HK 72: Poster

Time: Thursday 17:15–18:45 Location: HBR 14: Foyer

HK 72.1 Thu 17:15 HBR 14: Foyer

Deep-learning for 3D Photon Interaction Position Reconstruction in Monolithic Scintillation Detectors — •Beatrice Villata, Maria Kawula, and Peter G. Thirolf — Department of Medical Physics, Ludwig-Maximilians-Universität München, Germany

Accurate spatial localization of the photons is important for high-resolution medical imaging in PET systems or prompt-gamma Compton cameras. Monolithic scintillation $LaBr_3$ or $CeBr_3$ detectors offer excellent energy and time resolution and can register the light distribution when read out with position-sensitive photosensors. This work presents a supervised deep-learning algorithm to reconstruct the 2D irradiation position on a monolithic crystal, by stacking convolutional layers and creating a CNN. The training dataset includes images of the light patterns acquired by irradiating the detector with a collimated photon source. Addressing the challenge of the depth of interaction (DOI), an additional unsupervised deep-learning algorithm is presented. This architecture combines the data-driven approach of deep learning with the mathematical modeling of the setup, implemented by parameterizing the signal's evolution in the detector. The unsupervised approach is convenient because the current dataset does not contain information about the ground truth along the third dimension. This architecture would allow the reconstruction without the need to perform a Monte Carlo simulation or an additional irradiation of the setup to obtain a training dataset. Combining these approaches offers a promising approach to achieving precise 3D interaction position information in monolithic crystals.

HK 72.2 Thu 17:15 HBR 14: Foyer

Investigation of the Scissors Mode of ^{76}Ge — •M. Heumüller, V. Werner, S. Bassauer, T. Beck, M. Berger, M. Beuschlein, I. Brandherm, K. E. Ide, J. Isaak, R. Kern, J. Kleemann, O. Papst, N. Pietralla, P. Ries, G. Steinhilber, M. Stoyanova, and R. Zidarova — IKP, TU Darmstadt

^{76}Ge is the baseline isotope for experiments searching for neutrinoless double-beta decay. Nuclear structure input is needed to constrain $0\nu\beta\beta$-matrix elements calculated from nuclear theory. We aim for constraining in particular isovector degrees of freedom by the observation of the nuclear scissors mode, following previous experiments employing the method of nuclear resonance fluorescence (NRF) [1,2]. A bremsstrahlung measurement with an endpoint energy of 5.5 MeV was performed for minimizing systematic uncertainties, like the feeding effect, for cross section measurements below 5 MeV, the energy region of the low lying scissors mode. The photons were provided by the superconducting electron accelerator S-DALINAC, impinging on the enriched target in the Darmstadt High Intensity Photon Setup (DHIPS) surrounded by three HPGe detectors for γ-ray detection. A comparison of the experimentally determined collective transition strength of the scissors mode to its systematics [3] will be shown.

This work was supported by the DFG under grant numbers SFB 1245, Project-ID 279384907, and GRK 2891, Project-ID 499256822.

[1]A. Jung *et al.*, Nucl. Phys. A **584**, 103-132 (1995)
[2]R. Schwengner *et al.*, Phys. Rev. C **105**, 024303 (2022)
[3]N. Pietralla *et al.*, Phys. Rev. C **58**, 184 (1998)

HK 72.3 Thu 17:15 HBR 14: Foyer

HPGe-BGO Pair Spectrometer for ELI-NP — •Ilja Homm — Technische Universität Darmstadt, Germany

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

The 8 HPGe CLOVER detectors of ELIADE are important instruments for the γ-spectroscopic study of photonuclear reactions. We investigate the possibility to operate an advanced version of an anti-Compton shield (AC shield) as escape γ-rays pair spectrometer for one of the ELIADE CLOVERS. This should improve the performance at high energies where the pair production process dominates. The BGO shield operated as a stand-alone device can also be used as γ-beam intensity monitor and to investigate the cross section for pair production near the threshold. A prototype pair spectrometer, consisting of 64 BGO crystals with SiPM (silicon photomultiplier) readout, has been designed and built. Two test measurements with high energy photons have been performed at the University of Cologne and at the ILL in Grenoble. Results are going to be presented.

This work is supported by the German BMBF (05P15RDENA, 05P21RDFN2) and the LOEWE-Forschungsschwerpunkt "Nukleare Photonik".

HK 72.4 Thu 17:15 HBR 14: Foyer

Study of the dipole response of ^{242}Pu with nuclear resonance fluorescence — •M. Beuschlein[1], J. Birkhan[1], J. Kleemann[1], O. Papst[1], N. Pietralla[1], R. Schwengner[2], S. Weiss[2], V. Werner[1], U. Ahmed[1], T. Beck[1,3], I. Brandherm[1], A. Gupta[1], J. Hauf[1], K. E. Ide[1], P. Koseoglou[1], H. Mayr[1], C. M. Nickel[1], K. Prifti[1], M. Singer[1], T. Stetz[1], and R. Zidarova[1] — [1]IKP, TU Darmstadt, Germany — [2]HZDR, Dresden, Germany — [3]FRIB, East Lansing, MI, USA

Nuclear structure data of transuranium actinides play an important role in understanding the stellar nucleosynthesis. However, available information on photonuclear reactions is sparse. A first nuclear resonance fluorescence (NRF) experiment on the nucleus ^{242}Pu was conducted under various safety precautions at the Darmstadt High-Intensity Photon Setup to probe its low-energy dipole response. The superconducting linear electron accelerator S-DALINAC at TU Darmstadt produced bremsstrahlung up to 3.7 MeV to irradiate a sample of PuO_2 with a total mass of about 1 g. Measured NRF γ rays reveal evidence for dipole-excited states with intrinsic projection quantum numbers $K = 0$ and $K = 1$. The latter indicates a potential fragment of the scissors mode, a collective low-energy $M1$ excitation of deformed nuclei. The isotope ^{242}Pu is now the heaviest nuclide for which NRF information is available. Details of the experiment, γ-ray spectra, and preliminary results will be presented.

This work is supported by the LOEWE project 'Nukleare Photonik' by the State of Hesse and by the DFG under grant No. GRK 2891.

HK 72.5 Thu 17:15 HBR 14: Foyer

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

Since photons transfer only small angular momenta, (γ, γ') experiments are an established method to investigate the properties of the low-lying dipole strength of atomic nuclei [1]. To improve the understanding of the underlying dipole excitation modes, systematic studies of isotonic and isotopic chains are crucial. The nickel (Z = 28) isotopic chain is well suited for this purpose as it consists of four stable even-even isotopes covering a large range of N/Z ratios. Since ^{58,60,64}Ni have already been measured in (γ, γ') experiments, the dipole response of ^{62}Ni is one missing link to complete the systematics [2-5]. Thus, a (γ, γ') experiment using energetically-continuous bremsstrahlung with a maximal photon energy of $E_{\max} = 8.7$ MeV was performed at the γELBE facility at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) [6]. First results of this experiment will be presented.

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

[1] A. Zilges *et al.*, Prog. Part. Nucl. Phys. **122** (2022) 103903.
[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, submitted to Phys. Rev. C.
[6] R. Schwengner *et al.*, Nucl. Instr. and Meth. A **555** (2005) 211.

HK 72.6 Thu 17:15 HBR 14: Foyer

Activation experiment for cross-section measurements of proton-induced reactions around A=110 — •Benedikt Machliner, Felix Heim, Martin Müller, Svenja Wilden, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

Understanding the nucleosynthesis of stable isotopes on the proton-rich side of the valley of stability, the so called p-nuclei, is still subject of current reasearch. Most reactions relevant for the p-process take place far away from the valley of stability, hence theoretical calculations for cross sections and reaction rates are crucial. To adjust and verify theoretical models a wide database of experimental results is needed [1]. In the context of p-nuclei the region around A=110 is particularly interesting as it contains seven p-nuclei (^{102}Pd, ^{106}Cd, ^{108}Cd, ^{113}In, ^{112}Sn, ^{114}Sn and ^{115}Sn). In order to extend the experimental database in this mass region the activation method is well suited. Using the University of Cologne's 10 MV FN Tandem accelerator and the Cologne Clover Counting setup [2] proton-induced reactions on four cadmium isotopes, on ^{102}Pd, and ^{116}Sn were performed at astrophysically relevant energies, respectively. The cross section results will be presented and a method of analyzing reactions applicable to nuclei hindered by long-lasting metastable states in the reaction product will be introduced.

Supported by the DFG (ZI 510/8-2)

[1] M. Arnould and S. Goriely, *Phys. Rep.* **384**, 1 (2003).
[2] F. Heim *et al.*, Nucl. Instrum. Methods A **966** (2020) 163854.

HK 72.7 Thu 17:15 HBR 14: Foyer

Investigation of dipole excitations in ^{50}Ti by using the (d, pγ) reaction — •Jonathan Braumann, Markus Müllenmeister, Michael Weinert, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, Germany

The electric dipole strength around and below the neutron separation energy is known as Pygmy Dipole Resonance (PDR). Its exact emergence is still a part of research [1]. In recent years, there has been an increasing focus on investigating the PDR. Neutron transfer experiments have been established as a tool to investigate the single-particle nature of the PDR [2,3]. ^{50}Ti served as an initial start for studying the titanium isotope series, via using the $(d, p\gamma)$ reaction on ^{49}Ti. ^{50}Ti may provide further insights of the emergence of the PDR in lighter nuclei. A total of 61 states were successfully identified. Through the integration of Nuclear Resonance Fluorescence (NRF) experiments, spin and parity assignments were possible for 28 states. By comparing the excitation strength one gathered information about the single particle character of the identified $J = 1$ states. Furthermore, the experiment indicated the observation of spin-flip resonances at higher energies. Supported by the DFG (ZI 510/10-1).

[1] A. Bracco *et al.*, Prog. Part. Nucl. Phys. **106** (2019) 360
[2] M. Spieker *et al.*, Phys. Rev. Lett. **108** (2023) 014311
[3] M. Weinert *et al.*, Phys. Rev. Lett. **127** (2021) 242501

HK 72.8 Thu 17:15 HBR 14: Foyer

Development of a Compton camera prototype using monolithic and pixelated scintillators with segmented SiPM readout for medical imaging — •Sultan Alzahrani[1,2], Beatrice Villata[1], and Peter Thirolf[1] — [1]Department of Medical Physics, Ludwig-Maximilians-Universitat München, Germany — [2]Department of Physics and Astronomy, KSU, Riyadh, Saudi Arabia

The growing interest in particle beam therapy for cancer treatment is driven by the ability to provide high-precision dose delivery. However, this benefit demands a high accuracy of the determination of the well-localized dose deposition (Bragg peak), which has to be located within the tumour volume. Different methods of beam range monitoring are assessed globally. The Compton camera is a promising γ-ray detector that operates in a wide energy range. Compton scattering kinematics, utilized to determine the energy and origin of γ-rays from the irradiated volume without the need for a mechanical collimator, is the basis of Compton imaging. The objective of our project is to develop and implement an imaging system that uses a Compton camera, consisting of monolithic (CeBr3) and pixelated (GAGG or CeBr3) scintillators as scatterer and absorber, read out by segmented SiPM arrays. In order to facilitate the system to be used for clinical application, the signal readout and processing complexity could be reduced by a scalable DAQ electronics. The status of this project including different detector and readout configurations of a Compton camera prototype, associated imaging algorithms, improvement scopes, and their prospective features will be presented.

HK 72.9 Thu 17:15 HBR 14: Foyer

Characterization of Graphenic Carbon (GC) foils for heavy ion accelerator applications — •Konstantina Botsiou[1,3], Timo Dickel[1,2], Joachim Enders[1,3], Emma Haettner[1], Sivaji Purushothaman[1], Christoph Scheidenberger[1,2], and Marilena Tomut[1,4] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [2]Justus-Liebig-Universität, Gießen, Germany — [3]Institute for Nuclear Physics, Technische Universität Darmstadt, Darmstadt, Germany — [4]Institut for Materialphysik, University of Münster, Münster, Germany

Vacuum windows, essential in high-intensity electron accelerators, separate different vacuum areas or the beam vacuum from the atmosphere. GC, with its low atomic number and excellent thermo-mechanical properties, is ideal for such windows and stripper foils in ion beams. The general goal is to balance different material properties: windows and strippers need to withstand a high thermal load and intense radiation damage. A low material budget is desirable (to minimize energy losses and longituninal and transverse emittance growth) and long lifetimes are required. In addition, accurate knowledge of the area density of the GC material is essential for its application. Ketek GmbH, Munich, has developed GC windows with diameter of 7.5 mm and thickness of 1 μm, which can withstand 2 bar of pressure. These windows used as vacuum windows for X-ray detectors and tested for heavy ion applications. We use GC foils as test material for heavy ion applications. Using high-resolution alpha spectroscopy and theorical models we estimate the area density.

HK 72.10 Thu 17:15 HBR 14: Foyer

Development of Low-Budget and Compact Radition Monitoring Systems for Integration into Satellites and Stratospheric Balloons — •Nico Krug, Roman Bergert, Luisa Wennemann, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physics Institute Justus-Liebig-University Giessen

A cost-effective microdosimeter concept designed for integration into AmbaSat Ltd's open-community femto-satellite platform and its incorporation into the ongoing development of a stratospheric balloon experiment will be presented, aligning with the principles of NewSpace.

The microdosimeter and the Strato project, a row of stratospheric balloon experiments, rely on commercial off-the-shelf components. The Strato project features a custom Printed Circuit Board (PCB) based on a Raspberry Pi Zero readout, additionally including the MuonPi detector developed in-house along with commercial environmental sensors communicating over a generic I2C interface. The board is being developed for integration into the CubeSat-project "StratoSat". The concept design will be showcased with communication pathways based on LoRaWAN.

The poster will delve into the performance of this integrated system within the challenging conditions of free space. Rigorous stress tests have been conducted, offering a comprehensive performance mapping of various components in terms of their physical and electrical properties.

HK 72.11 Thu 17:15 HBR 14: Foyer

Test of a Novel Neutron Detector Prototype Using ^{10}B enriched BNNT — •Kim Tabea Giebenhain, Kai-Thomas Brinkmann, and Hans-Georg Zaunick — Justus-Liebig-Universität, Gießen, Germany

BNNT (Boron Nitride Nanotubes) is a material with excellent mechanical and thermal qualities. Enriched with the isotope ^{10}B, which has a high neutron cross section for thermal neutrons, it makes for a versatile and promising material for neutron detection. An enriched BNNT mat coupled to an inorganic GaGG scintillator, read out by a SiPM array or a PMT respectively, supplemented by a plastic scintillator-based detector prototype for fast neutrons, have been tested at the Marburg Ion beam therapy facility (MIT) and the COSY facility in Jülich for their neutron detection abilites.

HK 72.12 Thu 17:15 HBR 14: Foyer

Recent Progress of Front-End and Readout Electronics Assembly and Prototype Tests for the PANDA Barrel EMC* — •Aniko Tim Falk, Kai-Thomas Brinkmann, and Hans-Georg Zaunick for the PANDA-Collaboration — II. Physics Institute, Justus-Liebig-University, Gießen

The barrel part of the electromagnetic calorimeter EMC in the PANDA experiment at the future FAIR accelerator facility will provide an excellent photon energy resolution over a wide dynamic range. In order to achieve this, the individual parts of the calorimeter, in particular the readout and front-end electronics, have to run with operating and calibration parameters of utmost precision. This fact makes a vast variety of functional tests and calibration runs for determining the optimal setup indispensable. The currently running prototype setup as well as the results of beamtimes and laboratory tests over the last two years will be presented in this contribution. *supported by the BMBF, GSI and HFHF.

HK 72.13 Thu 17:15 HBR 14: Foyer

Readout Electronics for the Micro Vertex Detector of the PANDA Experiment — •Marvin Peter[1], Nils Tröll[1], Kai-Thomas Brinkmann[1], Hans-Georg Zaunick[1], Daniela Calvo[2], Fabio Cossio[2], Giovanni Mazza[2], Francesca Lenta[2], Michele Caselle[3], Tobias Stockmanns[4], Lukáš Tomášek[5], and Pavel Staněk[5] for the PANDA-Collaboration — [1]2. Physik, JLU Gießen — [2]INFN Torino — [3]KIT Karlsruhe — [4]FZ Jülich — [5]CTU Prague

The Micro Vertex Detector (MVD) is the tracking detector in the center of the PANDA experiment, closest to the interaction point. To read out the strip sensors of the MVD, the Torino Amplifier for silicon Strip detectors (ToASt) was developed by INFN in Turin. The ToASt ASIC is a self-triggering amplifier and time-over-threshold (ToT) digitizer. It meets the requirements imposed by the PANDA experiment where a free-running detector system is one of the key features. The Module Data Concentrator (MDC), which is planned to communicate with multiple ToASt chips, is currently under development at KIT. This poster shows an overview of the features and current status of the readout electronics for the MVD. *Funded by BMBF.

HK 72.14 Thu 17:15 HBR 14: Foyer

Prefilter methods in dielectron measurements in pp collisions at $\sqrt{s} = 13.6$ TeV at ALICE in Run 3 — •Davud Sokolovic — Goethe Universität Frankfurt

Thermal radiation in form of e^+e^- pairs carry undistorted information about the properties of the quark-gluon plasma (QGP) produced in heavy-ion collisions. However, the separation of dielectrons emitted by the QGP and the other sources is a highly non-trivial task. Therefore dielectron measurements in pp collisions, where no medium effects are expected in first order, serve as reference. Here, the main sources of e^+e^- pairs at low invariant mass are light- and heavy-flavour hadron decays, as well as background from real photon conversions in the detector material. In particular, electrons from π^0-Dalitz decays and real photon conversions contribute to the combinatorial background up to a relatively large mass and reduce the signal-to-background ratio and significance of the measurements.

In this poster, we will explain how the contribution from electrons from π^0-Dalitz decays and real photon conversion can be suppressed in the electron candidate sample with prefilter methods. Such techniques will be applied and optimised in the analysis of the ALICE pp data at 13.6 TeV recorded in 2022. The improvement will be quantified in terms of significance and signal-to-background ratio.

HK 72.15 Thu 17:15 HBR 14: Foyer

Development of a Tracking Detector for Charged Particles Based on Scintillating Fibers — •Lara Dippel, Hans-Georg Zaunick, and Kai-Thomas Brinkmann — II. Physikalisches Institut, Justus-Liebig-Universität Giessen

The primary motivation of this work was to develop a detector which produces a fast and precise time signal for time-of-flight measurements performed at the Marburger Ion Beam Therapy Center (MIT), where the beam intensity can reach up to 1.9×10^9 particles/s. For a first prototype, eight plastic scintillating fibers with a diameter of 1 mm were chosen as the detection material and individually read out by SiPMs. Different fiber coatings were tested and compared to maximize the light yield of the fibers. After a first in-beam test at the MIT, a new mechanical setup and signal-processing chain were developed and tested again at the MIT and the Cooler Synchrotron (COSY) in Juelich. The latest setup consists of two layers with 16 fibers each and was employed as a fast trigger and veto detector for neutron detection and particle identification, as well as a two-dimensional tracking detector. For the next iteration of this detector system, the readout chain will be improved to primarily enhance the spatial resolution which will be compared with the tracking detectors currently in use at the MIT facility. Supported by BMBF via the High-D consortium.

HK 72.16 Thu 17:15 HBR 14: Foyer

Onboard Particle Trigger and Data Compression for the AFIS Satellite Mission — •Peter Hinderberger[1], Liesa Eckert[1], Martin J. Losekamm[1], Luise Meyer-Hetling[1], Stephan Paul[1], Thomas Pöschl[2], and Sebastian Rückerl[3] — [1]School of Natural Sciences, Technical University of Munich, Garching, Germany — [2]CERN, Geneva, Switzerland — [3]School of Engineering and Design, Technical University of Munich, Ottobrunn, Germany

The Earth's magnetic field traps charged particles in the Van Allen radiation belts. To measure their antiproton flux at energies between 25 and 100+ MeV, we currently develop AFIS (Antiproton Flux in Space) using scintillating plastic fibers and silicon photomultipliers (SiPMs). The compact satellite platform that we intend to employ poses restrictions with respect to power, volume, and transmission bandwidth. In addition, a low signal-to-background ratio and the expected high event rates make data processing challenging. We are developing a hardware and software framework based on a pure field-programmable gate array (FPGA) that can acquire sensor data efficiently and implements a multi-stage particle trigger, exploiting the FPGA's advantages in low-power parallel computation. A compression stage in addition reduces the amount of data that needs to be transmitted to ground significantly. We present the current state of development, compression approaches, and future plans of this framework. Our work is funded by the German Research Foundation (DFG, project number 414049180) and under Germany's Excellence Strategy - EXC2094 - 390783311.

HK 72.17 Thu 17:15 HBR 14: Foyer

Experimental setup for the investigation of the internal conversion lifetime of ^{229m}Th in a solid state environment using VUV sensitive SiPMs — •Daniel Moritz[1], Lilli Löbell[1], Georg Holthoff[1], Mahmood Hussain[1], Tamila Rozibakieva[1], Kevin Scharl[1], Benedict Seiferle[1], Markus Wiesinger[1], Lars von der Wense[2], and Peter G. Thirolf[1] — [1]Ludwig Maximilians Universität München — [2]Johannes Gutenberg Universität Mainz

With its exceptionally low energy of the isomeric first excited nuclear state (8.334±0.024 eV), ^{229m}Th is in the focus of current research as the presently only suitable candidate to be used as the basis for building a nuclear clock. One of the isomer's properties investigated is the lifetime of neutral ^{229m}Th atoms for which the decay from the isomer to the ground state is dominated by the internal conversion (IC) decay channel. So far, the internal conversion lifetime has only been measured on metallic surfaces and first hints on its dependence on the electronic environment of ^{229m}Th have been obtained. Given that their entrance window dead layer is thin enough, VUV sensitive silicon photo multipliers (VUV SiPMs) provide the opportunity of implanting ^{229m}Th atoms into their depletion region where IC electrons can be detected, thus offering a possible way to investigate the IC lifetime within a solid state environment. To assure sufficient thickness, the dead layers of the VUV SiPMs need to be further reduced by etching. This poster presents the experimental setup at LMU as well as the corresponding etching treatments. This work was supported by the ERC Synergy Grant "ThoriumNuclearClock".

HK 72.18 Thu 17:15 HBR 14: Foyer

An input-output study with diffractive-production pseudodata for testing of a partial-wave analysis program — •David Spülbeck, Sumin Alff-Kim, Max Hariegel, Henri Pekeler, Mathias Wagner, and Bernhard Ketzer — Universität Bonn, Helmholtz-Institut für Strahlen- und Kernphysik Universität Bonn

Studying the excitation spectra of hadrons is crutial for gaining a better understanding of the strong interaction in the non-perturbative regime. In order to extract the quantum numbers, resonance parameters, and couplings of bound states formed in a reaction from the angular distributions of the decay products in the final state, a partial-wave analysis is usually performed.

It is important to test the implementation of the complex algorithm. One possible way is an input-output study, which proceeds in the following way: (i) generate pseudo-data from a physics model for a given reaction; (ii) perform a partial-wave analysis on the pseuda-data and compare the result to the input parameters. In the case presented in the poster, we apply this procedure to COMPASS-like diffractive reactions of the kind $\pi^- + p \to X^-(\to \pi^-\pi^+\pi^-\eta) + p$, with X^- as intermediate resonances. The study helps to debug the implementation, but also allows for further systematic studies by changing the fit model, including background processes, etc.

Supported by BMBF.

HK 72.19 Thu 17:15 HBR 14: Foyer

Implementation of a new ASIC-based data acquisition setup for the C-REX detector array — •Steffen Meyer[1], Corinna Henrich[1], Thorsten Kröll[1], Han-Bum Rhee[1], Roman Gernhäuser[2], and Sergei Golenev[2] — [1]TU Darmstadt — [2]TU Munich

The C-/T-REX Si detector array used for Coulomb excitation and transfer reaction experiments at the HIE-ISOLDE facility (CERN) faces limitations due to noise caused by cabling and grounding. To overcome these problems, a new data acquisition is tested. It is based on a new data acquisition that has been developed for the new HI-

TREX transfer setup [1]. The HI-TREX setup uses a FPGA-based GEAR platform to read out data from SKIROC2 ASICs. These ASICs make it possible to minimize and eliminate sources of noise, as they are able to pre-amplify, shape and digitize the data on-chip. In order to use this new data acquisition with the existing Si detectors of C-REX, the system was adapted and new components were designed.

The current state of implementation is presented.

This work is supported by the German BMBF under contract 05P21RDCI2.

[1] C. Berner et al., Nuclear Inst. and Methods in Physics Research, A 987 (2021) 164827

HK 72.20 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,2,3], David R. Pineiro[2], Tobias Rimke[1], and Malte Wilfert[1] — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Helmholtz Institute Mainz, Germany — [3]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain and a long measurement time are needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.21 Thu 17:15 HBR 14: Foyer

Determining the reaction volume with CBM — •Beatriz Artur for the CBM-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The main goal of the Compressed Baryonic Matter (CBM) Experiment at FAIR is to probe the QCD phase diagram at high net-baryon densities and moderate temperatures with nucleus-nucleus collisions, in order to locate the possible first order phase transition from hadronic to partonic matter and its critical end point (CEP). The higher moments (cumulants) of conserved quantities, such as baryon number, strangeness and electrical charge, are suggested to be sensitive to the proximity of the CEP. In order to assess the behavior of these cumulants, it is crucial to determine the reaction volume. Different procedures for centrality selection, based on participant multiplicity with the STS detector or on spectator multiplicity with the new FSD detector, allow us to study reaction volume fluctuations and their impact on net-baryon cumulants. In this work, we explore these different procedures using different hadronic transport models, such as SMASH and PHQMD.

This work has been supported by DFG-grant BL 982/4-1.

HK 72.22 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Université Paris-Saclay, Saclay, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.23 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.24 Thu 17:15 HBR 14: Foyer

Collective flow measurements with HADES in Ag+Ag collisions at 1.58 AGeV — •Christopher Grimm — Goethe-Universität, Frankfurt am Main

HADES provides a large acceptance combined with a high mass-resolution and therefore allows to study dielectron, hadron and light nuclei production in heavy-ion collisions with unprecedented precision. High statistics measurements of flow coefficients for protons and light nuclei, including ^{3}He and tritons in Ag+Ag collisions at 1.58 AGeV are presented here. The directed (v_1) and elliptic (v_2) flow components are investigated. All flow coefficients are studied multi-differentially for different centrality classes over a large region of phase space, i.e. as a function of transverse momentum p_t and rapidity. We will discuss the scaling properties of the various flow harmonics, which possibly provides information on the production processes of light nuclei, e.g. via coalescence, and puts constraints on the properties of dense matter, such as its viscosity and equation-of-state (EOS).

HK 72.25 Thu 17:15 HBR 14: Foyer

The motorised orifice system for the $\overline{\text{P}}$ANDA Beam Dump: programming and implementation of a control software in a local EPICS Slow Control System — •Liridon Deda, Daniel Bonaventura, Philipp Brand, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

The planned $\overline{\text{P}}$ANDA experiment at the future HESR ring will be vital for investigating the mysteries of hadron physics at FAIR in Darmstadt. A high target thickness of more than 10^{15} atoms/cm^2 will be crucial for the $\overline{\text{p}}-\text{p}$ interation studies at $\overline{\text{P}}$ANDA. The cluster-jet target system for the $\overline{\text{P}}$ANDA experiment, already achieved these required target thickness in $\overline{\text{P}}$ANDA geometry, i.e. in a distance of more than 2 m from the jet nozzle. Providing such a target thickness at the interaction point, requires to effectively remove the target beam after the interaction point via a beam dump. In order to mitigate any gas backflow, a multi-stage beam dump system with differential pumping has been implemented. Each stage comprises adjustable orifices, allowing for modification of the orifice width and position, in one direction. Additionally, the orifice control system and its implementation into the local EPICS slow control system is presented. Furthermore, the orifices are equipped with two motors each, controlled through a robust CAN-Bus communication system ensuring resistance against electrical disturbances and electromagnetic interference. The setup and its performance will be presented and discussed.

This project has received funding from BMBF (05P21PMFP1).

HK 72.26 Thu 17:15 HBR 14: Foyer

Quasi-real-time range Monitoring in hadron therapy using positron emitters of carbon and oxygen — •Sivaji Purushothaman for the BARB- and Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

A fast and reliable range monitoring method is required to fully exploit the high linear energy transfer (LET) provided by therapeutic ion beams such as carbon and oxygen while minimizing damage to healthy tissue due to range uncertainties. Quasi-real-time range monitoring, utilizing in-beam positron emission tomography (PET) with therapeutic beams of positron-emitters of carbon and oxygen, proves to be a promising approach. An experimental comparative study of therapeutically relevant positron emitters of carbon and oxygen within this context was performed at the fragment-separator facility (FRS) as part of the BARB (Biomedical Applications of Radioactive Beams) project at GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany. The experimental results and the figure of merit metric developed for the qualitative comparison of the studied isotopes will be presented.

This work is supported by European Research Council (ERC) Advanced Grant 883425 (BARB) to Marco Durante. The measurements were performed within the Super-FRS Experiment Collaboration (Experiment No. S533 by S. Purushothaman et al.) at GSI in the framework of the FAIR Phase-0 experimental program.

HK 72.27 Thu 17:15 HBR 14: Foyer

In-flight production and separation of positron emitters for hadron therapy — •Emma Haettner for the BARB- and Super-FRS Experiment-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The European project on Biomedical Applications of Radioactive Beams, BARB, was launched at GSI in 2021. It aims at pre-clinical validation of in-vivo beam visualization and ion-beam therapy with positron-emitting isotopes of carbon and oxygen. The positron emitters were produced, separated and identified with the Fragment separator FRS at GSI in a joint experimental effort of the the FRS and the biophysics groups at the GSI and Department of physics at LMU. In the first experiments different hadron therapy relevant positron emitters were investigated in terms of intensity, purity, energy, and energy spread. One branch of the FRS is connected to the bio-medical cave of the GSI. Here, we present the new ion-optical mode and commissioning results of the FRS-Cave M branch where positron emitting 15O-ions were provided to the medical cave for first time and also imaging results from experiments at the main branch of the FRS.

This work is supported by ERC Advanced Grant 883425 (BARB) to M. Durante. The measurements were performed within the Super-FRS Experiment Collaboration (Exp. No. S533 by S. Purushothaman et al.) in the framework of the FAIR Phase-0 experimental program.

HK 72.28 Thu 17:15 HBR 14: Foyer

Cooling of silicon photomultipliers for collinear laser spectroscopy using Peltier elements — •Aaron Flaig, Bernhard Maass, Wilfried Nörtershäuser, Julian Palmes, and Laura Renth — Institut für Kernphysik, TU Darmstadt, Germany

Collinear laser spectroscopy requires single photon detection with high efficiencies. Typically, photomultiplier tubes (PMTs) are used for this purpose. Compared to this classical approach, silicon photomultipliers (SiPMs) offer many benefits. Due to their small size and square layout they can be tiled closely together into a desired shape and they can be operated directly in a vacuum and in strong magnetic fields. At room temperature, SiPMs have a dark count rate which is too high for single photon detection, however, this can be overcome by cooling the SiPMs to very low ($<$ -40 °C) temperatures.

In order to reach such temperatures, the possibility of cooling SiPMs using Peltier elements in combination with a liquid cooling system is investigated. The performance of the new detection system for collinear laser spectroscopy is tested by performing spectroscopy on stable Strontium ions at the KOALA beamline at TU Darmstadt. The results are compared to measurements simultaneously performed with PMTs. Funded by BMBF, contract 05P21RDFN1.

HK 72.29 Thu 17:15 HBR 14: Foyer

Stimulated recovery for PWO-based electromagnetic calorimetry — •Pavel Orsich, Valery Dormenev, Hans-Georg Zaunick, and Kai-Thomas Brinkmann for the PANDA-Collaboration — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

Lead tungstate based calorimeters under ionizing radiation exhibit a degradation of optical transmittance and, as the result, deterioration of the energy resolution. Notably, this effect is more pronounced in calorimeters operating at low temperatures.

One technique to minimize the effect of radiation-induced damage of PWO crystals involves stimulated recovery. Stimulated recovery is achieved by illuminating the crystal with optical light of a specific wavelength. This approach enables rapid and effective in-situ restoration of the crystal's optical transmittance. Implementation occurs either during periods when the beam is inactive, using blue light, or in real-time during data acquisition using near-infrared light. Employing stimulated recovery has the potential to significantly prolong the operational period of PWO-based calorimeters, particularly those operating at low temperatures, by controlling radiation damage within acceptable levels.

This project is supported by BMBF and HFHF.

HK 72.30 Thu 17:15 HBR 14: Foyer

Towards a test of D3h symmetry in ^{12}C — •I. Jurosevic, J. Birkhan, I. Brandherm, B. Hessbacher, J. Isaak, N. Pietralla, T. Ramaker, M. Spall, and G. Steinhilber — Institut für Kernphysik, Technische Universität Darmstadt

Due to the pronounced cluster structure of ^{12}C it has been proposed that some of its excited states can be classified according to the D3h symmetry [1]. In particular, the electric ground state excitation strengths of different multipole orders should be related. We have contributed a precision measurement for the $E2$ strength of the 2_1^+ state by electron scattering at the S-DALINAC at low momentum transfer [2]. We aim, now, at a similar measurement of the form factors of the 3_1^- and 4_1^+ states of ^{12}C at low momentum transfer (0.3 $\mathrm{fm}^{-1} \leq q \leq 0.8\,\mathrm{fm}^{-1}$). The plans for our experiment will be presented.

*Project is supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under grant No. SFB 1245 - Project-ID 279384907.

[1] R. Bijker and F. Iachello, Prog. Part. Nucl. Phys. 110, 103735 (2020).
[2] A. D'Alessio *et al.*, Phys. Rev. C 102, 011302(R) (2020).

HK 72.31 Thu 17:15 HBR 14: Foyer

A simulation-based feasibility study of the measurement of K_L^0 in ALICE — •Laura Gans-Bartl for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The ALICE experiment is designed to study the characteristics of hot and dense nuclear matter created in heavy-ion collisions. The measurement of a large variety of identified particles can help to better understand the underlying physics processes at play, while particle production in proton proton (pp) collisions serves as a baseline for these measurements. The production of one of the eigenstates of the neutral Kaon, K_S^0, has been measured several times in pp collisions by the ALICE collaboration[1]. The K_L^0 has not been measured so far, as the measurement is more challenging due to its long flight time.

In this contribution, a simulation-based feasibility study of $K_L^0 \to \pi^+\pi^-\pi^0, \pi^0 \to \gamma\gamma$ in pp collisions with ALICE is presented. Charged pions can be measured with the main tracking detectors of the experiment, while neutral pions can be reconstructed from decay photons measured with eletromagnetic calorimeters. Based on a PYTHIA simulation, the influence of the efficiency and acceptence of the ALICE experiment is studied, and possibilities and limits of the measurement of K_L^0 are discussed.

Supported by BMBF and the Helmholtz Association.

[1] e.g. *Eur. Phys. J. C 81 (2021) 256*

HK 72.32 Thu 17:15 HBR 14: Foyer

Large-Scale XYZ Digital Microscope — •Konstantin Münning[1], Philip Hauer[1,2], Jan Paschek[1,2], and Bernhard Ketzer[1,2] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn, Germany — [2]Forschungs- und Technologie-Zentrum Detektorphysik, Universität Bonn, Germany

Modern particle physics experiments widely use Micro Pattern Gas

Detectors (MPGDs) for particle tracking and identification. The new Research and Technology Center for Detector Physics (FTD) in Bonn has recently commissioned infrastructure for production of micropatterned structures like Gas Electron Multipliers (GEMs). The performance of the MPGDs strongly depends on the physical properties of these structures. Therefore a rigorous Quality Assurance (QA) is imperative. Besides other in-house QA, a precise optical survey of the structures is performed. Recent large-scale MPGDs require large-size micropatterned structures that are not covered by commercially available digital microscopes. A new digital microscope with precise large-scale XYZ-positioning for cleanroom operation using standard technologies was developed to fill this gap and allow manual and automatic QA procedures.

The poster presents the specifications, the design and the present setup.

HK 72.33 Thu 17:15 HBR 14: Foyer

Lifetime measurements of excited states in ^{69}As — •Sven Wagner, Maximilian Droste, and Peter Reiter — Institut für Kernphysik, Universität zu Köln

Lifetime measurements in ^{69}As were motivated by the expected evolution of the shape of this nucleus, from oblate at low spin to triaxial prolate at intermediate spin [1]. Lifetimes and transition strengths values of excited states in ^{69}As are not well known yet and independent evaluated results are contradictory. Excited states were populated via the fusion evaporation reaction ^{40}Ca(^{32}S,3p)^{69}As at 100 MeV at the FN tandem accelerator at the University of Cologne. The Cologne plunger device, surrounded by an efficient γ-ray detector array comprising 18 HPGe detectors was employed to determine lifetimes with the recoil-distance Doppler-shift method using the differential decay-curve method in coincidence mode. First lifetime values, which deviate from previous results, will be presented.

[1] A. M. Bruce et al., Phys. Rev. C. 62, 027303 (2000)

HK 72.34 Thu 17:15 HBR 14: Foyer

Influence of the pixel mask on the EPICAL-2 calorimeter performance — •Dani Ateyeh — IKF Goethe Universität Frankfurt

The EPICAL-2 detector, a prototype for a digital pixel calorimeter, has been developed within the context of the proposed ALICE-FoCal detector. It consists of alternating layers of tungsten absorbers and silicon pixel sensors utilising the ALPIDE chip, designed for the ALICE-ITS upgrade, with two ALPIDE chips in each EPICAL-2 layer. Each ALPIDE chip consists of 1024×512 pixels with a size of approximately $30 \times 30\ \mu m^2$. The measurement of the energy of electromagnetic showers E with EPICAL-2 is based on counting charged shower particles via the number of pixel hits N_{hit} contrary to the direct measurement of deposited energy in conventional calorimeters.

Some pixels in the ALPIDE chips employed in the EPICAL-2 may be malfunctioning, either noisy or dead. To identify malfunctioning chips in the detector, criteria for a pixel masking procedure have been developed using experimental data acquired in test-beam measurements at DESY and at CERN-SPS. These pixels have been excluded from the analyses.

To investigate the influence of the malfunctioning pixels on the calorimeter performance, different scenarios of the amount of malfunctioning pixels have been investigated. In this poster, we present the influence of different masking schemes on the calorimeter performance with focus on the energy response and energy resolution.

Supported by BMBF and the Helmholtz Association

HK 72.35 Thu 17:15 HBR 14: Foyer

^{234}U($\vec{\gamma}$,f) photon-induced fission — •Vincent Wende[1], Dimiter Balabanski[2], Joachim Enders[1], Sean W. Finch[3], Alf Göök[4], Calvin R. Howell[3], Annabel Ibel[1], Ronald C. Malone[5], Maximilian Meier[1], Andreas Oberstedt[2], Stephan Oberstedt[6], Marius Peck[1], Norbert Pietralla[1], Jack A. Silano[5], Gerhart Steinhilber[1], Forrest Q. L. Friesen[3], Anthony P. D. Ramirez[5], Anton P. Tonchev[5], and Werner Tornow[3] — [1]Institut für Kernphysik, Fachbereich Physik, TU Darmstadt, Darmstadt, Germany — [2]ELI-NP, IFIN-HH, Magurele, Romania — [3]Triangle Universities Nuclear Laboratory, Duke University, Durham, NC, USA — [4]Uppsala Universitet, Uppsala, Sweden — [5]Lawrence Livermore National Laboratory, Livermore, CA, USA — [6]EC-JRC Geel, Belgium

High-precision data from photon-induced fission experiments provides strong motivation for developing a thorough description of the nuclear fission process. Mass, total kinetic energy and polar as well as azimuthal angular distributions of fission fragments can be simultaneously measured using a position-sensitive twin Frisch-grid ionization chamber. This contribution presents the current status of data analysis of a ^{234}U($\vec{\gamma}$,f) experimental run conducted at the High-Intensity γ-Ray Source (HIγS) facility using several quasi-monochromatic and nearly 100 % linearly polarized photon beams between 6.2 and 13 MeV.

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

HK 72.36 Thu 17:15 HBR 14: Foyer

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

The ^{83m}Kr conversion electrons are used for calibration purposes of different (astro-)particle physics experiments due to the narrow ^{83m}Kr line widths and short ^{83m}Kr half-life. In the KArlsruhe TRItium Neutrino experiment (KATRIN), that currently provides the best neutrino mass upper limit of 0.8 eV/c^2 (90% C. L.) in the field of direct neutrino-mass measurements, several systematic uncertainties are studied by a shape distortion of the quasi monoenergetic ^{83m}Kr spectrum. This creates high demands on precise knowledge of the undistorted spectrum.

In KATRIN we use the 32 keV N-lines lying in the high energy region of the spectrum including the weaker N_1 line. This poster summarizes the results of a dedicated measurement of the ^{83m}Kr electron N-spectrum with emphasis on N_1 line conducted at KATRIN experiment.

This work is supported by the Helmholtz Association, by the Ministry for Education and Research BMBF (05A23PMA, 05A23PX2, 05A23VK2, and 05A23WO6) and the Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology (KSETA)" through the GSSP program of the German Academic Exchange Service (DAAD).

HK 72.37 Thu 17:15 HBR 14: Foyer

First measurement of proton-deuteron and lambda-deuteron correlation function with data taken by ALICE in Run 3 — •Anton Riedel for the ALICE Germany-Collaboration — Technische Universität München, Garching, Deutschland

Femtoscopy is a powerful tool that uses correlation techniques to explore the details of how hadrons interact. In Run 2 of the LHC, the ALICE collaboration extended its femtoscopic studies to nuclei, investigating the correlation between protons and deuterons (p–d). The measurement hinted at the presence of significant three-body dynamics in the p–d system but was ultimately limited by the available statistics. As we transition into Run 3 of the LHC, where we have access to more data by two orders of magnitude, our goal is to conduct a more in-depth study of the p–d system. Additionally, we aim to take a preliminary look at the lambda-deuteron system (Λ–d). This poster presents the initial measurements of the correlation between protons and deuterons, as well as between lambdas and deuterons, using data collected by the ALICE experiment in pp collisions at $\sqrt{s}$=13.6 TeV during Run 3 of the LHC. This project has been funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.38 Thu 17:15 HBR 14: Foyer

The future of three-body interactions: femtoscopic p-p-p and p-p-Λ correlations in ALICE Run 3 — •Laura Serksnyte for the ALICE Germany-Collaboration — TUM

A satisfactory description of many-body systems, such as (hyper)nuclei or the core of neutron stars, demands a comprehensive understanding of two-body and three-body interactions. The latter are usually studied in traditional proton-deuteron scattering experiments or by measuring properties of (hyper)nuclei. The ALICE Collaboration recently proposed a novel way to access interactions in three-hadron systems by measuring the femtoscopic correlation functions in momentum space. Such an experimental approach provides a unique opportunity to study a 3→3 scattering process, including previously inaccessible systems, for example, three unbound protons (p-p-p) or a triplet including a Lambda hyperon (p-p-Λ). Such measurements performed in Run 2 by ALICE motivated the theorists to develop a framework calculating correlation functions with state-of-the-art description of the interactions. However, the available statistical sample in Run 2 is limited, and more data is needed to challenge theoretical models and to perform precision studies. In this poster, we present the preliminary measurements of p-p-p and p-p-Λ correlation functions in pp collisions at $\sqrt{s} = 13.6$ TeV measured by ALICE in the Run 3 data taking campaign which allowed for a sevenfold increase in statistics.

This research was funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and the BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.39 Thu 17:15 HBR 14: Foyer

Methods for three-particle correlation function analyses: from cumulants to full-fledged three-body calculations — •Raffaele Del Grande for the ALICE Germany-Collaboration — Technical University of Munich, Garching, Germany

In recent years the femtoscopy technique has been used by the ALICE Collaboration at the Large Hadron Collider (LHC) to perform new studies of the hadronic interactions. In pp and p–Pb collisions at the LHC particles are emitted at relative distances of about 1 fm and the final state interactions of the produced hadrons can be explored by measuring their correlation in the momentum space. The high statistics collected by ALICE during the LHC Run 2 data campaign allowed measuring for the first time the free scattering of three unbound hadrons, such as p–p–p, p–p–Λ, p–p–K^+ and p–p–K^-, providing new experimental information on the hadron dynamics in these three-body systems. The sensitivity to genuine three-body effects in the measured correlation functions has been studied using the cumulant analysis. This approach was used to show that in p–p–K^+ and p–p–K^- systems only pairwise interactions are present in the systems without strong evidence of genuine three-body effects. In the case of three-baryons, such as p–p–p and p–p–Λ, full-fledged three-body calculations are necessary to interpret the measurements. In this contribution, an overview of the results obtained by ALICE from the analysis of the LHC Run 2 data acquired in pp collisions at 13 TeV will be presented. Future plans will be also discussed. This research was funded by DFG SFB1258 and BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.40 Thu 17:15 HBR 14: Foyer

Conversion electron spectrometer with stacked Si pad detectors and Mini-Orange — •Han-Bum Rhee, Steffen Meyer, Corinna Henrich, Ilja Homm, Martin von Tresckow, and Thorsten Kröll — TU Darmstadt, Darmstadt, Germany

Spectroscopy of conversion electrons, in particular from E0 transitions, requires thick Si detectors. Often this is achieved by the use of Si(Li) detectors for which several mm thickness are available. We investigate the use of stacks of Si pad detectors of 1-1.5 mm thickness which are more convenient to operate. The Si detectors are read out by a digital DAQ.

We intend to use these stacks to refurbish an electron spectrometer including a Mini-Orange (MO) magnetic transport system [1]. The MO consists of a set of 6 orange-slide shaped permanent magnets. The provided magnetic field focuses the electrons on the detector surface. Our setup also allows to cool the silicon detector to further increase its resolution.

Potential experiments will address e.g. E0 transitions between shape coexisting nuclear states.

The status and preliminary results with a ^{207}Bi radioactive source are presented.

[1] D. Gassmann, Dissertation, LMU München, 2003

HK 72.41 Thu 17:15 HBR 14: Foyer

p-p-Λ correlation studies using scattering theory — •Dmytro Melnichenko — TUM Munich

Scattering theory is a primary tool used in quantum theory to determine cross-sections and asymptotic wave function behavior. In the case of three interacting hadrons, local three-body potentials can be treated perturbatively in the generalized Born series. In our work, first order Born approximation was used to treat available p-p-Λ interaction potentials and to calculate the corresponding three-body correlation function. We discuss our findings by inspecting the validity region of this approach and comparing it with numerical methods. Results are compared to the p-p-Λ correlation function measured by ALICE in pp collisions at 13 TeV. This research was funded by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.42 Thu 17:15 HBR 14: Foyer

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], •Rahima Krini[1], Frank Maas[1,3,4], Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The Mainz Energy recovering Superconducting Accelerator (MESA) is being built at the Institute for Nuclear Physics in Mainz. At MESA the P2 experiment is planned for a precision measurement of the weak mixing angle. The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is to measure the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics. Therefore an integrating measurement with the associated integrating data acquisition readout chain is needed. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is in development by collaborators of University of Manitoba. The latest prototype of a full differential integrating detector signal chain was built and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this conference.

HK 72.43 Thu 17:15 HBR 14: Foyer

Source Size Measurement in Jets — •Lars Jörgensen, Laura Fabbietti, and Maximilian Horst for the ALICE Germany-Collaboration — Technische Universität München

Antinuclei in cosmic rays could be an indicator for dark matter decay. In order to correctly interpret any future measurement of the flux of antinuclei in our galaxy, the formation mechanism of antinuclei must be understood. The coalescence model aims to describe the formation process on a microscopic level, assuming that nucleons close in phase space are likely to bind together. A powerful tool to test coalescence is the study of nuclear production in jets since their emission is highly collimated and therefore the coalescence condition is likely to be fulfilled. One key parameter in the coalescence model is the baryon emitting source size, which has never been measured in jets to date. The source size is extracted from the momentum correlation function of particle pairs using femtoscopy. In this contribution, perspectives on measurements of the source size in jets performing a femtoscopic analysis on p-p correlations using LHC Run 2 data are shown.

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

HK 72.44 Thu 17:15 HBR 14: Foyer

Investigations of the readout electronics of the P2 experiment — Sebastian Baunack[1], Maarten Bonekamp[2], Boris Gläser[1], Rahima Krini[1], Frank Maas[1,3,4], •Moran Neher[1], David R. Pineiro[3], Tobias Rimke[1] und Malte Wilfert[1] für die P2-Kollaboration — [1]Institute for Nuclear Physics, Mainz, Germany — [2]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France — [3]Helmholtz Institute Mainz, Germany — [4]PRISMA+ Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The superconducting electron accelerator MESA is currently being built in Mainz. At this facility, the P2 collaboration aims for a high-precision measurement of the weak mixing angle at low momentum transfer, serving as a test of the Standard Model with a sensitivity for new physics up to a mass scale of 50 TeV. In the experiment, spin-polarized electrons with changing helicity are scattered on a hydrogen target. The parity-violating asymmetry due to the weak interaction of the scattered electrons is measured using a Cherenkov detector ring.

The readout electronics is developed in collaboration with the University of Manitoba and needs to be understood and characterized. In this poster, the P2 experiment is introduced, test setups will be described, and the first results will be presented.

HK 72.45 Thu 17:15 HBR 14: Foyer

Indication of a p-ϕ bound state from a correlation function analysis — •Emma Chizzali — TUM, Munich, Germany

The existence of a nucleon-ϕ (N-ϕ) bound state has been subject of theoretical and experimental investigations for decades, as the interaction is poorly understood and only spin-averaged information is available. Studying the interaction among the constituents, which is characterized by the two spin channels 1/2 and 3/2, can give hints on the possible existence of such a state. Therefore, analyzing the two-particle correlation function between protons and ϕ mesons measured by ALICE provides an alternative approach to invariant mass spectra. By constraining the spin 3/2 p-ϕ interaction using newly available lattice calculations by the HAL QCD collaboration it is possible to infer on the interaction in the spin 1/2 for the first time, which is found to be sufficiently strong, to support a p-ϕ bound state. Funded by IMPRS EPP.

HK 72.46 Thu 17:15 HBR 14: Foyer

Status of the Fierz term analysis with PERKEO III — •Anna Schubert for the PERKEO III-Collaboration — Technical University of Munich, Garching, Germany

Measurements of the free neutron decay enable a variety of tests of the Standard Model of particle physics. Observables of the decay are, among others, the beta asymmetry A and the Fierz interference term b. From precision measurements of A the CKM matrix element V_{ud} may be determined, while a non-zero Fierz term b would signal the existence of scalar and tensor interactions beyond the Standard Model.

Determinations of these neutron decay parameters were pursued by the PERKEO III experiment by measurements of the electron and/or proton energy spectrum, during multiple runs at the ILL PF1b facility. For these measurements, we used a pulsed beam of cold neutrons to control major systematic effects. This beam is guided into the 2 m long decay volume of the experiment, in which some of the neutrons decay. The charged particles from the decay are guided by a magnetic field towards one of two scintillation detectors with PMT readout. With this measurement technique, PERKEO III delivers the currently most precise values for A and b with a polarized neutron beam.

We present experimental details of the 2019/2020 campaign to measure the electron spectrum from unpolarized neutrons to extract an improved limit for the Fierz interference term and the ongoing analysis, where we currently focus on the characterization of the readout electronics.

HK 72.47 Thu 17:15 HBR 14: Foyer

Lifetime measurement of neutron rich Xe isotopes applying Fast-Timing method — •Andi Messingschlager[1], Martin von Tresckow[1], Thorsten Kröll[1], Matthias Rudigier[1], Andrey Blazhev[2], Julia Fischer[2], Sorin Pascu[3], and Jonathan N. Wilson[4] for the nu-Ball2 N-SI-120-Collaboration — [1]TU Darmstadt — [2]U Cologne — [3]U Surrey — [4]IJCLab Orsay

^{140,142}Xe are neutron rich isotopes which lie in a region of emerging quadrupole collectivity [1,2]. The lifetimes of the excited states of ^{140,142}Xe are in the range of a few tens of picoseconds, making the Fast-Timing method suitable so that the resulting transition strength can be compared to predictions by theory. The isotopes of interest are produced through a fission reaction ^{238}U(n,f) during the nu-Ball2 campaign. The nu-Ball2 spectrometer comprises a detector array consisting of 24 HPGe Clover detectors and 20 $LaBr_3$(Ce) detectors from FATIMA, offering excellent energy and time resolution, respectively. The campaign was performed 2022 at IJCLab in Orsay, France. Preliminary results will be presented. Supported by BMBF under Verbundprojekt 05P2021 (ErUM-FSP T07) grant 05P21RDFN1 and ARIEL grant 847594.
[1] S. Ilieva et al., PRC 94, 034302 (2016).
[2] C. Henrich, Dissertation TU Darmstadt (2020)

HK 72.48 Thu 17:15 HBR 14: Foyer

Implementation of a MagneTOF detector into the COALA Beamline — •Leo Reissler, Kristian König, Wilfried Nörtershäuser, Patrick Müller, Julian Palmes, Julien Spahn, and Emily Burbach — TU Darmstadt

The COALA beamline at the institute for nuclear physics of TU Darmstadt is a facility for high precision collinear laser spectroscopy. Measurements are performed on singly and multiply charged ions produced in an electron beam ion source or a Penning ion source. In order to optimize the ion beam production, knowledge of the ion beam composition is crucial. This characterization of an unknown ion beam was achieved by a time of flight measurement. We therefore implemented a MagneTOF detector into the beamline which allows for high time resolution (<1 ns FWHM pulse width) and ion detection efficiency of up to 80%. Details on the technical integration in the beamline and first results will be presented.
This project is funded by BMBF under contract 05P21RDFN1.

HK 72.49 Thu 17:15 HBR 14: Foyer

Development of Machine Learning Algorithms to Optimise the Detection of Low-mass Dileptons — •Saket Sahu[1], Johan Messchendorp[2], and James Ritman[1,2,3] for the HADES-Collaboration — [1]Ruhr-Universität Bochum, Bochum, Germany — [2]GSI Helmholtzzentrumfür Schwerionenforschung GmbH, Darmstadt, Germany — [3]Forschungszentrum Jülich, Jülich, Germany

Radiative transitions and decays of hadrons provide valuable information on their electromagnetic structure. Particular, the usage of virtual photon (dileptons) is promising since it allows to extract observables, such as spin-density matrix elements (SDMEs), that are not accessible using real photons. The experimental challenges lie in the identification of (mostly) low-mass dilepton pairs and separating the physics channels of interest from bremsstrahlung and external conversion processes. The **H**igh **A**cceptance **Di**- **E**lectron **S**pectrometer (HADES) at GSI Darmstadt is designed for an excellent e^+/e^- reconstruction in hadronic reactions. The current reconstruction algorithm fails to efficiently identify dilepton pairs with very small opening angles. Convolutional Neural Networks (CNN) are known to show great performance in image analysis and thus can be used for ring reconstruction. This poster outlines the analysis strategy for the SDME extraction based on recently taken data in proton-proton collisions with HADES, with an outlook on the implementation of the CNN for the ring reconstruction.

HK 72.50 Thu 17:15 HBR 14: Foyer

Inelastic cross section of antinuclei in Run 3 with ALICE — •Rafael Manhart for the ALICE Germany-Collaboration — Technische Universität München

Low-energy cosmic-ray antinuclei are a promising probe for indirect detection of dark matter. Theoretical predictions foresee dark matter flux to be orders of magnitude higher than the background due to interactions of cosmic rays with the interstellar medium, at low kinetic energies ($E_{kin} \sim 1$ GeV). In order to interpret any future measurements correctly, it is important to study the inelastic cross section of antinuclei. Such inelastic cross section measurements have been carried out in the past using fixed target experiments. ALICE, thanks to its outstanding tracking and particle identification capabilities, has contributed to the measurements of the inelastic cross section of light antinuclei, namely of antideuterons, antitritons and anti^{3}He. In this contribution, results of the measurements carried out during the LHC Run 2 of the inelastic cross section of antimatter will be shown, together with prospects on similar measurements carried out with the improved statistics of the LHC Run 3 campaign.

Fundedf by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.51 Thu 17:15 HBR 14: Foyer

Exploring deuteron production with pion-deuteron femtoscopy — •Bhawani Singh — Technical University of Munich, James-Franck-Straße 1, 85748 Garching bei München

The ALICE Collaboration presents a new experimental approach to explore the interactions in three-hadron systems by analyzing femtoscopic correlation functions of deuteron-hadron pairs produced in high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV at the LHC. These measurements provide unique information on the aspects of strongly-coupled systems, such as the genuine three-particle interaction, the formation of light nuclei, and the search for exotic bound states. A microscopic understanding of (anti)nuclei production in hadron-hadron collisions is the subject of discussion for experimental and theoretical efforts in nuclear physics. This topic is also very relevant for astrophysics since the rare production of antinuclei in our Universe could be a doorway to discover new physics. The results presented in this poster are obtained by measuring the pion-deuteron (π–d) femtoscopic correlations. The observed π–d correlations are compared with theoretical predictions, employing scattering parameters from conventional experiments for $\pi^{\pm}$–d systems. A noticeable discrepancy arises when calculations only consider the strong interaction between the pion and deuteron. The signal due to the presence of strongly decaying resonances in $\pi^{\pm}$–d systems indicates a delayed (anti)deuteron formation compared to hadrons in hadron-hadron collisions. This research was funded by BmBf Verbundforschung (05P21WOCA1 ALICE)

HK 72.52 Thu 17:15 HBR 14: Foyer

First differential measurement of the femtoscopic source with data taken by ALICE in Run 3 — •Georgios Mantzaridis and Jaime Gonzalez Gonzalez for the ALICE Germany-Collaboration — TUM, Garching, Germany

Femtoscopy has proven itself as a precise tool to constrain the strong interaction between hadrons in previously inaccessible sectors. When the source of particles in a collision is known, it is possible to probe the interaction potential between two particles. Already during the Run2 datasample, a universal emitting source of hadrons in pp collisions has been identified and benchmarked by studying the correlations of the produced proton-proton (p-p) and proton-lambda (p-Λ) pairs. With this result as a foundation it was possible to probe the strong force between many different exotic pairs of hadrons like p-Ω, p-ϕ, and many more. With the newly available data from the LHC Run 3 and the upgraded ALICE detector, femtoscopic studies can now be performed with an even greater precision and even more exotic interactions can be experimentally constrained for the first time. In this poster, we present the measurement of the p-p and p-Λ correlation functions as well as the femtoscopy source differentially in mT and multiplicity in pp collisions at 13.6 TeV at the ALICE experiment at the LHC. This will be the starting point for the femtoscopy campaign with ALICE in Run 3.

This project has been funded by the DFG under Germany's Excellence Strategy - EXC2094 - 390783311 and by BMBF Verbundforschung (05P21WOCA1 ALICE).

HK 72.53 Thu 17:15 HBR 14: Foyer

Theoretical investigation of light transmittance in PWO crystals under radiation damage — •Ather Ahmad[1], Pavel Orsich[1], Hans-Georg Zaunick[1], Kai-Thomas Brinkmann[1], and Simone Sanna[2] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Gießen, Germany — [2]Institut für Theoretische Physik, Gießen, Germany

Fast response, high density and radiation hardness make lead tungstate ($PbWO_4$ or PWO) a well suited scintillator for calorimetry of electromagnetic radiation. Lead tungstate crystals are already used as working material in various experiments, e.g. CMS at LHC in CERN. Next-generation crystals (PWO-II) with improved properties were developed for the PANDA experiment at FAIR in Darmstadt. To reduce absorption of the scintillation light within the crystals, the lead tungstate is doped with Lanthanum and Yttrium. This results in a change of the electronic and optical properties. In order to assess the functionality of the calorimeter, we first need to analyse these electronic and optical properties of lead tungstate

Experimental measurements of light transmittance in PWO-II after irradiation with a Co-60 source were done in our working group. In this work we do theoretical calculations in the framework of density functional theory (DFT) to calculate the light transmittance in PWO-II with different defects implemented. These results can be compared to the experiment to obtain a better understanding of radiation induced damage.

This project is supported by HFHF and HGS-hire

HK 72.54 Thu 17:15 HBR 14: Foyer

Basic GEANT4 examples for the FRS Ion Catcher and SARAF — •Frederik Uhlemann[1], Heinrich Wilsenach[3,1], Timo Dickel[1,2], Israel Mardor[4,3], Erez Cohen[5], Wolfgang Plass[1,2], and Christoph Scheidenberger[1,2,6] — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany, — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany — [3]School of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel — [4]Soreq Nuclear Research Center, Yavne, Israel — [5]Physics department, Beer-Sheva, Israel — [6]Helmholtz Research Academy Hesse for FAIR (HFHF), GSI Helmholtz Center for Heavy Ion Research, Gießen, Germany

Due to the complex geometries and physical processes of particles travelling through matter, scientists created a general simulation toolkit called Geant4. This project aims to show three basic Geant4 examples. A simple simulation of a Passivated Implanted Planar Silicon detector was created, like it is used as a diagnostics tool for the FRS-IC. A beginner-friendly guide was also written and is provided on the project website. The second experiment shows how Geant4 can combine nuclear reaction cross-sections and interaction kinematics to calculate neutron induced reaction rates and escape probabilities from a thin foil at the SARONA instrument in SARAF [1]. The last example shows how to read complex tabulated data into Geant4 from other simulation programs. This poster will provide beginners a starting point in the program through the three example projects.

[1] I. Mador et al., Frontiers in Physics, 11, 2296-424X (2023)

HK 72.55 Thu 17:15 HBR 14: Foyer

Test of a spatially-resolving fluorescence detection region for collinear laser spectroscopy — •Pascal Gabel, Bernhard Maass, Patrick Müller, Laura Renth, and Wilfried Nörtershäuser — Institut für Kernphysik, TU Darmstadt, 64289 Darmstadt, Germany

Collinear laser spectroscopy is a well-established method to determine nuclear properties such as nuclear charge radii and nuclear electromagnetic moments. For the extraction of these properties from fluorescence spectra, effects that change the shape of the spectrum, such as photon recoils or optical population transfer between hyperfine structure states, need to be well understood.

We present a fluorescence detection region (FDR) comissioned at the collinear apparatus for laser spectroscopy and applied physics (COALA) at TU Darmstadt that allows us to probe the fluorescence spectrum at different positions inside the FDR. For this, measurements of the $5s\,{}^2\mathrm{S}_{1/2} \rightarrow 5p\,{}^2\mathrm{P}_{1/2}$ electronic transition in Sr^+ ions were performed. The spatial resolution of the FDR was tested in a separate offline test station. First results will be presented.

This work has been supported by BMBF under contract # 05P21RDFN1.

HK 72.56 Thu 17:15 HBR 14: Foyer

Implementing a low-cost THGEM detector for science outreach and education — •Oguz Alp Duran, Leonardo Bugia, and Berkin Ulukutlu — Technische Universität München, Munich, Germany

In the last fifty years, particle and nuclear physics have made significant progress due to advancements in detection technologies. Modern experiments use cutting-edge tools like MAPS or MPGD devices alongside traditional methods such as cloud chambers, which remain valuable in science education. A new cost-effective particle detector using PCB ThickGEMs is being developed, employing accessible components like Arduino and Raspberry Pi to track low-rate charged particles, such as those from cosmic sources. This contribution details the creation of a specialized readout board that interfaces the detector with an Arduino system. The board enables the measurement of a 10x10 cm2 area using 64 channels equipped with low-noise preamplifiers. It also discusses important design considerations for the detector chamber's mechanical structure, highlights performance limitations faced in this setup, and explores educational possibilities for the new detector. The research was funded by the DFG Sachmittel FA 898/5-1.

HK 72.57 Thu 17:15 HBR 14: Foyer

βPlast, a plastic scintillator for fast timing and decay spectroscopy — •Carole Chatel for the DESPEC-Collaboration — IKP, TU Darmstadt, Darmstadt, Germany — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — HFHF

Decay SPECtroscopy (DESPEC) setup investigates the properties of exotic nuclei at the FRagment Separator (FRS) at GSI and in the future at the Super-FRS at FAIR. It is composed of state-of-the-art detectors allowing fast-timing, high-precision or high-efficiency measurements. The core of the DESPEC setup comprises a stack of implantation detectors within a "snout", wherein exotic ions are implanted. It typically comprises one or more highly-segmented AIDA double-sided silicon strip detectors sandwiched by two β-plastique scintillators.

The βPlast detectors are of primary importance to provide excellent timing resolution for β particles emitted by the exotic ions of interest to enable gamma-gamma timing-measurements. They comprise rectangular monolithic plastic sheets with 1-dimensional arrays of Silicon PhotoMultipliers optically-coupled to the edges. The fast-timing characteristics of the detectors are exploited thanks to the use of TAMEX multi-channel TDCs developed in-house at GSI. The βPlast detectors have been operated during FAIR Phase-0 experiments in recent years in several configurations. This contribution provides information regarding technical details and detector characterisation, as well as recent work to improve detector performance and an outlook for future development work.

HK 72.58 Thu 17:15 HBR 14: Foyer

Properties of the Polyethylene Naphthalate (PEN) Organic Scintillation Material — •Valerii Dormenev[1], Kai-Thomas Brinkmann[1], Karl Eichhorn[2], Jan Friedrich[2], Dzmitry Kazlou[1], Martin J. Losekamm[2], and Hans-Georg Zaunick[1] — [1]2nd Physics Institute, Justus Liebig University, Giessen, Germany — [2]School of Natural Sciences, Technical University of Munich, Garching, Germany

Development of new or optimization of already widely used scintillation materials for high-energy physics applications has become a very important research activity during the last decade. There are presently several detector concepts in consideration that are based on organic scintillator material for fast timing of charged particles or sampling calorimeters. In recent years, the widely used organic material polyethylene naphthalate (poly(ethylene 2,6-naphthalate) or PEN) was discovered and intensively studied as a potential cost-effective plastic scintillator. We tested a set of PEN samples produced by injection molding in the framework of R&D towards the LEGEND project for the search of neutrinoless double beta decay. The material was evaluated through the measurement of changes of the optical transmittance under irradiation with ^{60}Co photons, light yield and scintillation kinetics parameters at different temperatures. The paper will report on the obtained results.

We acknowledge support by BMBF via the High-D consortium.

HK 72.59 Thu 17:15 HBR 14: Foyer

Significance of the number space $\mathbb{Q}$ and the coordinate system for energy ratios of elementary particles — •Helmut Christian Schmidt — LMU München

For energy relations, as in the GR, a system of 3 objects, each with 3 spatial coordinates (φ,r,θ) and the common time, is sufficient. The quantum information from these 10 independent parameters results in a polynomial $P(2)$. Each measurement consists of coincidences of revolutions $q\pi$ $q \in \mathbb{Q}$. A transformation into $P(2\pi)$ provides the energy ratios. $P(2\pi)$ is compatible with quantum theory and GR.

E.g. neutron:
$E_p = (2\pi)^4 + (2\pi)^3 + (2\pi)^2$
$E_e = -((2\pi)^1 + (2\pi)^0 + (2\pi)^{-1})$
$E_{measuring-device} = 2(2\pi)^{-2} + 2(2\pi)^{-4} - 2(2\pi)^{-6}$
Christoffel-Symbol
$E_{time} = 6(2\pi)^{-8}$
$m_{neutron}/m_e = E_p + E_e + E_{measurement} + E_{time} = 1838.6836611$
$measured: 1838.68366173(89) m_e$
Neutrinos correspond to $\nu_\tau = \pi$, $\nu_\mu = 1$, $\nu_e = \pi^{-1}$.
$hG_N c^5 s^8/m^{10}\sqrt{\pi^4 - \pi^2 - \pi^{-1} - \pi^{-3}} = 0,999991$

A photon is made up of neutrinos and can be viewed as two entangled electrons e^- and e^+. The charge results in an energy ratio E_C.
$E_C = -\pi^1 + 2\pi^{-1} + \pi^{-3} - 2\pi^{-5} + \pi^{-7} - \pi^{-9} + \pi^{-12}$
$m_{proton} = m_{neutron} + E_C m_e = 1836.15267363\ m_e$

An approach to an algorithm for calculating the muon and tauon mass is presented.

HK 72.60 Thu 17:15 HBR 14: Foyer

Recent measurements and developments at ISOLTRAP — •Paul Florian Giesel for the ISOLTRAP-Collaboration — Universität Greifswald, Institute of Physics, Germany

Isoltrap [1] is a multi ion-trap mass spectrometer located at ISOLDE/CERN dedicated to high-precision mass measurements of artificially produced, short-lived, exotic radionuclides far from stability. The experiment employs multi-reflection time-of-flight and Penning-trap mass spectrometry for absolute and relative mass measurements. By using Einstein's famous formula $E = mc^2$, a measured mass can be translated into a binding energy. This binding energy reflects all underlying interactions in the nucleus and allows the study of nuclear structure and nuclear astrophysics, the weak interaction and other fundamental physics applications. The current status of the experimental setup and recent technical developments will be presented as well as the results of the most recent beamtime periods. These include the neutron deficient ^{97,98}Cd ground states in the vicinity of the doubly-magic ^{100}Sn and the ^{97m}Cd isomeric state, as well as the first mass measurements of the neutron-rich ^{209,210}Hg. A measurement of the ^{79*}Zn isomer resolved the state ordering of the 1/2+ and 5/2+ states and solidifies previous evidence of shape coexistence [2].

[1] Lunney, D. *et al.*, *J. Phys. G: Nucl. Part. Phys.* **44**, 064008 (2017) [2] Nies *et al.*, PRL. In print (2023), *arXiv:2310.16915

HK 72.61 Thu 17:15 HBR 14: Foyer

Systematic studies with a laser ablation carbon cluster ion source at the FRS Ion Catcher — •Leonard Welde[1], Jiajun Yu[2], and Christine Hornung[1,2] for the FRS Ion Catcher-Collaboration — [1]Justus-Liebig-Universität Gießen, Gießen — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt

A laser ablation carbon cluster ion source (LACCI) was commissioned at the FRS Ion Catcher at GSI Darmstadt, Germany. The LACCI will be used in future experiments with exotic nuclei to provide calibrant ions from different carbon and metal targets in the mass range of interest up to about 300 u. ^{13}C-enriched Fullerene targets allow calibrant ions with nearly every mass number in the medium mass range. These ions can be mixed with the ions of interest using a radio frequency quadrupole (RFQ) switchyard. Afterwards, the ions are sent to a RFQ mass filter and further to a multiple-reflection time-of-flight mass spectrometer (MR-TOF-MS).
First measurements targeting rate stability and long term stability were taken with a variety of different targets, such as carbon targets (Sigradur®, Fullerene) and different metal targets. Influence of the energy and repetition rate of the laser on the mass range of the produced carbon cluster ions was investigated. In addition, first results merging ions from LACCI and ions from a thermal ^{133}Cs ion source inside the FRS Ion Catcher were achieved. The results of this first measurements and studies will be reported in this contribution.

HK 72.62 Thu 17:15 HBR 14: Foyer

Arduino Readout Electronics — •Markus Köhli[1], Jannis Weimar[1], Simon Schmidt[1], Fabian Schmidt[2], Jochen Kaminski[2], and Ulrich Schmidt[1] — [1]Physikalisches Institut, Heidelberg University, Germany — [2]Physikalisches Institut, University of Bonn, Germany

Open Hardware-based microcontrollers, especially the Arduino platform, have become a comparably easy-to-use tool for rapid prototyping and implementing creative solutions. Such devices in combination with dedicated frontend electronics can offer low cost alternatives for student projects and independently operating small scale instrumentation. The capabilities can be extended to data taking and signal analysis at decent rates. We present two projects, covering the readout of proportional counter tubes and of scintillators or wavelength shifting fibers with Silicon Photomultipliers. With the SiPMTrigger we have realized a small-scale design for SiPMs as a trigger or veto detector. It consists of a custom mixed signal frontend board featuring signal amplification, discrimination and a coincidence unit for rates up to 200 kHz. The nCatcher board transforms an Arduino Nano to a proportional counter readout with pulse analysis - time over threshold measurement and a 10-bit analog-to-digital converter for pulse heights. The device is therefore suitable for low to medium rate environments, where a good signal to noise ratio is crucial - in case presented here to monitor thermal neutrons.