HK 24: Hadron Structure and Spectroscopy V

Time: Thursday 16:30–18:30 Location: H3

Group Report HK 24.1 Thu 16:30 H3

Measurement of the proton radius with the PRES experiment at MAMI — •Vahe Sokhoyan — Universität Mainz, Institut für Kernphysik

The so-called "proton radius puzzle" originated due to significant discrepancies between some of the results for the proton charge radius measured in experiments with electronic or muonic hydrogen and in electron-proton scattering experiments. Recently, the PRad Collaboration published new results favoring smaller proton radius compared to many of the previous electron-proton scattering measurements. Further scattering experiments utilizing new concepts for detection of particles in the final state are underway.

We are planning to perform a new measurement of the electron-proton scattering cross section at low momentum transfer at the Mainz Microtron (MAMI). The project is conducted in the framework of the PRES Collaboration with participation of the University of Mainz, Petersburg Nuclear Physics Institute, and collaborators from other contributing institutions. The experimental setup consisting of a Hydrogen Time Projection Chamber, Forward Tracker, and beam monitoring system will allow us to measure the energy and the angle of the recoil proton in combination with the angle of the scattered electron and to determine the electron flux with high accuracy. The performance of this experiment will open avenue for further studies of this kind using deuterium and helium targets. In this talk, the current status of this project and the future plans will be presented.

HK 24.2 Thu 17:00 H3

Isoscalar electromagnetic form factors of the nucleon in $N_f = 2+1$ lattice QCD — Dalibor Djukanovic[1,2], Georg von Hippel[3], Harvey B. Meyer[1,2,3], Konstantin Ottnad[3], •Miguel Salg[3], Jonas Wilhelm[3], and Hartmut Wittig[1,2,3] — [1]Helmholtz Institute Mainz, Staudingerweg 18, D-55128 Mainz, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — [3]PRISMA$^+$ Cluster of Excellence and Institute for Nuclear Physics, Johannes Gutenberg University of Mainz, Johann-Joachim-Becher-Weg 45, D-55128 Mainz, Germany

We present results for the isoscalar electromagnetic form factors of the nucleon computed on the CLS ensembles with $N_f = 2 + 1$ flavors of $\mathcal{O}(a)$-improved Wilson fermions and an $\mathcal{O}(a)$-improved conserved vector current. In order to estimate the excited-state contamination, we investigate several source-sink separations and apply the summation method. For the computation of the quark-disconnected diagrams, a stochastic estimation using the one-end trick is employed. By these means, we obtain a clear signal for the form factors including the quark-disconnected contributions, which have a distinguishable effect on our data.

HK 24.3 Thu 17:15 H3

Monte Carlo Simulations to estimate the Efficiency of an Electromagnetic Calorimeter to detect neutral Pions — •Julian Moik[1], Frank Maas[1,2,3], Alaa Dbeyssi[1], Luigi Capozza[1], Oliver Noll[1], David Rodriguez Pineiro[1], Sahra Wolff[1], Peter Bernd Otte[1], Dong Liu[1], Alexander Christian Greiner[1], and Samet Katilmis[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz, Germany — [3]Prisma Cluster of Excellence, Mainz, Germany

The PANDA experiment at the future FAIR facility requires a complex detector system, whose backward calorimeter is being developed by the group at the Helmholtz Institute in Mainz. For the FAIR Phase-0 experiment at the electron accelerator MAMI it is planned to use this detector for a measurement of the electromagnetic transition form factor of the neutral pion.

To estimate the efficiency of the experimental setup regarding the pion detection, a Monte Carlo simulation of the pion decay and the detection of the decay photons in the software environment *primasoft* was performed. By reconstructing the pion events from the photon energy measurement, the efficiency of the pion detection was determined as a function of the pion energy and momentum direction. This analysis helped to choose between two different calorimeter geometries and allowed for the calculation of the effective cross-section of the pion production in this experimental setup.

HK 24.4 Thu 17:30 H3

Measurement of the $\omega \to \pi^0\gamma$ decay at A2/MAMI, towards an $\omega\pi^0$ transition form factor analysis — •Daniel Maurer, Achim Denig, and Lena Heijkenskjöld — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Deutschland

Electromagnetic meson Transition Form Factors (TFF) describe the interaction between mesons and photons (real or virtual). Studies of meson TFFs are an important input to the understanding of the anomalous magnetic moment of the muon (a_μ). Currently, the most precise experimental results of a_μ deviate from the Standard Model (SM) predictions by a total of $\sim 4.2\sigma$ and thus giving hints at physics beyond the SM. Additionally, the $\omega\pi^0$ TFF is interesting to study due to the significant deviations between existing precise experimental measurements and theory predictions. Data has been collected at the A2/MAMI experiment aiming to improve the precision of the $\omega\pi^0$ TFF. Within the project presented here, the first steps towards such an analysis has been taken by studying the $\omega \to \pi^0\gamma$ channel, which has a $\sim$100 times larger decay width than the rare $\omega \to \pi^0 e^+ e^-$ channel. Furthermore, the $\omega \to \pi^0\gamma$ channel is needed as a normalization to the $\omega\pi^0$ TFF analysis. As a result $\sim (420 \pm 1) \cdot 10^3$ $\omega \to \pi^0\gamma$ events were observed with good MC-data agreement.

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HK 24.5 Thu 17:45 H3

Accessing the annihilation dynamics using femtoscopic correlations with ALICE at LHC — •Valentina Mantovani Sarti for the ALICE-Collaboration — TUM

Baryon–antibaryon ($B\overline{B}$) systems are characterised, already at threshold, by a relevant contribution of several multi-meson channels related to the presence of short-range annihilation processes. Predictions on the formation of bound states (baryonia) from the attractive elastic $B\overline{B}$ interaction have been suggested but a precise understanding of the role played by the annihilation interaction is required to assess the possibility of forming such states.
In this talk, we will present the most precise measurements on the baryon–antibaryon interaction ($p\overline{p}$, $p\overline{\Lambda}$ and $\Lambda\overline{\Lambda}$) at low momenta by means of correlation studies in high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV measured by the ALICE Collaboration. The effect of annihilation channels on the correlation function and a quantitative determination of the inelastic contributions in the three different pairs will be discussed.

HK 24.6 Thu 18:00 H3

Antihyperons in nuclear matter at PANDA Phase One — •Falk Schupp[1], Patrick Achenbach[1], Michael Bölting[1], Josef Pochodzalla[2], and Marcell Steinen[2] for the PANDA-Collaboration — [1]Helmholtz Institute Mainz, Mainz, Germany — [2]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz, Germany

The PANDA experiment will be located in the Facility for Antiproton and Ion Research (FAIR) currently under construction at GSI in Darmstadt (Germany). Even in the early experimental phase (Phase One) the high energy storage ring (HESR) at FAIR will supply a high intensity antiproton beam in the GeV range respresenting an unparalleled factory for various hyperon-antihyperon pairs. The study of antihyperons in convential nuclear matter provides a unique opportunity to elucidate strong in-medium effects in baryonic systems. Quantitative information on the antihyperon potentials may be obtained via exclusive antihyperon-nuclear interactions. The collision of antiprotons with Neon-20 nuclei is simulated using the hadronic transport model simulation tool GiBUU and different effective antihyperon potentials. The event reconstruction with the PANDA detector is simulated with Geant3/4 using the PandaRoot framework and the effect of the antihyperon potential on the observables studied.

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HK 24.7 Thu 18:15 H3

The Study of Genuine Three-Body Interactions in pp collisions with ALICE — •Laura Serksnyte for the ALICE-Collaboration — Technische Universität München

The femtoscopic studies done by the ALICE Collaboration provided results with unprecedented precision for the short-range strong interactions between different hadron pairs. The next challenge is the development of the three-particle femtoscopy which will deliver the first ever direct measurement of genuine three-body forces. Such results would be a crucial input for the low-energy QCD and neutron star studies. In particular, the momentum correlation of p–p–p triplets can provide information about genuine three-nucleon forces while the p–p–Λ interaction is a necessary piece to understand if the production of Λ hyperons occurs in neutron stars.
In this talk, the first study of p–p–p and p–p–Λ correlations will be presented. The results were obtained using high-multiplicity pp collisions at $\sqrt{s}$ = 13 TeV measured by ALICE at the LHC. The measured three-body correlation functions include both three- and two-particle interactions. The cumulant method was applied to subtract lower-order contributions and infer directly on the genuine three-body forces. The two-particle contributions were estimated both experimentally by applying mixed-event technique, and mathematically by projecting known two-body correlation functions on the three-body systems. The measured p–p–p and p–p–Λ correlation functions and the corresponding cumulants will be shown.