interaction between pions and air molecules is of utmost importance. Fixed target experiments with pions from accelerators like the SPS at CERN are suitable for pion interaction studies. As a proxy for nitrogen, the dominant component of air, carbon is used as a target material. The produced particles and their spectra are measured by the NA61/SHINE detector at the CERN North Area. The detector consists of multiple time projection chambers which allow momentum measurements and particle classification.

In this talk we will present the analysis of a new pion-carbon dataset, including meson spectra and resonance cross sections. Furthermore predictions of hadron interaction models used for air shower simulations are compared with the new data.

HK 72.2 Thu 16:00 SCH/A252

krypton level measurement in XENONnT and beyond — •ying-ting lin, steffen form, matteo guida, robert hammann, hardy simgen, and jonas westermann for the XENON-Collaboration — Max-Planck Institut fur Kernphysik, Heidelberg, Germany

The XENONnT experiment is in search of dark matter and other rare physical phenomena via a ton-scale liquid-xenon detector. To reach its target sensitivity, competing background has to be suppressed to unprecedented level. One main internal background is the pure beta-emitter, ^{85}Kr. With dedicated purification system in XENONnT, the krypton concentration over xenon can be reduced down to 100 ppq (parts per quadrillion 10^{-15}). Precisely quantifying the ^{85}Kr remnant in this ultra pure xenon detector is therefore an important and challenging task. The rare gas mass spectrometer (RGMS) at MPIK Heidelberg is capable of performing such measurement by a two stage process: applying a gas-chromatographic separation of krypton from xenon and tracing the amount of Kr gas using a mass spectrometer. For future low-background liquid-xenon detectors, a fully automatic rare gas mass spectrometer (AutoRGMS) is under development. The AutoRGMS will be a major improvement in reducing the complexity and duration of its operations, and thus allow frequent krypton monitoring. The highlight will cover both the results from RGMS and the progress toward AutoRGMS.

HK 72.3 Thu 16:15 SCH/A252

Experiments with the MuonPi Cosmic Particle Detector — Simon Glennemeier-Marke[1], •Kai-Thomas Brinkmann[1], Hans-

Georg Zaunick[1], Lara Dippel[1], Marvin Peter[1], Lukas Nies[2], and Katharina Dort[1] — [1]Justus-Liebig-University — [2]EP Department, CERN

The MuonPi project is an open-community research project dedicated to the investigation of cosmic particle showers. Its goal is to establish a wide-spanning network of detector units for measuring muons originating from shower cascades. Nanosecond time synchronization for all stations is achieved using navigation satellites. By aggregating the individual detections and analyzing their timestamps, the shower geometry and energy can be reconstructed. However a single detector unit can already be used for some interesting experiments, enabling students, teachers, makers and otherwise interested individuals to study the field of high energy physics. In this presentation we will showcase some of these experiments as well as the results of a stratospheric balloon launch. *supported by ELJEN Technology

HK 72.4 Thu 16:30 SCH/A252

Photon identification and their uncertainties for the displaced production vertices in search for ALPs with ATLAS — Peter Krämer, Kristof Schmieden, Matthias Schott, and •Olivera Vujinović for the ATLAS-Collaboration — Johannes Gutenberg University, Mainz, Germany

Some puzzling questions in particle physics, such as the strong CP problem or the discrepancy of the muon magnetic moment could be solved by introducing light scalar or pseudo-scalar axion-like particles (ALPs). Theoretical models allow a wide range of ALP-masses and couplings to SM particles such as photons and the Higgs boson. Therefore, parts of the ALP parameter space could be investigated with collider experiments like the ATLAS experiment at the LHC.

In this analysis, we search for the SM Higgs boson decaying into a pair of ALPs further decaying into two photons each. Depending on ALP properties such as mass and their coupling to photons, the signal is expected to form different final states, ranging from 2 to 4 photons, with a special focus on the photons originating from displaced vertices. This resulted in developing a dedicated approach in estimating the systematic uncertainties for this case. In this talk, the preliminary analysis results will be presented.

HK 72.5 Thu 16:45 SCH/A252

Neural network based identification of collimated photon pair signatures in a search for axions in SM Higgs boson decays with the ATLAS detector — •Peter Krämer, Kristof Schmieden, Matthias Schott, and Olivera Vujinović for the ATLAS-Collaboration — Johannes Gutenberg University, Mainz, Germany

Some puzzling questions in particle physics, such as the strong CP problem or the discrepancy of the muon magnetic moment could be solved by introducing light scalar or pseudo-scalar axion-like particles (ALPs). Theoretical models allow a wide range of ALP-masses and couplings to SM particles such as photons and the Higgs boson. Therefore, parts of the ALP parameter space could be investigated with collider experiments like the ATLAS experiment at the LHC.

In the ongoing analysis, we search for the SM Higgs boson decaying into a pair of ALPs further decaying into two photons each. For low mass ALPs, the decay photons can appear strongly collimated. These collimated photon pairs are reconstructed as a single photon only differing in the shape of the electromagnetic shower. In this talk it will be discussed how these collimated photon pair signatures can be identified using neural networks and how the corresponding uncertainties can be estimated.

HK 73: Outreach Diverse (joint session T/HK)

Time: Thursday 15:50–17:20 Location: HSZ/0204

HK 73.1 Thu 15:50 HSZ/0204

Z0-Versuch im Jupyter notebook — •Gianni Di Paoli, Guenter Duckeck und Nikolai Hartmann — LMU München

Der 'Z0-Versuch' mit OPAL/LEP Daten ist an der LMU München seit vielen Jahren ein klassischer Versuch im Fortgeschrittenen Praktikum und wird in verschiedenen Varianten auch an anderen Universitäten verwendet. Er illustriert exemplarisch Analysemethoden in der Teilchenphysik und erlaubt die Bestimmung fundamentaler Parameter wie Z0-Masse, -Breite und Zahl der Neutrino-Generationen. Im Rahmen einer Bachelor Arbeit wurde die bisherige Root-basierte Analyse auf die Python data-science Umgebung und jupyter notebooks umgestellt. Das erleichtert zum einen den Studierenden die Versuchsdurchführung, weil die meisten schon mit der Python/Jupyter Umgebung vertraut sind. Zum anderen lernen sie anspruchsvolle Filter-techniken, komplexe Visualisierungen und Fit-Verfahren kennen, die über die Standard-Beispiele in den einschlägigen Kursen und Tutorials hinausgehen.

HK 73.2 Thu 16:05 HSZ/0204

Forschung trifft Schule @home - Digitale Teilchenphysik-Fortbildungen für Lehrkräfte — •Philipp Lindenau[1], Carolin Gnebner[2], Niklas Herff[1], Michael Kobel[1], Frank Siegert[1] und Steffen Turkat[1] für die Netzwerk Teilchenwelt-Kollaboration — [1]Technische Universität Dresden — [2]DESY Zeuthen

Häufig unter den Herausforderungen der Covid-19-Pandemie entstanden, haben digitale Angebote mittlerweile einen festen Platz in der Bildungslandschaft. Auch die von Netzwerk Teilchenwelt dank der Förderung durch die Dr. Hans Riegel-Stiftung durchgeführte Fortbildungsreihe "Forschung trifft Schule" wurde um in der Regel halbtägige digitale Formate erweiterte, die nun unter dem Titel "Forschung trifft Schule @home" zum permanenten Veranstaltungsportfolio gehören. Das digitale Angebot beinhaltet insbesondere Fortbildungen zur Forschungsmethodik in der Teilchenphysik unter dem Motto "Von der Kollision zur Entdeckung" sowie Veranstaltungen zur Astroteilchenphysik und deren Behandlung im Schulunterricht unter Nutzung des Online-Tools Cosmic@Web. Die Veranstaltungen wurden bundesweit beworben und von Lehrkräften aus fast dem gesamten Bundesgebiet sowie von deutschen Schulen im Ausland besucht. Im Vortrag werden sowohl die bisher umgesetzten als auch geplante Formate sowie das Feedback der teilnehmenden Lehrkräfte vorgestellt und diskutiert.

HK 73.3 Thu 16:20 HSZ/0204

Physik der kleinsten Teilchen in der Schule - Eine multiperspektivische Tagungsreihe zur kohärenten Vermittlung — Stefan Heusler[1], Christian Klein-Bösing[1], Michael Kobel[2], •Philipp Lindenau[2], Oliver Passon[3] und Thomas Zügge[4] — [1]Westfälische Wilhelms-Universität Münster — [2]Technische Universität Dresden — [3]Bergische Universität Wuppertal — [4]Universität Greifswald

Es existiert eine Vielzahl von Unterrichtsentwürfen für die Vermittlung der Teilchenphysik, Hadronen- und Kernphysik sowie Astroteilchenphysik. Engagierte Physiker:innen aus Outreach, Schulpraxis, Fachwissenschaft und Fachdidaktik, aber auch populärwissenschaftliche und Schulbuchverlage konzipierten Vermittlungskonzepte – häufig unabhängig voneinander. Mit zunehmender Aufnahme der Themen in die Lehrpläne stieg das Bedürfnis nach Austausch der Akteur:innen. Einige für die kohärente Vermittlung zentrale Fragen erwiesen sich als nur gemeinsam bearbeitbar, etwa jene nach der verwendeten Nomenklatur, den bildenden Inhalten, Bezügen zur aktuellen Forschungspraxis und Verknüpfung mit den in den Lehrplänen ausgedrückten Kompetenzerwartungen. So fand 2018 ein interdisziplinäres Symposium in Wuppertal statt. Weitere Tagungen folgten in Münster und Dresden. Sukzessive trug der kollegiale Austausch dazu bei, Unschärfen in unseren Vermittlungspraxen zu erkennen und bildende Gelegenheiten der Themen zu identifizieren. Die nächste Tagung ist 2023 in Greifswald mit dem Schwerpunkt "Nature of Science" geplant. Im Vortrag werden die Tagungsreihe sowie einige ihrer bisherigen Ergebnisse vorgestellt.

HK 73.4 Thu 16:35 HSZ/0204

Bausteine der Materie – ein Mitmachexperiment für Schüler:innen — •Luisa Faber für die Netzwerk Teilchenwelt-Kollaboration — Institut für Kernphysik, WWU Münster

Das Projekt „Bausteine der Materie – Ein Mitmachexperiment für Schüler:innen“ soll Schüler:innen durch die Vermittlung von Inhalten der Kern- und Teilchenphysik für Natur und Technik begeistern. Als Kernelement wurden die weitverbreiteten Klemmbausteine gewählt, um eine aktive Beteiligung und selbstständiges Arbeiten der Schüler:innen zu ermöglichen.

Inhalte des Buchs „Particle Physics Brick by Brick“ von Dr. Ben Still dienen als erster Kontakt der Schüler:innen mit den Elementar-

teilchen des Standardmodells – den Bausteinen der Materie. Der Nachbau des ALICE-Detektors aus LEGO® in verschiedenen Maßstäben ist ein zentraler Bestandteil des Projekts. Dabei soll der gemeinschaftliche Charakter der wissenschaftlichen Arbeit vermittelt werden.

Ziel der Arbeit ist die Einbindung der beschriebenen Komponenten in einen Workshop. Dieser soll in unterschiedlichem Umfang in Schulklassen und bei verschiedenen Events durchgeführt werden können. Beim Bau eines ALICE-Modells aus 18.000 LEGO®-Teilen in einer AG an einem Gymnasium in Münster werden bereits erste Elemente des Workshops angewendet.

In dem Vortrag wird über den aktuellen Stand des Projekts und bereits erfolgte Events, die in Zusammenarbeit mit dem Netzwerk Teilchenwelt durchgeführt wurden, berichtet. Gefördert durch die Joachim Herz Stiftung.

HK 73.5 Thu 16:50 HSZ/0204

Cosmic Watch - Bau eines Myonendetektors für Schulkinder — •Sebastian Laudage — Argelander-Institut für Astronomie, Universität Bonn

Sekundäre Teilchen der kosmischen Strahlung, insbesondere Myonen, erreichen zu hoher Zahl jede Sekunde unsere Erdoberfläche und sind ohne dass wir es merken, Teil unseres alltäglichen Lebens. Sie sind ein unsichtbares, aber höchst interessantes Phänomen astronomischen Ursprungs. Im privaten Kontext oder an Schulen war die Untersuchung dieses Bereichs der Physik bislang nur rudimentär möglich, da zuverlässige Detektoren komplex und teuer in der Herstellung sind. 2017 wurde das Projekt Cosmic Watch durch einen PhD-Studenten am MIT (Spencer N. Axani) entwickelt, welches den Bau eines bezahlbaren (≈ 120 Euro), zuverlässigen und mobilen Myonendetektors beschreibt. Der fertige Detektor ist nur etwa 8x7x4cm groß, ist leicht zu bedienen und kann autark die lokale Rate, Energie und Richtung von passierenden Myonen messen. Damit ist er sehr gut geeignet um Schüler:innen oder Fachfremden einen Einblick in die Welt der Astroteilchenphysik zu geben. Neben spannenden experiementellen Möglichkeiten bietet der Detektor die Möglichkeit Erfahrungen im löten und mit elektrischen Schaltungen zu sammeln, da er nach Anleitung selber zusammengebaut werden kann. Der Vortrag beschreibt den Aufbau des Detektors, die Umsetzbarkeit des Baus als Projekt für Schüler:innen oder Hobbybastler:innen und gibt Ausblick auf Anwendungmöglichkeiten in der Lehre.

HK 73.6 Thu 17:05 HSZ/0204

Die Selbstbau-Nebelkammer als Hands-On Exponat für Events und Ausstellungen — •David Borgelt und Christian Klein-Bösing für die Netzwerk Teilchenwelt-Kollaboration — Wilhelm-Klemm-Str. 9 48149 Münster

Diffusions-Nebelkammern sind ein beliebtes Exponat für physikbezogene Ausstellungen. Beispielsweise verfügen sowohl die Dauerausstellung des FB Physik der WWU, das ExperiMINTum, als auch das Universum in Bremen über solche Nebelkammern. Allerdings sind diese wie klassische Exponate in Museen zu bestaunen und besitzen keine Hands-On Charakteristika.

In zahlreichen Workshops für Schulen sowie in Masterclasses (siehe Netzwerk-Teilchenwelt) erweist sich das Konzept der Hands-On Exponate in Form von Selbstbau-Nebelkammern des Netzwerk Teilchenwelt als überaus beliebt. Auch für Ausstellungen oder Events mit naturwissenschaftlichem Schwerpunkt können diese von Bedeutung sein. Die Selbstbau-Nebelkammern sind wie die Diffusions-Nebelkammern hervorragend dazu geeignet, die Relevanz von Teilchenphysik im Alltag zu zeigen. Darüber hinaus kann mit der Selbstbau-Nebelkammer zusätzlich das Experimentieren als Bestandteil der Physik vorgestellt und Aspekte von Nature of Science diskutiert werden.

In diesem Vortrag werden die Hands-On Charakteristika der Selbstbau-Nebelkammer vorgestellt und Erfahrungsberichte über ihren Nutzen in Ausstellungen und auf Events präsentiert.

HK 74: Poster

Time: Thursday 17:30–19:00 Location: HSZ EG

HK 74.1 Thu 17:30 HSZ EG

Mimicking an Fe55 Source with X-Ray Fluorescence — •Philip Hauer, Alexander Rachev, and Bernhard Ketzer — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

With its low-energetic and well-known X-ray spectrum, Fe55 is a commonly used radioactive source to calibrate particle detectors. The X-ray spectrum does not originate from the radioactive decay directly. Instead, Fe55 decays via electron capture into the excited state Mn55*. This excited state lacks one electron (typically from the K-shell) which is filled by an electron from an outer shell (typically the L- or M-shell) and an X-ray photon is emitted.

This process can be mimicked by X-ray fluorescence. If pure manganese (which consists to 100% of the isotope Mn55) is irradiated with X-rays, the excited state Mn55* is created as well (if the energy of the X-rays exceed the binding energy of the K-shell). In the relaxation process, the same spectrum as the one of an Fe55 source is emitted.

In order to confirm these considerations with measurements, we set up an X-ray tube which irradiated a piece of manganese. Two different detectors were used to analyse the emitted spectra. The first one is a semiconductor detector and the second one is a gaseous detector. With the performed measurements, we could show that a clean Fe55 spectrum can be observed with the X-ray fluorescence method.

On this poster, the measurements of X-ray fluorescence at manganese compared to Fe55 spectra are shown. Furthermore, the advantages and disadvantages of this method are discussed.

Supported by BMBF.

HK 74.2 Thu 17:30 HSZ EG

Laser Spectroscopy of Thulium-169 — •Hendrik Bodnar, Julian Palmes, Wilfried Nörtershäuser, and Kristian König — Institut für Kernphysik, TU Darmstadt

Laser spectroscopy is an established way to obtain information about the charge radius and the electromagnetic moments of a nucleus and has been applied to many isotopes all across the nuclear chart. In preparation for the investigation of short-lived Tm isotopes at the proton dripline [1], the stable 169-Tm was investigated at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) at the Institute of Nuclear Physics at TU Darmstadt. Singly charged thulium was produced with a surface ionization source. Several transitions from the ionic ground state in the wavelength range between 340 nm and 425 nm have been studied and the hyperfine structure was analyzed. This allowed the selection of a suitable transition for efficient studies of rare isotope beams. Funding from the BMBF under contracts 05P21RDCI1 and 05P21RDFN1 is acknowledged. [1] B. Cheal et al., CERN-INTC-2022-041 / INTC-1-245 (2022)

HK 74.3 Thu 17:30 HSZ EG

Towards the Establishment of an Electrofission Experiment at the S-DALINAC — •Gerhart Steinhilber[1], Michaela Arnold[1], Jonny Birkhan[1], Michael Block[2], Martha Liliana Cortès[1], Tetyana Galatyk[1], Pavlos Koseoglou[1], Norbert Pietralla[1], and Maximilian Spall[1] — [1]IKP, Technische Universität Darmstadt — [2]GSI Helmholtzzentrum für Schwerionenforschung

To account for the observed abundances of heavy elements, the rapid-neutron capture process is essential [1]. It was first proposed more than six decades ago but is still not completely understood. The r-process is thought to occur in very neutron rich environments such as neutron star mergers, where the fission yields play an important role in determination of the final abundances. The fission yields depend on the excitation energy of the compound nucleus, which is not well studied. To increase our understanding of fission processes, a new setup for electron-induced fission is in development at the S-DALINAC electron accelerator at TU Darmstadt. Combining the established large acceptance QCLAM electron spectrometer which provides the excitation energy of the nucleus with fission fragment detector modules (FFDM) allows for a coincident measurement of fission fragments with an excellent mass resolution as a function of the excitation energy. The FFDMs which will be placed around the actinide target will provide precise timing information and the kinetic energy of the fission fragments. This poster will present the design of the setup.
This work is supported by the Hessian cluster project ELEMENTS.
[1] J. J. Cowan et al., Rev. Mod. Phys. 93, 015002 (2021).

HK 74.4 Thu 17:30 HSZ EG

Analysis of the bremsstrahlung contribution in electron-gamma coincidence experiments at the S-DALINAC — •Bastian Hesbacher, J. Birkhan, I. Brandherm, J. Isaak, I. Jurosevic, N. Pietralla, M. Singer, M. Spall, and G. Steinhilber — IKP, 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 - can not be distinguished from the γ-radiation of decaying nuclei after excitation by inelastic electron scattering. In 2021 a successful ^{96}Ru$(e, e'\gamma)$ measurement was performed at the S-DALINAC with 35 times improved resolution [2]. The scattered electrons were registered with the QCLAM spectrometer. The γ-radiation was detected by 6 $LaBr_3$:Ce detectors. The double differential cross section of the bremsstrahlung contribution is computed within PWBA and combined with GEANT4 simulations to model pure bremsstrahlung spectra. A subtraction of the bremsstrahlung background will be applied to the ^{96}Ru$(e, e'\gamma)$ data and allow for the extraction of ground-state γ-decays of excited states. Preliminary results on treating the bremsstrahlung contribution will be presented.
This work is supported by the Research Training Group GRK 2128 and the Hessian cluster project ELEMENTS.
[1] C. N. Papanicolas et al., Phys. Rev. Lett. 54 (1985).
[2] G. Steinhilber, Ph.D. thesis, TU Darmstadt (2022).

HK 74.5 Thu 17:30 HSZ EG

A distributed network of cosmic shower detectors — •Lara Dippel[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Simon Glennemeier-Marke[1], Marvin Peter[1], Lukas Nies[2], and Katharina Dort[1] — [1]II. Physikalisches Institut, Giessen, Deutschland — [2]EP Department, CERN

The MuonPi project is a distributed network of Raspberry Pi-based Internet-of-Things (IoT) detector stations for measuring muon showers caused by the interaction of ultrahigh-energy particles of the primary cosmic rays with earth's atmosphere. By connecting the detectors to the global navigation network (GNSS), the individual events can be time-stamped with nanosecond-time accuracy. Thus, further information, such as shower geometry and possibly energy, can be obtained from the time correlations between the detectors. Among others, the project offers students, teachers, makers, HAMs and interested laymen an insight into the research field of astroparticle physics of the highest energies in the cosmos. The individual detector stations have also proven to be efficient in measuring charged particles on parabolic flights and stratospheric balloon missions.

*supported by ELJEN Technology

HK 74.6 Thu 17:30 HSZ EG

New Electronics for the HADES Drift Chambers — •Jan Michel[1], Ole Artz[1], Thomasz Gniadzdowski[3], Christian Müntz[1], and Christian Wendisch[2] for the HADES-Collaboration — [1]Goethe-Universität Frankfurt am Main — [2]GSI Helmholtzzentrum für Schwerionenforschung — [3]Warsaw University of Technology

The drift chambers (MDC) of the HADES Experiment at GSI, Darmstadt form the main tracking system of the spectrometer. Being designed more than twenty years ago, we are currently replacing the whole electronics read-out chain with state-of-the-art electronics.

The new analog signal processing is based on the PASTTREC ASIC, originally developed at AGH Krakow for the PANDA Straw Tube Tracker. The digitization of data happens in FPGA-based TDCs before data is sent on an optical link to the event server farm.

The main challenges of the project are the strict spatial constraints given by the experiment setup and the noise sensitivity of the large area gas detectors. In addition, the power consumption needed to be kept low to ease cooling of the electronics.

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

HK 74.7 Thu 17:30 HSZ EG

Evolution of the KATRIN energy scale measured with ^{83m}Kr — •Justus Beisenkötter for the KATRIN-Collaboration — Institut für Kernphysik, WWU Münster

The KATRIN experiment has the aim to measure or exclude the effective electron neutrino mass to 0.2 eV/c^2 (90% C.L.) by measuring the tritium beta spectrum near its endpoint. To study the energy scale of KATRIN, which is influenced by beamline workfunctions and plasma effects in the gaseous tritium source, ^{83m}Kr conversion electron lines are used. Gaseous ^{83m}Kr is inserted into the tritium source, which allows to measure energy shifts and broadenings that would also affect the beta spectrum. This poster gives an overview of the time evolution of the line position of the L_3-32 and N_{23}-32 lines, which were measured many times over the course of the KATRIN operation. This work is supported by BMBF under contract number 05A20PMA.

HK 74.8 Thu 17:30 HSZ EG

Studies on Alternative Sensor Carrier Concepts for the CBM MVD* — •Fabian Hebermehl for the CBM-MVD-Collaboration — Goethe-Universität Frankfurt

The Micro Vertex Detector (MVD), part of the Compressed Baryonic Matter (CBM) Experiment at the future FAIR facility, comprises four detector stations, of four 0.3−0.5% X_0 thin quadrants, respectively. As the MVD will be operating in vacuum, efficient thermal management by the carrier of the sensors is mandatory. For this reason, the carrier materials chosen are Thermal Pyrolitic Graphite (TPG) for the larger stations and pCVD diamond for the smallest, first station. Studies have been conducted on alternative concepts for the TPG stations to balance thermal performance, material budget and production yield. The station production yield is driven by the need to populate both carrier sides with large-area MIMOSIS sensors to minimize inactive areas inside the detector acceptance. The options to (i) integrate ladders rather then carrier plates and (ii) separate front and back side sensor integration have been studied. The contribution will summarize the findings and gives a recommendation of which design is best suited for refining MVD station concept accordingly.

*This work has been supported by BMBF (05P21RFFC2) and EURIZON.

HK 74.9 Thu 17:30 HSZ EG

Lifetime measurement of low-lying 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], R. Menegazzo[3], D. Mengoni[2,3], C. Müller-Gatermann[4,6], O. Papst[1], G. Pasqualato[7], C.M. Petrache[8], N. Pietralla[1], F. Recchia[2,3], 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

Previous experiments in the region of the Hf and W isotopic chains have shown a change in the first 2^+ states' mean lifetimes in comparison to the literature values due to advancements in experimental techniques. A sudden increase of the $2_1^+ \rightarrow 0_1^+$ $E2$ transition strength in the W isotopic chain between $N = 96$ and $N = 98$ is significant and not seen in the neighboring isotopic chains. Therefore, a measurement of the low-lying level lifetimes of ^{170}W ($N = 96$) with the RDDS method was performed at LNL. The GALILEO array and the GALILEO plunger device were used. Lifetimes for the first 2^+, 4^+ and 6^+ state were obtained and the deduced $E2$ transition strengths compared to predictions of the CBS model.

*Supported by the BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) under Grant Nos. 05P21RDFN9, 05P21RDFN1 and 05P21PKFN1.

HK 74.10 Thu 17:30 HSZ EG

Evaluation of coincidence time resolution of YAG, LuAG, GAGG, YSO, LYSO, LSO, YAP and LuAP scintillators — •Dzmitry Kazlou, Valerii Dormenev, Kai-Thomas Brinkmann, Markus Moritz, Rainer Willi Novotny, and Hans-Georg Zaunick — 2nd Physics Institute, Justus Liebig University, Giessen, Germany

Development of new or optimization of already widely used scintillation materials for fast timing applications have become a very important research activity during the last decade. A significant progress with cerium doped inorganic materials has been made in the improvement of the timing characteristics of the scintillation pulse. Here we present test results of garnets YAG/LuAG/GAGG, lutetium-yttrium oxyorthosilicates YSO/LYSO/LSO and orthoaluminate perovskites YAP/LuAP with different types of doping. Samples have two types of dimensions: 3x3x3 and/or 3x3x20 mm^3. The main activity was concentrated on the measurements of the coincidence time resolution (CTR) with the help of an oscilloscope by offline analysis of

recorded signals and the dependence on temperature and the sample shape. Measurements were performed inside a climate camber and done with SiPM readout and commercial evaluation kits from different producers as well as with own developments.

The work was supported by funding from BMBF Projects 05K2019, UFaCal, EFRE, the High-D consortium and in the spirit of the Crystal Clear Collaboration.

HK 74.11 Thu 17:30 HSZ EG

Influence of detector settings on the EPICAL-2 response — •Johannes Keul — Institut fuer Kernphysik Frankfurt

In context of the proposed ALICE-FoCal detector, a prototype of a digital electromagnetic pixel calorimeter, EPICAL-2, has been developed. EPICAL-2 consists of 24 layers with alternating tungsten absorbers and silicon sensors facilitating monolithic active pixel sensors (MAPS). The design features an active area of $30 \times 30\,\mathrm{mm}^2$ and a depth of 20 radiation lengths with a total of 25 million pixels.

An EPICAL-2 test-beam measurement has been performed at the CERN-SPS facility in September 2021, including measurements with different detector settings.

In this poster, an overview of the structure and functionality of EPICAL-2 is presented. Furthermore a study of the differences in detector response as e.g. the size of pixel clusters at different detector settings is presented.

Supported by BMBF and the Helmholtz Association.

HK 74.12 Thu 17:30 HSZ EG

Correlation of hit and particle densities in EPICAL-2 — •Jan Schöngarth — Institut für Kernphysik, Goethe Universität Frankfurt

A prototype of a digital electromagnetic pixel calorimeter, EPICAL-2, consisting of alternating tungsten absorber and silicon sensor layers has been developed. EPICAL-2 has been designed in the context of the proposed ALICE-FoCal detector. High granular ALPIDE sensors are employed in EPICAL-2 and will be utilized in two layers of the FoCal detector.

The measurement of the electromagnetic shower energy E with EPICAL-2 is based on the number N_{part} of charged shower particles. The number N_{hits} of pixel hits is considered as a measure of N_{part} and thus E, as long as the particle density is low. In order to understand the relation between N_{hits} and N_{parts} under varying density conditions, both observables have been investigated per local area, as well as their correlation, in Allpix^2 simulation, which includes the propagation of deposited charge carriers.

In this poster, the correlation of hit and particle densities is presented, aiming to provide input for EPICAL-2 to investigate saturation effects in areas of high particle density and for FoCal to circumvent detailed charge carrier propagation in simulation. The poster will present the current status of this analysis.

Supported by BMBF and the Helmholtz Association.

HK 74.13 Thu 17:30 HSZ EG

Triton Emission from Ag+Ag Collisions at 1.58A GeV — •Wojciech Trynda for the HADES-Collaboration — Goethe-Universität Frankfurt

Multi-differential emission rates of triton are part of the investigation of statistic data from Ag(1.58A GeV)+Ag collisions, measured in March 2019.

Triton candidates are selected out of all charged particle tracks by using the specific energy loss in the detector material.

The final count rates are extracted multi-differential in an m_t-y grid using the reconstructed particle mass. The background under the triton signal is estimated by an iterative interpolation method between the minimum of the signal peaks of other charged particle tracks and the tail of the triton signal peak. Based on full scale Geant-detector response simulation the extracted signals are corrected with response coefficients. The corrected triton signals are used to determine the multi-differential emission rate per event depending on center-of-mass rapidity and transverse mass. The obtained phase-space distribution of triton is put into context of available published data.

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

HK 74.14 Thu 17:30 HSZ EG

Impact of the charm fragmentation fractions on the dielectron spectrum in pp collisions at the LHC — •Emma Ege for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt, Germany

Charm and anti-charm quarks are produced abundantly in pp collisions at LHC energies. Until recently, it was assumed that the hadronization process, i.e. the formation of charm hadrons from the partonic matter, can be described by universal fragmentation functions. Measurements performed by the ALICE Collaboration have nevertheless shown an enhancement of the relative charm-baryon contributions with respect to the ones observed in e^+e^- collisions. This suggests a significant difference of the fragmentation fractions in hadronic collisions at the LHC compared to e^+e^- and ep collisions at lower energies. The PYTHIA event generator is able to reproduce part of these findings by including string fragmentation beyond the leading color approximation.

On this poster, we will discuss how sensitive the dielectron yield from correlated open-charm hadron decays is from the charm hadronization process. For this purpose, predictions with the PYTHIA generator using different tunes will be compared. Additionally, the consequences on the heavy-flavour cross section measurements via the dielectron channel will be shown.

HK 74.15 Thu 17:30 HSZ EG

Setup of high-precision voltage dividers for collinear laser spectroscopy experiments at TU Darmstadt and ISOLDE/CERN — •Finn Köhler[1], Kristian König[1], Johann Meisner[2], Wilfried Nörtershäuser[1], and Stephan Passon[2] — [1]Institut für Kernphysik, TU Darmstadt, Germany — [2]Physikalische Technische Bundesanstalt, Braunschweig, Germany

Collinear laser spectroscopy is a well-established technique to investigate ground-state properties of stable and short-lived isotopes. By accelerating an ion beam electrostatically to 20-60 keV, the Doppler width is drastically reduced to the order of the natural linewidth, which enables measurements with high resolution. To achieve a high accuracy in the isotope shift measurements, the acceleration voltage of the ions needs to be precisely known to account for the Doppler shift of the ions.

To determine this voltage, three high-voltage dividers inspired by precision dividers of the Physikalisch-Technische Bundesanstalt were set up and calibrated against a reference divider. With active temperature stabilization a relative accuracy of 5 ppm was achieved. At ISOLDE the voltage of the beam preparation trap and of the MIRACLS multi-reflection electrodes are measured and at TU Darmstadt, it is used to actively stabilize the voltage of the ion source. We additionally report on an upgrade of the 25m deep-UV laser-light transport to COLLAPS.

Support from BMBF under contract 05P21RDCI1 is acknowledged.

HK 74.16 Thu 17:30 HSZ EG

Silicon pixel sensors for the PANDA luminosity detector — •Niels Boelger, Stephan Bökelmann, Florian Feldbauer, René Hagdorn, Stephan Maldaner, Gerhard Reicherz, and Miriam Fritsch — On behalf of the PANDA Collaboration — Ruhr University Bochum AG Physics of Hadrons and Nuclei, 44780 Bochum

The PANDA experiment is one of the key experiments at the future FAIR accelerator facility in Darmstadt. Its purpose is to study the properties of hadronic states in detail and to search for exotic states of matter.

The PANDA detector will have a luminosity detector 11 meters downstream from the interaction point. This detector, consisting of two retractable half-detectors, uses silicon pixel sensors to measure the distribution of elastically scattered antiprotons as a function of the scattering angle, from which the luminosity is determined. The MuPix sensors intended for track reconstruction in the luminosity detector are High-Voltage Monolithic Active Pixel-Sensor (HV-MAPS), which offer two advantages over conventional pixel sensors: The active sensor part and the readout electronics are combined on the same chip. Secondly, due to the high voltage, the charge transport is much faster. The production of sensor modules consisting of several pixel sensors, as well as the data acquisition system prepared for this setup will be presented.

This project is supported by the BMBF - Gefördert durch das BMBF

HK 74.17 Thu 17:30 HSZ EG

A comparison of initial condition models for hydrodynamic evolutions in heavy ion collisions — •Lucas Constantin[1,2], Hannah Elfner[1,2,3], and Niklas Götz[1,2] — [1]Goethe Universität Frankfurt am Main — [2]Frankfurt Institute for Advanced Studies — [3]GSI Helmholtzzentrum für Schwerionenforschung

For a hydrodynamical description of the quark-gluon plasma created during a heavy ion collision, initial conditions of a thermalized system are needed. In this work, a comparison between three initial conditions models (SMASH, TRENTo, and IP-Glasma) is made. General quanti-

ties of the collision such as the number of participants and the number of binary nucleon collisions are determined, and the transverse plane energy densities from the different models are compared, along with their eccentricity distributions, for different collision systems at RHIC and LHC energies. The collisions in SMASH have slightly fewer participants and significantly fewer binary nucleon collisions. TRENTo not only produces lower eccentricities, but also has smaller event by event fluctuations. In addition, the elliptic flow from SMASH is shown, as well as the momentum anisotropy, found to be higher in SMASH than in IP-Glasma.

HK 74.18 Thu 17:30 HSZ EG

Feasibility studies for measuring electrical conductivity in heavy ion collisions with ALICE 3 — •Clara Peter for the ALICE Germany-Collaboration — Goethe University, Frankfurt, Germany

The ability of matter to transport electrical charges is described by its electrical conductivity. For the medium produced in heavy-ion collisions this fundamental property has, up to now, no experimental constraints, while theoretical predictions give a large range of possible values. This transport coefficient is not only of great interest in itself, but also an important input for the model calculations. The dielectron production rate in the hot partonic and hadronic phase of the collision is directly related to the electrical conductivity of the medium at vanishing mass and pair p_{T}. For this reason precise dielectron measurements in this phase space would be of great interest.

In this contribution we will explain the challenges to achieve such measurements focusing in particular on possible processes contributing to the irreducable physical background. Further we will discuss how the unique features of the ALICE 3 detector, planned at the LHC beyond 2030s, could enable dielectron measurements at very low invariant mass and pair p_{T}.

HK 74.19 Thu 17:30 HSZ EG

KATRIN like MINI MAC-E Filter with a tritium source for the advanced physics lab course — •Sarah Untereiner for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Wolfgang-Gaede-Str. 1, 76131 Karlsruhe, Germany

The KATRIN experiment at the Karlsruhe Intitute of Technology (KIT) aims to determine the effective neutrino mass using the kinematics of electrons from the tritium β-decay. The integral energy spectrum of the electrons is measured by an electro-static high-pass filter, using the MAC-E filter principle (Magnetic Adiabatic Collimation and Energy filter). Only electrons with energies above the retarding potential of the filter are counted at the detector at the end of the MAC-E spectrometer. In order to give students the opportunity to learn more about the experimental principles behind KATRIN, a smaller version of the MAC-E filter setup, called MiniMACE, has been built, which will be used in the advanced physics lab course at KIT. With a scale of approximately 1:20 the MiniMACE experiment includes all the major components of KATRIN: a tritium source, the spectrometer with adjustable high voltage, a high resolution detector and the magnetic guiding field. Other than KATRIN, the source uses two implanted disks with tritium and ^{83m}Kr that can be exchanged inside the ultra-high vacuum source chamber. This poster shows the design of the physics lab setup and reports on first results. This project has been supported by RIRO (Research Infrastructure in Research-Oriented teaching), which is part of the ExU project at KIT.

HK 74.20 Thu 17:30 HSZ EG

First pp correlation function with data taken by ALICE in Run 3 — •Anton Riedel and Georgios Mantzaridis for the ALICE Germany-Collaboration — Technical University of Munich (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 Run 2 of the LHC an universal source of hadrons in pp collisions has been identified and benchmarked by studying the correlations of the produced proton-proton pairs. With this result as a foundation it was possible to probe the strong force between many different pairs of hadrons like p-Λ, p-Ω, p-ϕ and many more. With the recently started 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. The proton-proton correlation function will be the starting point for gauging the universal hadron emission source in the new available data.

In this poster we present the first steps in the femtoscopy campaign of ALICE in Run 3, namely the proton proton correlation function, measured in pp collisions at $\sqrt{s} = 13.6$ TeV at the ALICE experiment at the LHC.

This project has been funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 74.21 Thu 17:30 HSZ EG

Studying (anti)nuclei formation in heavy ions using an advanced coalescence model — •David Casado — Technical University Munich

Coalescence is a major model used to describe the formation of light (anti)nuclei in high energy collisions. It is based on the assumption that two nucleons close in phase-space can coalesce and form a nucleus. Antideuteron and antihelium nuclei have been proposed as a detection channel for dark matter annihilations and decays in the Milky Way, due to the low astrophysical background expected. In order to correctly interpret any future antinuclei measurement in space, the production of antinuclei has to be well understood. In this presentation a more advanced approach is employed combining event-by-event Monte Carlo simulations with a microscopic coalescence picture based on the Wigner function formalism. The antiproton production in the event generator EPOS 3 is compared to measurements from the STAR Collaboration.

This work was supported by BMBF.

HK 74.22 Thu 17:30 HSZ EG

Studying the strong interactions in proton-deuteron at LHC — •Bhawani Singh for the ALICE Germany-Collaboration — TUM, Munich Germany

In the journey to explore the strong interaction among hadrons, ALICE has for the first time extended its femtoscopic studies to nuclei. The large data sample of high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV allows the measurement of the proton-deuteron (p-d) momentum correlations. The femtoscopic study of such systems opens the door to investigate the interaction in three-body systems as well as formation mechanism of the light nuclei in hadron-hadron collisions. In this contribution, the measured momentum correlation function for p-d is presented. The measured p-d correlation shows a shallow depletion at low relative momenta while the model calculation which assumes the interaction of two point-like particles shows a clear discrepancy with respect to the data. This discrepancy can be resolved by employing a full three body wave function that accounts for the internal structure of the deuteron including all relevant partial waves and quantum statistical effects. This demonstrates that the study of correlations among light nuclei provides access to the details of the many-body system's wave function at the LHC. Funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 74.23 Thu 17:30 HSZ EG

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-University, Frankfurt

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 74.24 Thu 17:30 HSZ EG

Collisional broadening in a transport model — Hannah Elfner[1,2,3,4], Renan Hirayama[1,2], and •Branislav Balinovic[2,3] — [1]Helmholtz Forschungsakademie Hessen für FAIR (HFHF), GSI Helmholtzzentrum für Schwerionenforschung, Campus Frankfurt — [2]Frankfurt Institute for Advanced Studies (FIAS) — [3]Institut für The-

oretische Physik, Goethe Universität — [4]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt

In this work, we study the effect of collisional broadening in different hadron species, for both resonances and stable particles, using different temperatures in the hadronic transport approach SMASH (Simulating-Many-Accelerated-Strongly-Interacting-Hadrons). In SMASH the information about the phase space and interactions is available at all times, which makes the lifetimes and mass distributions of particles directly accessible. Our set up simulates a thermalized hadron gas, used to study the absorption of particles in equilibrium. The collisional broadening is measured using effective widths, which are a measure for decay plus absorption probabilities. We also calculate the corresponding dynamical spectral functions, which are interesting from theoretical perspective, since they can be an indicator of chiral symmetry restoration. Moreover, we investigate the impact on collisional broadening of different assumptions for the mass dependence of vacuum decays, finding that a mass-dependent vacuum experiences a stronger collisional broadening than the mass-independent case.

HK 74.25 Thu 17:30 HSZ EG

Signal-to-noise ratio in the ALICE TPC with GEMs — •Janis Noah Jäger for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

A major aspect of the recent ALICE upgrade is the upgrade of the Time Projection Chamber (TPC). The TPC is the main tracking and particle identification device of ALICE. By replacing the Multi-Wire Proportional Chambers (MWPC) with stacks of four Gas Electron Multiplier (GEM) foils, continuous readout of the TPC is achieved. Furthermore the installation of the GEMs implies specific design goals, such as the intrinsic noise of the electronics channels as well as the signal-to-noise ratio at the nominal gas gain of 2000. Different pad area and trace length result in variations of the properties. Additionally, external influences cause local variations of the noise.

In this poster the intrinsic noise together with the signal-to-noise ratio for minimum ionizing particles, measured in first pp collisions in LHC Run3, will be presented for the different pad regions of the TPC. The results will be compared with the design goals.

HK 74.26 Thu 17:30 HSZ EG

Background-Corrected Collinear Saturation Spectroscopy at COALA — •Julien Spahn, Phillip Imgram, Kristian König, Patrick Müller, and Wilfried Nörtershäuser — Institut für Kernphysik, TU Darmstadt

All-optical determinations of nuclear charge radii in He-like systems will come into reach with increasing accuracy in atomic structure calculations of He-like systems. To this end, the $1s2s\,^3S_1 \rightarrow 1s2p\,^3P_J$ transitions in He-like $^{12}C^{4+}$ and $^{13}C^{4+}$ were measured at the Collinear Apparatus for Laser Spectroscopy and Applied Physics (COALA) at the Institute of Nuclear Physics of TU Darmstadt. The C^{4+} ions are produced with an electron-beam ion source (EBIS) and collinear/anticollinear laser spectroscopy was performed using Doppler tuning. Variations in the background signal, caused by fluctuations in the collinear laser beam position, significantly contributed to the uncertainty of the measured transition frequencies, especially at high dwell times. Additionally, the residual Doppler broadening is still rather large compared to the natural linewidth of the transitions due to the initial energy spread of the ions inside the EBIS. This contribution will present and compare the improvements obtained by implementing a laser-beam position stabilization system and a voltage modulation of the fluorescence detection region. Moreover, a first attempt of background-corrected collinear saturation spectroscopy – a method that allows to overcome the limitations imposed by the residual Doppler broadening – will be presented.
This project is supported by DFG (Project-ID 279384907 - SFB 1245).

HK 74.27 Thu 17:30 HSZ EG

HYDRA: HYpernuclei Decay at R^3B Apparatus — •Simone Velardita[1], Hector Alvarez-Pol[2], Yassid Ayyad[2], Meytal Duer[1], Alexandru Enciu[1], Liancheng Ji[1], Alexandre Obertelli[1], and Yelei Sun[1] for the R3B-Collaboration — [1]Technische Universität Darmstadt, Fachbereich Physik, Darmstadt, 64289, Germany — [2]Universidade de Santiago de Compostela, Santiago de Compostela, E-15782, Spain

HYDRA is a physics program within the R^3B collaboration to study the decay spectroscopy of hypernuclei produced from heavy-ion collisions at GSI/FAIR. The program aims at measuring with high resolution the in-flight pionic decay of light and medium mass hypernuclei. To achieve that, a pion tracker is conceived as a time projection chamber inside the GLAD magnet of the R^3B setup.

The full experimental setup has been simulated within the R3BROOT framework, to optimize the geometry and define conditions for the forthcoming accepted experiment which will take place at R^3B in 2024. The first experiment aims at the mass-radius of hypernuclei such as the hypertriton, predicted to be halo, from measurements of its interaction cross-section. The experimental method developed for the measurement will be presented in the poster, together with first results from a tracking algorithm that will be used to reconstruct the decayed particle trajectories.

HK 74.28 Thu 17:30 HSZ EG

Characterization of prototypes of an active Transverse Energy Filter (aTEF) — •Kyrill Blümer[1,4], Kevin Gauda[1,4], Sonja Schneidewind[1,4], Christian Gönner[1,4], Volker Hannen[1,4], Hans-Werner Ortjohann[1,4], Wolfram Pernice[2,3], Lukas Pöllitsch[1,4], Richard Salomon[1,4], Maik Stappers[2], and Christian Weinheimer[1,4] — [1]Institute for Nuclear Physics, University of Münster — [2]CeNTech and Physics Institute, University of Münster — [3]Kirchhoff-Institute for Physics, University of Heidelberg — [4]KATRIN Collaboration

In the Karlsruhe Tritium Neutrino Experiment (KATRIN) the mass of the electron neutrino is intended to be measured directly by precision energy spectroscopy of the tritium β-decay electrons in its endpoint region. To achive the target sensitivity of $0.2\,\mathrm{eV/c^2}$, a reduction of background electrons, assumed to be caused by Rydberg atoms and autoionizing states, is needed. An active transverse energy filter (aTEF, Eur. Phys. J. C 82, 922 (2022)) distinguishes electrons due to their angle to a magnetic field line. It preferentially detects signal electrons with a broad angular distribution rather than background electrons with a small angular distribution. This poster presents insight in the testing procedures and characterization of aTEF-prototypes in dedicated test environments.
This work is supported by BMBF under contract number 05A20PMA.

HK 74.29 Thu 17:30 HSZ EG

(Anti)nuclei production in ALICE — •Rafael Manhart for the ALICE Germany-Collaboration — Technische Universität München

High-energy hadronic collisions at accelerators create a suitable environment for the production of light (anti)(hyper)nuclei. Precise measurements of the antinuclei production at accelerators are essential to study the different sources of antinuclei in our Universe and to correctly interpret any future measurement of antinuclei in space. (Anti)nuclei production measurements are also interesting to investigate their production mechanisms, which are under intense debate in the scientific community. The description of the experimental measurements is currently based on two competing phenomenological models: the statistical hadronisation model and the coalescence approach. The production of (anti)nuclei, up to A=4, has been measured with ALICE in the last 10 years, from small collision systems (i.e., pp and p*Pb) to heavy-ion collisions (i.e., Xe*Xe and Pb*Pb). In 2022, LHC Run 3 has started and pp collisions at top centre-of-mass energy of $\sqrt{s} = 13.6$ TeV have been recorded with the unprecedented luminosity of $18\ pb^{-1}$. In this contribution, new measurements of (anti)nuclei from Run 3 data will be shown, together with a review of (anti)nuclei results from Run 1 and 2.
This work is funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 74.30 Thu 17:30 HSZ EG

Machine Learning Approach to the Sexaquark Search in ALICE — •Sven Hoppner for the ALICE Germany-Collaboration — Physikalisches Institut, Heidelberg, Germany

The sexaquark was proposed by G. Farrar in 2017 to be a compact, stable and neutral particle consisting of six quarks with a quark content of *uuddss*. Its charge neutrality, stability, and expected production rate in the QCD phase transition in the early universe make it an interesting dark matter candidate within the standard model, while its similarity to the neutron in experimental settings could explain why it has not been discovered so far. A new search for the sexaquark S in heavy- ion collisions at the Large Hadron Collider (LHC) using the ALICE detector started in 2022 which will look for characteristic decay chains in the annihilation of the anti-S with the detector material. The search benefits from the excellent tracking and particle identification

(PID) capabilities of ALICE, especially for low momenta. Based on Monte Carlo simulations it is investigated how the sexaquark search with ALICE can be improved with a decision tree based machine learning approach using XGBoost.

HK 74.31 Thu 17:30 HSZ EG

The ComPWA project: speeding up amplitude analysis with a Computer Algebra System — •Remco de Boer[1], Miriam Fritsch[1], Wolfgang Gradl[2], Stefan Pflüger[1], and Leonard Wollenberg[1] — [1]Ruhr-Universität Bochum — [2]Johannes Gutenberg Universität Mainz

In the ideal world, we describe our models with recognizable mathematical expressions and directly fit those models to large data samples with high performance. It turns out that this can be done with a CAS, using its symbolic expression trees as a template to computational back-ends like JAX. The CAS can in fact further simplify the expression tree, which can result in speed-ups in the numerical back-end.

The ComPWA project offers Python libraries that use this principle to formulate large expressions for amplitude analysis, so that the user has the flexibility to quickly implement different formalisms and can easily perform fast computations on large data samples. The CAS additionally allows the project to standardise and automatically document these formalisms as they are being implemented.

HK 74.32 Thu 17:30 HSZ EG

Detector response simulations for the CBM-TRD — •Lena Rossel for the CBM-Collaboration — Institut für Kernphysik, Goethe Universität, Frankfurt am Main

To ensure the best functionality of the Transition Radiation Detector (TRD) of the Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR), it is crucial to simulate the detector response as precisely as possible. Simulations are an instrument to optimize the detector design and account for possible challenges in the extraction of physics observables affected by design decisions.

After the event generation, the propagation of the particles through the detector setup is simulated with GEANT3. The detector behavior, including signal generation and collection, is simulated. This includes handling of transition radiation photons, energy deposition in the detector gas and signal-digitization.

In this contribution the general process of the detector response simulation is carried out with CbmRoot for the CBM-TRD. The focus lies on the reconstruction of the specific energy loss for charged particles. In addition, DESY test beam data of one TRD module will be compared to the simulation results. This work is supported by the BMBF-grant 05P21RFFC3.

HK 74.33 Thu 17:30 HSZ EG

Study of the $\pi^-\pi^+$ subsystem with $J^{PC} = 1^{--}$ in the diffractively produced $\pi^-\pi^-\pi^+$ final state at COMPASS * — •Martin Bartl for the COMPASS-Collaboration — Physik-Department E18, Technische Universität München

The COMPASS experiment is a fixed-target experiment at CERN fed by the SPS beam. The flagship spectroscopy analysis is based on the diffractive process $\pi^- p \to \pi^-\pi^-\pi^+ p$, for which a large data sample of 46×10^6 events has been collected.

This large data sample allows us to apply the so-called freed-isobar partial-wave analysis method, which extracts the amplitudes of the decay process with well-defined J^{PC} quantum numbers for the $\pi^-\pi^+$ subsystem, as well as for the 3π system. The $\pi^-\pi^+$ amplitudes are extracted in a quasi-model-independent way as a function of 2π mass, 3π mass, and squared four-momentum transfer. This highly detailed information allows us not only to test the assumptions of the isobar model, but also to perform in-depth studies of the 2π resonances that appear in the 3π system.

We study the 2π amplitudes with $J^{PC} = 1^{--}$. These 2π amplitudes are dominated by the well-known $\rho(770)$ resonance, but may also contain signals from excited ρ states, which are still elusive. The employed approach allows us to extract the pole positions, i.e. masses and widths, of these resonances and study their systematics.

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

HK 74.34 Thu 17:30 HSZ EG

Reflectivity measurements with VUV light in xenon and vacuum — •Robert Braun, Lutz Althüser, and Johanna Jakob for the XENON-Collaboration — Institut für Kernphysik, WWU Münster

Rare event searches as performed with liquid xenon (LXe) detectors demand a precise knowledge of the employed materials. Measurements of optical properties at the xenon scintillation wavelength in the VUV regime are required for accurate simulations and detector characterization. The Reflectivity Setup in Münster has a focused light beam from deuterium lamp with a VUV monochromator to select the wavelength and as detector a PMT capable of 290° angular movement, allowing to study the reflectivity and transmission properties of a sample. The sample is placed in a quartz tube and can be studied in vacuum, in gaseous or in liquid xenon, which is kept stable by the built-in cold-head.

In the past, the setup was used for transmission measurements of polytetrafluorethylen (PTFE) (JINST 15 (2020) P12021), which is a common material to encapsulate the active volume in LXe detectors as used by the XENON dark matter project. In the near future, the setup will be used for reflectivity measurements of PTFE samples from the XENONnT experiment. This poster gives an overview of the Reflectivity Setup in Münster and the reflectivity and transmission measurements taken with it.

HK 74.35 Thu 17:30 HSZ EG

Correlation of flow coefficients measured in Au+Au collisions at 1.23 AGeV with HADES — •Laura Lauf for the HADES-Collaboration — Institut für Kernphysik, Frankfurt am Main, Deutschland

HADES has a large acceptance as well as excellent particle identification capabilities and therefore allows the study of dielectron, hadron, and light nuclei production in heavy-ion collisions with great precision. The harmonic flow coefficients v_n of the order $n = 1 - 6$ are measured with HADES as a function of centrality, transverse momentum, and rapidity in Au+Au collisions at 1.23 AGeV. Combining them allows to construct for the first time a complete, multi-differential picture of the emission pattern as a function of rapidity and transverse momentum. The predictions of ideal hydrodynamic simulations, confirmed by transport model calculations, suggest a scaling between various flow coefficients. For protons at mid-rapidity the ratio v_4/v_2^2 is found to be close to 0.5. The correlations of flow coefficients are investigated based on an event-by-event selection of the mid-rapidity final state elliptic flow of protons. The correlations are compared to the results of transport models and to eccentricity calculations within the Glauber Monte Carlo approach.

This work is supported by the Helmholtz Forschungsakademie HFHF

HK 74.36 Thu 17:30 HSZ EG

Noise Calibration of the ALICE-TRD in Run03 — •Archita Rani Dash for the ALICE Germany-Collaboration — Westfälische Wilhelms- Universität Münster

The ALICE Transition Radiation Detector (TRD) provides excellent electron identification and is part of the global tracking in the central barrel of ALICE. The operation data taking and the calibration of the ALICE TRD is one of the important aspects of the experiment.While the TRD calibration procedure involves four basic parameters,namely time offset, drift velocity, gain, and noise, this poster presentation is chiefly focused on the noise aspects of the detector. Short pedestal/noise runs are taken roughly once per month during data taking period, recording the data without the usually-applied zero suppression. As a result, we determine the status of each of the more than 1 million readout channels, calculating the noise value for every channel. This is obtained by calculating mean and rms of the ADC valuesfor each channel. In this work, we look at the latest noise run data of December 2022, obtaining the noise map of the whole detector.

Supported by BMBF in the ErUM Framework and DFG GRK2149.

HK 74.37 Thu 17:30 HSZ EG

Stability Tests for a Pulsed LED Gain Monitoring System for CALIFA — •Carl Georg Boos, Christian Sürder, and Thorsten Kröll for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt

The CALIFA array is part of the R3B set-up used for kinematically complete measurements of nuclear reactions. Those measurements are conducted at GSI and later FAIR, Darmstadt. The CALIFA is one of the core elements, functioning both as a calorimetre and a spectrometre for gamma-rays and light charged particles. It is built out of over 2000 CsI(Tl) crystals connected to APDs. As the gain is not constant

for these detector systems - e. g. through possible ageing of the scintillation crystals and the temperature dependencies of the APDs - an Pulsed LED Gain Monitoring System is currently tested. The stability is examined to understand, to which extend the LEDs shift and to identify the reasons. Parameters investigated are pulse lengths and frequencies, the mimicing of the spill structure of the beam as well as the coupling of the fibres. In addition to lab test, a long measurement was started at the CALIFA array at GSI for possible correlations with temperature. This work was supported by BMBF 05P19RDFN1 and 05P21RDFN2.

HK 74.38 Thu 17:30 HSZ EG

Constraining the interaction between Λ and Kaons with femtoscopy at LHC — •Emma Chizzali for the ALICE Germany-Collaboration — Technical University of Munich, Munich, Germany

The meson-baryon interaction among short-lived strange particles as Λ and kaons is very challenging to be accessed in scattering experiments. Recently, an alternative approach to access the strong interaction in these systems was provided by measuring of two-body momentum correlations. Of special interest is the ΛK- interaction, which is characterized by the presence of the Xi(1620) state, recently observed by Belle, which can couple to ΛK- and lies just above the threshold. The ΛK+,- correlation function, already studied by the ALICE Collaboration in Pb-Pb collisions, has now been measured in pp Collisions at sqrt(s)=13 TeV. The small size of the particle-emitting source produced in this colliding system makes it possible to study short-ranged strong potentials with much higher precision. The results show that the ΛK+ interaction is repulsive and dominated by elastic processes. The measured ΛK- correlation function indicates an attractive interaction composed of a resonant contribution, through the Xi(1620) resonance, and a non resonant one.

Funded by DFG Projekt "C^3ATS: Effekte aufgrund der Kopplung der Kanäle im Analysis Tool für Korrelationen das die Schrödinger Gleichung verwendet" (MA 8660/1-1), BMBF Verbundforschung (05P21WOCA1 ALICE) and MPP IMPRS

HK 74.39 Thu 17:30 HSZ EG

Performance investigation of a DSSSD coupled to SKIROC2 ASICs — •Steffen Meyer[1], Thorsten Kröll[1], Roman Gernhäuser[2], Sergei Golenev[2], Corinna Henrich[1], and Han-Bum Rhee[1] — [1]TU Darmstadt — [2]TU Munich

Double-sided silicon-strip detectors (DSSSD) have been in use at the Coulomb excitation and transfer setup at the ISOLDE facility (CERN) for many years. Recently a new transfer setup, HI-REX, has been designed, which employs a FPGA-based GEAR platform to read out data of SKIROC2 ASICs [1].

Here, this new SKIROC ASIC-based DAQ is tested with a standard DSSSD. The TREX setup is known to face challenges with noise due to cabling and grounding. ASICs of the SKIROC family allow to minimize and eliminate such sources, because they are able to preamplify, filter, shape and digitize on-chip. To have comparable data, first tests with an MADC-32 module by Mesytec and FEBEX3 cards, designed at GSI, are performed.

The current status will be 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 74.40 Thu 17:30 HSZ EG

Physics Performance Studies of K_s^0 with the CBM Experiment — •Felix Fidorra for the CBM-Collaboration — Institut für Kernphysik WWU Münster, Münster, Germany

The Compressed Baryonic Matter (CBM) is a fixed target heavy-ion experiment which is currently under construction at FAIR in Darmstadt. It will explore the QCD phase diagram at high net-baryon densities ($\mu B > 500\,\mathrm{MeV}$). A key element for the investigation of the dense baryonic matter are the measurements of the strange hadron yields, the most often produced K_s^0 and Λ as well as rare (multi-)strange hyperons and their antiparticles. To reconstruct the decays of these particles, a particle finder, based on the Kalman Filter, is used. A boosted decision tree machine learning model has been trained to distinguish between signal and background. Simulations using two different event generators, UrQMD and DCM-QGSM-SMM, are used for this study. Since K_s^0 decay with the highest probability symmetrically into two soft pions of opposite charge, their reconstruction gives insights into the performance of the CBM detector. This poster will be about the status of K_s^0 analysis. The aim is to maximize the signal significance of the K_s^0 decay candidates selection using the machine learning algorithms and validate the multi-step and multi-differential fitting routine for K_s^0 yield extraction.

HK 74.41 Thu 17:30 HSZ EG

CBM-TRD tracking performance studies for mCBM 2022 — •Axel Puntke for the CBM-Collaboration — Institut für Kernphysik, WWU Münster

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) will explore the QCD phase diagram in the region of very high net baryon densities. The Transition Radiation Detector (TRD) is an important subdetector of the final CBM experiment and is used to identify electrons at high momenta, contributes to tracking of particles and supports the identification of light nuclei via their specific energy loss.

For commissioning and performance measurements, the TRD takes part in the mCBM high-rate beam measurement campaigns at the SIS18 accelerator, which are part of the FAIR-Phase 0 program. Together with the TOF, STS, RICH and MuCH detectors, also TRD is connected to the full CBM DAQ, making data available for common analysis.

In this poster, TRD data QA as, e.g., a first tracking approach using straight tracks is presented and its results are shown.

This work is supported by BMBF grant 05P21PMFC1.

HK 74.42 Thu 17:30 HSZ EG

Deuteron emission from Ag+Ag Collisions at 1.58A GeV — •Carl-Philipp Roy for the HADES-Collaboration — Goethe-Universität Frankfurt

A high statistics data sample of Ag(1.58A-GeV)+Ag events recorded in scope of the FAIR phase 0 program in March 2019 is used to study multi-differential emission rates of deuteron.

In this contribution, we discuss details of the extraction of deuteron signals from the bulk of reconstructed charged particle tracks. The extracted deuteron signals are corrected with simulated detector response coefficients and then used to calculate the multi-differential emission rate per event as a function of transverse mass and center-of-mass rapidity. The obtained phase-space distribution of deuteron yields is fitted with thermally motivated model functions and extrapolated to phase-space not covered by the detector geometry. The results are discussed in context of available world data.

*This work has been supported by bmbf (05P21RFFC2) and gsi.

HK 74.43 Thu 17:30 HSZ EG

Arduino-based readout electronics for particle detectors — •Markus Köhli[1], Jannis Weimar[1], Fabian Schmidt[2], Jochen Kaminski[2], Klaus Desch[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Heidelberg University — [2]Physikalisches Institut, University of Bonn

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, slow control and independently operating small scale instrumentation. The capabilities can be extended to data taking and signal analysis at decent rates. We present two projects, which cover 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 74.44 Thu 17:30 HSZ EG

Ultra-clean magnetically-coupled piston pump for noble gas experiments. — •Andria Michael[1], Lutz Althüser[1], David Koke[1], Christian Huhmann[1], Michael Murra[1,2], Philipp Schulte[1], Henning Schulze Eissing[1], and Christian Weinheimer[1] for the XENON-Collaboration — [1]Institut für Kern-

physik, Universität Münster, Germany — [2]Columbia University, New York, USA

The high performance magnetically-coupled piston pump is interesting for the usage in low background experiments dealing with noble gases as target. In such ultra-clean experiments, pumps are used for the circulation of the target material. Therefore, the reduction of radioactive emanating materials such as radon is of great importance. For this purpose, a radon-free, hermetically sealed, ultra-clean magnetically-coupled piston pump was developed (JINST 16 (2021) P09011) to be operated as a xenon gas compressor for the XENONnT experiment.

The magnetically-coupled piston pump is made of four cylinders connected in parallel, featuring a high flow by keeping high pressure differences for a good compression. The custom-made control gives the possibility to operate the system with different configurations and to monitor the status of each pump during the operation.

In this poster the function and the operation experience with this magnetically-coupled piston compressor is presented.

This research was partially supported by BMBF under contract 05A20PM1.

HK 74.45 Thu 17:30 HSZ EG

CBM-TRD Component Database — •Philipp Munkes for the CBM-Collaboration — Institut für Kernphysik WWU Münster, Münster, Germany

The Compressed Baryonic Matter (CBM) experiment is an upcoming heavy-ion physics experiment at the future Facility for Anti-proton and Ion Research (FAIR) which will investigate the low-temperature and high baryonic density region of the Quantum-ChromoDynamic (QCD) phase diagram.

The Transition Radiation Detector (TRD), one of the sub-detectors of the CBM experiment, will be used to provide particle identification information on electrons and pions at high momenta and light nuclei, as well as tracking information for charged particles.

For long-running experiments it is important to keep track of all of their components already during production of the detector, as soon as they have been assigned an identity. This enables not only full QA processes of those components, but also correlating the product behavior to the components and/or to the production process, if necessary at some point. For this reason, a long-term stable database for production data needs to be implemented, deployed, and tested.

In this poster, the design of the CBM-TRD Component Database concept and its current status will be presented.

This work is supported by BMBF grant 05P21PMFC1.

HK 74.46 Thu 17:30 HSZ EG

pp correlation in e^+e^- collisions at Belle to study the particle emitting source — •Maria Leibelt[1], Laura Serksnyte[1], Umberto Tamponi[2], and Laura Fabbietti[1] — [1]TU München, Garching, Germany — [2]INFN, Sezione di Torino, Turin, Italy

The light antinuclei cosmic rays are considered as a promising probe for the searches of Weakly Interacting Massive Particles (WIMPs) - one of the dark matter candidates. The antinuclei can be produced in dark matter annihilations and detected by experiments near Earth. Understanding the antinuclei fluxes requires knowledge about how light antinuclei are formed. One of the available models is coalescence which suggests that first antinucleons are formed as degrees of freedom and then they coalesce to antinuclei. The probability for the antinucleons to create a bound state depends on the relative momentum in the pair rest frame and the distance at which they are produced. The latter can be constrained with femtoscopic correlation measurements, currently available only for pp and heavy-ion collisions. As a proxy to constrain the source for antinuclei production in the dark matter annihilation, e^+e^- collisions are preferred since electrons are point-like particles and do not interact strongly. In this poster, we will show the first results on femtoscopic p-p correlations in e^+e^- collisions measured by Belle at the KEKB collider. The obtained correlation function is then modeled using well known interaction potentials and the size of the source for nucleon pairs is extracted.

HK 74.47 Thu 17:30 HSZ EG

A new TPC with a hybrid GEM-Micromegas detector — •Liancheng Ji[1], Meytal Duer[1], Alexandru Enciu[1], Bastian Löher[2], Alexandre Obertelli[1], Yelei Sun[1], Simone Velardita[1], Piotr Gasik[2], and Joerg Hehner[2] for the R3B-Collaboration — [1]Technische Universität Darmstadt, Institut für Kernphysik, 64289, Darmstadt, Germany — [2]GSI, Helmholtzzentrum für Schwerionenforschung, 64291 Darmstadt

HYDRA (HYpernuclei Decay at R^3B Apparatus), a physics program within the R^3B collaboration at GSI/FAIR, is dedicated to studying the production of light and medium mass hypernuclei in ion-ion collisions by measuring their pionic decay. With HYDRA day-one experiment in 2024 the mass radius of the hypertriton, the lightest hypernucleus will be extracted for the first time. The main tracking detector, a time projection chamber (TPC) is being developed and will be operated inside an inhomogeneous magnetic field of the GLAD large-acceptance dipole magnet at the R^3B setup.

As the first step, a prototype GEM-Micromegas hybrid TPC has been built to implement all the technologies proposed for the full TPC. It covers an active area of 256 x 88 mm^2 , with a 300 mm drift distance. A two-layer wired field cage holds up the electric field. Along with it, a laser system is employed to generate reference tracks with which the homogeneity of the drift field can be quantified and calibrated.

Currently the prototype is being tested at TU Darmstadt. Simulations and first test results will be presented in the poster.

HK 74.48 Thu 17:30 HSZ EG

A GEANT4 simulation of gamma clustering in CsI. — •Philipp Klenze[1], Leyla Atar[2], and Roman Gernhäuser[1] for the R3B-Collaboration — [1]Technische Universität München — [2]Technische Universität Darmstadt

With over 1500 CsI(Tl) crystals, the CALIFA calorimeter is one of the cornerstones of the upcoming R^3B experiment at the FAIR accelerator complex. One of its tasks will be the detection of gamma rays in the range from 100 keV to 30 MeV. Due to the high granularity of CALIFA, these energy deposit of gamma rays will generally be spread over multiple crystals. In this work a simplified geometry model in GEANT4 is used to study both the quantitative behavior of photons in CsI, cluster sizes and shapes, and energy and position reconstruction efficiency.

HK 74.49 Thu 17:30 HSZ EG

Pulse-shape analysis with the new Miniball triple-cluster detector — •Kai Henseler, Darius Luyken, Jasper Wehlitz, Rainer Abels, Jürgen Eberth, Herbert Hess, Rouven Hirsch, and Peter Reiter — IKP Universität zu Köln, Cologne, Germany

The Miniball (MB) array is a high-resolution γ-ray spectrometer used for low multiplicity experiments with low-intensity radioactive ion beams at HIE-ISOLDE, CERN. It consists of eight triple-cryostats, each housing three n-type six-fold segmented HPGe crystals. New preamplifier electronics was implemented in the cold part of the cryostat and the feedback loop is now coupled to the AGATA preamplifier [1]. The seven preamplifier outputs from one crystal are digitized at a rate of 100 MHz using 14-bit ADCs [2]. The new electronics yield comparable energy resolution results with respect to standard analog electronics and enable pulse-shape analysis of all channels simultaneously. Measurements with a collimated γ-ray source of ^{137}Cs were conducted to produce data sets of interactions along one line, so called 'pencil beams'. These pulses are filtered and analyzed with respect to the deposited energy, rise time and pulse shapes. Aim of the PSA is to identify the location of individual interaction points. Especially along the detector axis three dimensional position information is crucial for improved Doppler correction. First results will be presented and discussed. Supported by BMBF Projects 05P18PKCI1, 05P21PKCI1.

[1] S. Akkoyun *et al.*, Nucl. Inst. Meths. Phys. Res. A 668 (2012) 26
[2] A. Pullia *et al.*, IEEE NSS MIC Record (2012) 819-823

HK 74.50 Thu 17:30 HSZ EG

High-energy gamma calibration of CALIFA with a Pu-C source — •Phuong Nguyen, Leyla Atar, Christian Suerder, and Thorsten Kroell for the R3B-Collaboration — Institut für Kern- physik, TU Darmstadt, Darmstadt, Germany

CALIFA (CALorimeter for In-Flight detection of gamma-rays and high energy charged pArticles) is the scintillator based calorimeter of the R3B (reactions with relativistic radioactive beams) experiment at FAIR that surrounds the target. It currently consists of 1528 scintillation CsI(Tl) crystals and detects gamma-rays and light charged particles simultaneously. The energy calibration of CALIFA crystals is done using different sources, from low energy-gamma peaks (22Na) to high energy-gamma peaks (Pu-C) reaching from 511 keV up to 6.1 MeV. This is essential due to the high dynamic range (100keV to 300MeV) of CALIFA. To improve the calibration quality, various gamma sources are combined in the calibration procedure and automated by a Python script.

This work is supported by BMBF under contract 05P19RDFN1 and 05P21RDFN2 and the Helmholtz Research Academy Hesse for FAIR

- HFHF.

HK 74.51 Thu 17:30 HSZ EG

New evidence for alpha clustering structure in the ground state band of ^{212}Po — •Martin von Tresckow for the IFIN212Po-Collaboration — IKP TU Darnstadt, Schlossgartenstraße 9, 64289 Darmstadt

^{212}Po has two-protons and neutrons outside the doubly-magic nucleus ^{208}Pb and it may be assumed that the nuclear structure can be well described within the shell-model. But various experimental properties, such as the short-lived ground state, are better described by an α-clustering model. The B(E2) values of the decays of the low-lying yrast states are an important finger print to describe the structure of ^{212}Po. Especially the missing B(E2; $4_1^+ \rightarrow 2_1^+$) value is important in this discussion. We have performed an α-transfer experiment to investigate excited states of ^{212}Po and determine the lifetimes using the ROSPHERE γ-ray detector array at IFIN-HH in Magurele, Romania. This array consisted of 15 HPGe detectors and 10 $LaBr_3$(Ce) scintillator detectors and was supplemented with the SORCERER particle-detector array. The combination of γ-ray and the particle detectors was an important tool to determine the mean lifetimes of all ground-state band levels up to the 8^+ state applying the fast-timing method [Ma. von Tresckow et al., PLB 821, 136624 (2021)]. I will present our lifetime analysis and discuss the results within the shell-model and α-clustering model. *Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) via grant 05P21RDFN1

HK 74.52 Thu 17:30 HSZ EG

CBM-TRD hit time extraction — •Philipp Kähler[1], Marius Kunold[2], and David Schledt[2,3] for the CBM-Collaboration — [1]Institut für Kernphysik, WWU Münster — [2]Institut für Kernphysik, Goethe-Universität Frankfurt — [3]Infrastruktur und Rechnersysteme in der Informationsverarbeitung, Goethe-Universität Frankfurt

The Transition Radiation Detector (TRD) of the upcoming CBM experiment will be based on Multi-Wire Proportional Chambers (MWPCs), which are read-out via their segmented cathode pad-planes. The incoming charge from hits is amplified and shaped in the analogue part of the read-out ASICs, i.e. the SPADIC chip. The resulting shaper signals are digitised directly in its integrated sampling ADC. As the transmission function of the shaper is well known, the signal arrival time can be extracted from the transmitted ADC samples with a precision well below the sampling frequency of 16 MHz.

This poster shows implementations of the time value extraction for measured signals, which is used in the chain to TRD hit reconstruction. Different methods, based on a look-up table approach as well as on direct calculation, have been tested on real data from mCBM measurements (FAIR phase 0 programme) at the SIS18 accelerator. Implementations for online application of the time extraction in the Common Readout Interface (CRI) FPGA of our system will be covered. This work is supported by BMBF grants 05P21RFFC1 and 05P21PMFC1.

HK 74.53 Thu 17:30 HSZ EG

Magnetic field dependence of dielectron measurements with ALICE 3 — •Zafar Momtaz for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Ultra-relativistic heavy-ion collisions are used to study strongly interacting matter under extreme conditions, i.e. high temperature and energy density, where a deconfined state of quarks and gluons is formed and chiral symmetry is expected to be restored. At the LHC, a next-generation heavy-ion experiment, called ALICE 3, is planned beyond the 2030s to address the remaining fundamental questions still open. In particular, ALICE 3 should enable precise measurements of the temperature evolution of the quark-gluon plasma created in heavy-ion collisions via dielectron analyses. Moreover it should allow us to study the mechanisms of chiral symmetry restoration from the spectrum of dielectron created in the medium in the vicinity of the transition temperature via the spectral function of the ρ - meson. In order to achieve these physics goals, the ALICE 3 detector setup would include an ultra-light tracker, covering the pseudorapidity range of of $|\eta| < 4$ and installed within a superconducting magnet system.

This poster will show the expected dielectron measurement performance with ALICE 3 for different magnetic fields. In particular, we will focus on the tracking and electron identification efficiencies for different detector configurations and explain how they influence the predicted uncertainties of the temperature measurements of the fireball.

HK 74.54 Thu 17:30 HSZ EG

Development of a Muon Tagger System for the future MuonEDM Experiment — •Dhruv Chouhan, Melike Akbiyik, Elisa Ruiz Choliz, Francesco Fallavolita, and Matthias Schott — Johannes Gutenberg University of Mainz, Germany

The future MuonEDM experiment aims to search for an electric dipole moment of the muon based on the frozen-spin technique. With the advent of the new high intensity muon beam, HIMB, and the cold muon source, muCool, at PSI the sensitivity of the search for the muon EDM could be improved by several orders of magnitudes. In this context, the latest developments on a muon-tagger system for the MuonEDM experiment are discussed. Special focus is drawn on a straw-tube based approach as well as a Micromegas based TPC detector.

HK 75: Members' Assembly

Time: Thursday 19:00–20:00 Location: HSZ/0002

All members of the Hadronic and Nuclear Physics Division are invited to participate.

HK 76: Invited Talks IV

Time: Friday 11:00–12:30 Location: HSZ/0002

Invited Talk HK 76.1 Fri 11:00 HSZ/0002

Thermalization of heavy quarks in the QGP — •Federica Capellino — Physikalisches Institut Heidelberg, Heidelberg, Germany

Heavy-ion collision experiments allow us to study the high-temperature deconfined phase of QCD, the quark-gluon plasma (QGP). Heavy quarks (i.e. charm and beauty) are powerful tools to characterize the transport properties of the QGP. Although they are initially produced out of kinetic equilibrium via hard partonic scattering processes, recent experimental measurements of charmed hadrons pose the question regarding the possible thermalization of heavy quarks in the medium. Exploiting a mapping between transport theory and fluid-dynamics, we will show how a fluid-dynamic description of the dynamics of charm quarks in the QCD plasma is feasible. Calculations for heavy-flavor observables which assume charm quarks to be in local thermal equilibrium with the plasma will be shown in comparison with experimental data. The model-to-data comparison is a fundamental step towards constraining the spatial- and momentum-diffusion coefficient of the QGP.

Invited Talk HK 76.2 Fri 11:30 HSZ/0002

Hadron structure in Lattice QCD — •Konstantin Ottnad — PRISMA+ Cluster of Excellence and Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

Quantum chromodynamics (QCD) at low energies gives rise to a plethora of states as quark and gluons become bound in hadrons. Among these hadronic states are nucleons which account for the bulk part of visible matter in the universe. Due to their dynamical origin they are not pointlike particles but exhibit a rich and complex internal structure which is studied extensively in both experiment and theoretical studies.

Concerning the theoretical side, lattice QCD provides the obvious framework for ab initio hadron structure calculations as it is the only known method to deal with QCD in the non-perturbative regime from first principles. In recent years it has finally become feasible to obtain

precise physical results with fully controlled systematics from such lattice calculations of hadron structure observables. Still, this remains a very challenging and computationally expensive endeavour as these calculations are always affected by a notorious signal-to-noise problem that hinders the extraction of groundstate matrix elements.

In this talk I will outline some of the essential methods used to carry out state-of-the-art hadron structure calculations within lattice QCD and discuss recent results from the Mainz group for nucleon matrix elements at zero and nonvanishing momentum transfer.

Invited Talk HK 76.3 Fri 12:00 HSZ/0002

LISA: LIfetime measurements with Solid Active targets — •Kathrin Wimmer — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The coexistence of single-particle and collective degrees of freedom in atomic nuclei gives rise to various exotic phenomena. In nuclei with very asymmetric proton-to-neutron ratios, the strong nuclear interaction drives shell evolution which alters the orbital spacing, and in some cases even the ordering present in stable nuclei. In the absence of large gaps between orbitals, nuclei can take on non-spherical shapes and their excitations proceed through coherent and collective motion of many nucleons. Where and how collectivity emerges from the single-particle dynamics of protons and neutrons is an open question in nuclear structure physics that will be addressed with LISA in a unique way. The aim of the LISA (LIfetime measurements with Solid Active targets) project is to develop a novel method for lifetime measurements in atomic nuclei. Lifetimes probe the collectivity of a nucleus through its electromagnetic transition properties. The experimental approach is based on active solid targets and will dramatically enhance the scope of measurements of excited-state lifetimes and thus transition probabilities achievable in exotic nuclei. Coupled to state-of-the-art gamma-ray tracking detectors such as AGATA, this novel instrument will overcome the present challenges of lifetimes measurements with low-intensity beams of unstable nuclei. In this talk, I will present an overview of the LISA project and show the potential for future physics experiments at FAIR.