HK 52: Poster (b)

Time: Thursday 16:30–18:30 Location: Grotte

HK 52.1 Thu 16:30 Grotte

Improving the precision of the hypertriton binding energy by pion spectroscopy — •Pascal Klag[1], Patrick Achenbach[1], Philipp Eckert[1], Toshiyuki Gogami[2], Philipp Herrmann[1], Masashi Kaneta[3], Sho Nagao[3], Satoshi Nakamura[3], Josef Pochodzalla[1], and Yuichi Toyama[3] — [1]Johannes Gutenberg-Universität Mainz — [2]Kyoto University, Kyoto — [3]Tohoku University, Sendai

A precise binding energy measurement of hypertriton ${}^{3}_{\Lambda}$H is planned for the near future at MAMI. Currently the precision is limited by the absolute momentum calibration of the decay-pion spectrometers. Presently this limitation is caused by the uncertainty of the absolute beam energy of $\delta E_{beam} = 160\,\text{keV}$. For the hypertriton experiment two independent high precision beam energy measurements are under development. For one method a dipole of the beam-line leading to the spectrometer facility is used as a high-accuracy beam spectrometer. It is based on an acurate field map and precise monitoring of the beam trajectory. Secondly, a method based on undulator radiation interferometry is in development which is optimized for the lower energy range.
Supported by DFG (PO 256/7-1)

HK 52.2 Thu 16:30 Grotte

Development and beam test of a high luminosity lithium target at MAMI — •Philipp Herrmann[1], Patrick Achenbach[1], Toshiyuki Gogami[2], Philipp Eckert[1], Masashi Kaneta[3], Pascal Klag[1], Sho Nagao[3], Satoshi Nakamura[3], Josef Pochodzalla[1], and Yuichi Toyama[3] — [1]Johannes Gutenberg-Universität Mainz — [2]Kyoto University, Kyoto — [3]Tohoku University, Sendai

One of the near future goals of the strangeness nuclear physics program at Mainz is a precise binding energy measurement of hypertriton ${}^{3}_{\Lambda}$H. Detailed simulations show that lithium is the optimal target nucleus for this experiment. To reach a high luminosity and to minimize energy straggling of outgoing pions, the target is 50 mm long in beam direction and 1 mm wide. To withstand the heating by a $10\,\mu$A beam current, the target was embedded in a cooling system. Such a target system was successfully tested under these beam conditions.

Supported by DFG (PO 256/7-1)

HK 52.3 Thu 16:30 Grotte

Exploring the ^{12}C$(e, e'\pi^+\pi^+)$ and ^{12}C$(e, e'p\,\pi^+)$ reactions at the A1 multi-spectrometer facility at MAMI — •Philipp Eckert[1], Toshiyuki Gogami[2], Masashi Kaneta[3], Sho Nagao[3], Satoshi Nakamura[3], and Yuichi Toyama[3] — [1]Johannes Gutenberg-Universität Mainz — [2]Kyoto University — [3]Tohoku University, Sendai

Within the past years the chart of observed nuclides was continuously extended to more extreme proton-to-neutron ratios. For a further high resolution study of especially neutron rich nuclei, a new experimental method via electron scattering was explored at the Mainz Mikrotron. This method includes the missing mass spectroscopy of the reactions ^{12}C$(e, e'\pi^+\pi^+)$ and ^{12}C$(e, e'p\,\pi^+)$, where the three spectrometer facility of the A1 Collaboration and the precise MAMI beam energy would allow a yet unprecidented missing mass resolution of around $100\,\text{keV}/c^2$.

We will present the results of a test experiment performed at MAMI.

HK 52.4 Thu 16:30 Grotte

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

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

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

HK 52.5 Thu 16:30 Grotte

Radiative corrections in proton-antiproton annihilation to electron-positron and their application to the PANDA experiment — •Alaa Dbeyssi[1], Manuel Zambrana[1], Frank Maas[1,2,3], Egle Tomasi-Gustafsson[4], Yuri M. Bystritskiy[5], Vladimir A. Zykunov[5], Samer Ahmed[1], Luigi Luigi[1], Oliver Noll[1], David Rodriguez Pineiro[1], and Sahra Wolff[1] — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany — [3]Prisma Cluster of Excellence, Mainz, Germany — [4]CEA, IRFU, SPhN, Saclay, France — [5]Joint Institute for Nuclear Research, Dubna, Russia

The precise measurements of the time-like electromagnetic form factors of the proton, expected at the future PANDA experiment via the reaction $\bar{p}p \to e^+e^-$, require to take into account radiative corrections. In this work, first order radiative corrections to the reaction $\bar{p}p \to e^+e^-$ are calculated in the proton point-like approximation, including virtual and real photon emission. Soft and hard photon emission regimes are covered in the calculation. A Monte Carlo event generator is developed on the basis of the calculated radiative cross section and its application to the PANDA experiment is illustrated.

HK 52.6 Thu 16:30 Grotte

Gas gain measurements for the CBM-TRD MWPCs — •Isabel Kuhn for the CBM-Collaboration — Institut für Kernphysik, Uni Frankfurt

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt will allow the investiga- tion of the phase diagram of Quantum Chromodynamics (QCD) at high net- baryon densities with unprecedented precision. Part of the detector setup will be a Transition Radiation Detector (TRD) The TRD will be composed of an irregular foam radiator and a Multi Wire Proportional Chamber (MWPC).It is part of the track reconstruction concept of CBM and will deliver particle identification, mainly providing the electron and pion separation capabilities at high particle momenta. A precise knowledge of the gas gain is an important factor in the opti- misation of the detector performance. Thus, a prototype MWPC with the given geometrical configuration was build for thes investigations. This poster will review the production of the prototype and the procedure of the gas gain measurement. Finally, the results of the measurement with different gas mixtures at high voltage settings will be presented. Supported by the German BMBF-grant 05P19RFFC1

HK 52.7 Thu 16:30 Grotte

Femtoscopic study of the lambda-deuteron interaction in pp collisions at 13 TeV — •Michael Jung for the ALICE-Collaboration — Goethe Universität Frankfurt

A study of the lambda-deuteron interaction using femtoscopic methods in high-multiplicity pp collisions at 13 TeV will be presented. This interaction is in particular important to understand the properties of the hypertriton, a bound state made of a lambda and deuteron. With the good momentum resolution and particle identification capabilities of the ALICE experiment at the CERN LHC, a so called correlation function can be measured. Since this function depends on the two particle wave function, the potential of the interacting particles can be determined using comparisons to theoretical models. In this poster, the femtoscopy technique and the status of the analysis will be presented.

HK 52.8 Thu 16:30 Grotte

Beta-gated gamma spectroscopy using GALILEO detector system — •Arzoo Sharma[1,7], J. Gerl[1], M. Gorska-Ott[1], H. M. Albers[1], I. Kojouharov[1], H. Schaffner[1], A. Mistry[1,2], Nicolas J. Hubbard[1,2], T. Arici[1], A. Banerjee[1], E. Sahin[1,2], S. Alhomaidhi[1,2], M. Polettini[3,4], A. Yaneva[1,5], R. Palit[6], and Pushpendra P. Singh[7] — [1]GSI Helmholtzzentrum für Schwerionenforschung, Plackstrasse 1, Darmstadt, 64291, Germany — [2]TU Darmstadt, Karolinenpl. 5, Darmstadt, 64289, Germany — [3]Università degli Studi di Milano, Via Festa del Perdono, 7, Milano MI, 20122, Italy — [4]INFN, Sezione di Milano, 20133, Italy — [5]Sofia University, "St. Kliment Ohridski", bul. "Tsar Osvoboditel" 15, 1504, Sofia, Bulgaria — [6]TIFR, Homi Bhabha Road, Colaba Mumbai 400005, India — [7]Dept. of Physics, IIT Ropar, Rupnagar, Punjab-140001, India

The goal of DEcay SPECtroscopy (DESPEC) experiments is to study the decay of a nucleus of interest. The experimental set-up at GSI comprises FRS (Fragment Separator), AIDA DSSDs (Double-Sided Silicon Strip Detector), bPlast (plastic scintillator detector), FATIMA (FAst TIMing Array of Lanthanum Bromide detectors) and an array of GALILEO triple cluster detectors (3 HPGe crystals each). The nuclei of interest are implanted in AIDA and their decay is studied. A DESPEC beam commissioning run has been performed with 40Ar primary beam at 300MeV/U energy and secondary beam of 34Si produced via fragmentation. The beta decay of 34Si has been used in this test. The first test results of performance of the GALILEO detectors will be presented.

HK 52.9 Thu 16:30 Grotte

Characteristics of background electrons due to radioactive decays in the KATRIN spectrometers — •Dominic Hinz for the KATRIN-Collaboration — Karlsruhe Institute of Technology (KIT), Institute for Nuclear Physics (IKP)

The Karlsruhe Tritium Neutrino (KATRIN) experiment aims to measure the effective neutrino mass of electron anti neutrinos in a model-independent way by precise determination of the beta spectrum of molecular tritium. To achieve the sensitivity of $m_\nu = 0.2\,\mathrm{eV}/c^2$ (90% C.L.) on the effective neutrino mass, knowledge of statistical and systematic uncertainties as well as the background processes is essential.

The sensitivity is currently limited by a higher than anticipated background. Dedicated commissioning measurements showed that the sensitivity is affected by background electrons which are correlated to radioactive decays. Therefore, an understanding of the remaining background processes induced by radioactivity is of high relevance.

This poster focuses on background events due to radioactive decays in the KATRIN spectrometers and its impact on neutrino mass analysis.

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

HK 52.10 Thu 16:30 Grotte

Avoiding anomalies — •Klaus Morawetz — Münster University of Applied Sciences,Stegerwaldstrasse 39, 48565 Steinfurt, Germany — International Institute of Physics- UFRN,Campus Universitário Lagoa nova,59078-970 Natal, Brazil

The quantum anomaly can be written alternatively as conservation-breaking term or as non-gauge invariant current. This is exemplified on the anomalous term $\sim \vec{E}\vec{B}$ in the balance of the chiral density. This term is derived from the quantum kinetic equations for systems with SU(2) structure within a completely conserving approach. Therefore the origin of this term is not a unique signal of symmetry-breaking terms in the field-theoretical Lagrangian. By reinterpreting the many-body averaging the connection to Pauli-Villars regularization is established which gives the anomalous term a new interpretation as arising from quantum fluctuations at short distances. A proper balance of these fluctuations by many-body effects on the same level avoids these anomalies. The origin of the $\sim \vec{E}\vec{B}$ is therefore proposed not due to anomalies but as a completely conventional quantum kinetic effect. [Eur. Phys. J. B 92 (2019) 176, Phys. Lett. A 383 (2019) 1362]

HK 52.11 Thu 16:30 Grotte

Determination of beam intensities from proton scattering experiments between 2 MeV and 15 MeV — •Marco Menen, Felix Heim, Sarah Prill, Philipp Scholz, Michael Weinert, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

Cross section measurements are of great importance for nuclear astrophysics and our understanding of the structure of atomic nuclei. At the University of Cologne, we use two different target chambers dedicated to special types of experiments: The particle-γ spectrometer SONIC@HORUS is used to examine nuclear structure and determine branching ratios, while the target chamber dedicated for nuclear astrophysics is used to measure cross sections for astrophysically important nuclear reactions. Both target chambers will be presented with focus on their ability to determine precisely the number of impinging particles, which are needed to calculate absolute cross sections.

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

HK 52.12 Thu 16:30 Grotte

Ongoing investigation of a new Doppler-shift attenuation-approach to determine nuclear-level lifetimes — •Anna Bohn, Vera Everwyn, Michelle Färber, Florian Kluwig, Miriam Müscher, Sarah Prill, Philipp Scholz, Michael Weinert, Julius Wilhelmy, and Andreas Zilges — Institute for Nuclear Physics, University of Cologne

The Doppler-shift attenuation-method is a well-established technique to determine nuclear-level lifetimes in the range of sub-picoseconds. Such experiments are performed at the combined detector array SONIC@HORUS at the 10 MV FN-Tandem accelerator in Cologne, which provides complete knowledge of the reaction kinematics via particle-γ coincidences [1-3].

An alternative analyzing technique has been tested where the entire data set is Doppler corrected by assuming different values for the attenuation factor $F(\tau)$, which connects the lifetime τ to the observed energy shift of the de-exciting γ-ray. The optimal attenuation factor, which minimizes the Doppler broadening of the analyzed γ peak, yields the lifetime. This procedure uses summed up statistics and thus might be more efficient for weakly excited states. First results on ^{130}Te are in good agreement with known level lifetimes. Further tests to benchmark the new technique are planned.

Supported by DFG (ZI 510/9-1). A.B. is supported by the BCGS.

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

HK 52.13 Thu 16:30 Grotte

Antihyperons in nuclei at PANDA day-1 — •Falk Schupp[1], Sebastian Bleser[1], Marcell Steinen[1], Michael Bölting[1], Josef Pochodzalla[1,2], and Patrick Achenbach[1,2] — [1]Helmholtz-Institut Mainz — [2]Institut für Kernphysik, Universität Mainz

The exclusive production of hyperon-antihyperon pairs close to their production threshold in $\bar{p}$-nucleus collisions offers a unique and hitherto unexplored opportunity to elucidate the behavior of antihyperons in nuclei. Calculations find a substantial sensitivity of the transverse momentum correlations of coincident $\Lambda\bar{\Lambda}$-pairs to the assumed depth of the $\bar{\Lambda}$-potential. [Lorente et al., Phys. Lett. B 749 (2015) 421]

The facility for antiproton and ion research (FAIR) currently under construction in Darmstadt, Germany will offer a high quality, high luminosity $\bar{p}$-beam to be used in experiments. Starting from 2026 the PANDA experiment at FAIR will begin with its "day-1" setup where a partial setup of the detector and reduced luminosity will be available. Because of the high cross section for the process and the simplicity of the experimental method the "day-1" setup can be used to measure these momentum correlations.

We present our current feasibility study of the event reconstruction for the reaction $\bar{p} +^{20} Ne \rightarrow \Lambda\bar{\Lambda}$ close to production threshold in the PANDA "day-1" setup. The GiBUU framework is used to simulate the primary interaction and GEANT4/GENFIT2 for propagation, tracking and reconstruction. The detector efficiency and resolution are being studied and the observable momentum correlations calculated.

HK 52.14 Thu 16:30 Grotte

Has the $^{4}_{\Lambda\Lambda}$n been observed? — Sebastian Bleser[1], •Michael Bölting[1], Theodoros Gaitanos[2], Josef Pochodzalla[1,3], Falk Schupp[1], and Marcell Steinen[1] — [1]Helmholtz-Institut Mainz, Deutschland — [2]Aristoteles-Universität Thessaloniki, Griechenland — [3]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

Despite several promising experimental results, the question whether bound or resonant light neutral nuclei exist is not yet answered beyond doubt. The E906 experiment was the first fully electronic experiment to produce and study double hypernuclei with large statistics [J. K. Ahn *et al.*, Phys. Rev. Lett. **87**, 132504 (2001)]. We show, that the interpreatation of the dominant structure in the correlated $\pi^-\pi^-$ momentum matrix at (133, 114) MeV/c in terms of $^{3}_{\Lambda}$H + $^{4}_{\Lambda}$H remains questionable. Neither hypernuclei production from stopped Ξ^- by a ^{9}Be nuclues nor interactions of energetic Ξ^- with ^{9}Be nuclei in the target material can produce a sufficient amount of such twin pairs. We have therefore explored the conjecture that decays of the $^4_{\Lambda\Lambda}$n may be responsible for the observed structure. Indeed, the inclusion of $^4_{\Lambda\Lambda}$n with a two-body π^- branching ratio of 50% in a statistical multifragmentation model allows to describe the E906 data remarkably well. This interpretation is, however, hampered by the fact, that this neutral nucleus is predicted to be unbound.

HK 52.15 Thu 16:30 Grotte

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

The low-lying nuclear structure of ^{142}Xe was probed in a "safe" Coulomb excitation experiment at HIE-ISOLDE (CERN). While beam and target nuclei were detected utilizing the segmented Silicon detector array C-REX, the MINIBALL spectrometer was used to detect the emitted gamma rays in coincidence. ^{142}Xe is located north east of the doubly-magic nucleus ^{132}Sn and in the proximity of ^{144}Ba. The latter shows the largest octupole collectivity in the region. Therefore, this work aims to follow the evolution of quadrupole and octupole collectivity by means of spectroscopic quadrupole moments and reduced transition probabilities.

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

HK 52.16 Thu 16:30 Grotte

Lifetime measurements of excited states in ^{55}Cr — •H. Kleis, M. Seidlitz, P. Reiter, K. Arnswald, M. Droste, and L. Kaya — IKP, Universität zu Köln

Lifetime measurements in neutron-rich Cr nuclei provide key observables to study the $N = 32$ sub-shell closure. Following an earlier measurement in ^{56}Cr [1], excited states in the neighboring $N = 31$ isotope ^{55}Cr have been populated in a ^{48}Ca(^{11}B, $p3n$)^{55}Cr fusion-evaporation reaction at a beam energy of 32 MeV at the FN tandem accelerator of the University of Cologne. The Cologne plunger device, surrounded by a γ-ray detector array consisting of one EUROBALL cluster detector and five Ge detectors, was employed to determine lifetimes with the recoil distance Doppler-shift method (RDDS). $\gamma\gamma$-coincidence data were analyzed using the differential decay-curve method (DDCM) and precise lifetimes for the first $5/2^-$ and $9/2^-$ states of $\tau = 5.61(28)$ ps and $\tau = 6.33(46)$ ps, respectively, were extracted. In addition, the experimentally determined transition probabilities were confronted with the theoretical results from large-scale shell-model calculations.

[1] M.Seidlitz et al., Phys. Rev. C 84, 034318 (2011)

HK 52.17 Thu 16:30 Grotte

A cryogenic Paul trap for ^{229}Th — •Daniel Moritz[1], Benedict Seiferle[1], Lars von der Wense[1,2], and Peter G. Thirolf[1] — [1]LMU München — [2]JILA , Boulder , USA

The comparably low energy of the isomeric first excited nuclear state of ^{229}Th, which has most recently been constraint to 8.28±0.17 eV [1], allows for direct laser excitation with current technology. This offers the unique opportunity to develop a nuclear clock [2] capable of competing with existing atomic clocks. One of the next steps towards the realization of such a clock is the determination of the ^{229}Th isomer's ionic lifetime, which is expected to be in the range of several minutes up to hours. In order to achieve the required ion storage times, a cryogenic Paul-trap is currently set up at the LMU Munich.

This work was supported by DFG (Th956/3-2) and by the European Union's Horizon 2020 research and innovation program under grant agreement 6674732 "nuClock".

[1] B.Seiferle et al., Nature 573, 243 (2019).
[2] E.Peik & C.Tamm, Europhys. Lett. 61, 181 (2003).

HK 52.18 Thu 16:30 Grotte

Subatomic particles represented as focal points. — •Osvaldo Domann — Stephanstr. 42, 85077 Manching, Germany

Examples of approaches to represent subatomic particles (SPs) are point-like, strings, wave-packets, etc. The present work is based on an approach where (SPs) are represented as focal points of rays of Fundamental Particles (FPs) that move from infinite to infinite. FPs are emitted from the focal point and at the same time regenerate it. FPs store the energy of a SP as rotation defining angular momenta. Interactions between SPs are so the product of the interactions of the angular momenta of their FPs. **One important finding 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. Another important finding is that all four forces are electromagnetic forces and described by QED. As quantum-mechanics rely heavily on classical physics, all new findings of the latter have repercussions on the former. More at: www.odomann.com