HK 57: Hadron Structure and Spectroscopy VII

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

Group Report HK 57.1 Wed 17:30 HBR 62: EG 18

High-resolution spectroscopy experiments with WASA-FRS at GSI — •Yoshiki K. Tanaka for the WASA-FRS and Super-FRS Experiment-Collaboration — RIKEN, Wako, Saitama, Japan

The NUSTAR Super-FRS Experiment Collaboration performs high-resolution spectrometer experiments at the border line of atomic, nuclear and hadron physics. The spectroscopic study of exotic hadron-nucleus bound systems is one of the important topics in hadron physics since such systems provide valuable information on hadron properties and interactions in the low-energy region of quantum chromodynamics. In this contribution, we report two pilot experiments recently performed with a newly constructed WASA-FRS setup that integrates the WASA central detector into the fragment separator FRS at GSI.

The first experiment aims at observing η'-meson bound states in carbon nuclei for studying in-medium η'-meson properties. We performed high-resolution missing-mass spectroscopy of the ^{12}C(p,d) reaction near the η'-meson production threshold with the FRS and simultaneously detected particles emitted in the decay of the η'-mesic nuclei with the WASA detector. In the second experiment, we performed invariant-mass spectroscopy of light hypernuclei produced via projectile fragmentation of a 2 GeV/u ^{6}Li beam. The π^- emitted in the mesonic decay was measured with the WASA detector, whereas the residual ion was momentum-analyzed by the FRS. Both experiments were successfully conducted in 2022 in the framework of the FAIR phase-0 program at GSI. In this contribution, the current status of the data analysis as well as the preliminary results will be discussed.

HK 57.2 Wed 18:00 HBR 62: EG 18

The bridge between two-body nucleon-hyperon data and the nuclear equation of state — •Dimitar Mihaylov[1] and Johann Haidenbauer[2] — [1]Technische Universität München, Physics Department, James-Franck-Str., 85748 Garching, Germany — [2]Forschungszentrum Jülich, Institute for Advanced Simulation (IAS-4), 52428 Jülich, Germany

Femtoscopy is a powerful technique for studying final-state interactions between hadrons, employing two- and three-body correlations to analyze the emission source and final-state interactions of particles with low relative momentum. Recent research by the ALICE collaboration has demonstrated the realization of a common baryon-baryon emission source in pp collisions, opening new avenues for studying the properties of the final-state interaction (FSI). In particular, the pΛ system has been measured with unprecedented precision, allowing for a better constraint on existing theoretical models

This talk will present the results of a combined analysis of femtoscopy and scattering involving pΛ, along with the impact on the allowed scattering parameters, the in-medium U_Λ potential as a function of density, and the consequences for the nuclear equation of state, as well as the appearance of hyperons within neutron stars.

This research was funded by the BmBf Verbundforschung (05P21WOCA1 ALICE).

HK 57.3 Wed 18:15 HBR 62: EG 18

The first study of the $\Lambda\pi$ strong interactions with ALICE — •Marcello Di Costanzo for the ALICE Germany-Collaboration — Technical University, Munich, Germany

Due to its non-perturbative nature at low energies, a deep understanding of the strong force still represents a challenge for the physics community. From the theoretical side, the study of low-energy QCD is typically conducted employing effective field theories (EFT) which are based on low-energy constraints to be anchored to the experimental measurements. Understanding the $S = -1$ meson-baryon systems is extremely relevant because they are characterised by a rich coupled-channel structure and feature the emergence of dynamically generated states. At present, EFT calculations have been well constrained by experimental data for energies above the K^-N threshold. At lower energies, there are tensions among models due to the limited amount of measurements. The study of $\Lambda\pi^+$ and $\Lambda\pi^-$ interactions is so relevant because it allows accessing the K^-N sub-threshold energies, leading to new experimental inputs to EFTs. In this contribution, the measurement of the $\Lambda\pi$ scattering parameters is carried out by exploiting correlation function analysis and using ALICE data consisting of high-multiplicity proton-proton collisions at $\sqrt{s} = 13$TeV.

HK 57.4 Wed 18:30 HBR 62: EG 18

Study of p–p–$\pi^\pm$ and p–$\pi^\pm$ femtoscopic correlations with ALICE at the LHC — •Marcel Lesch for the ALICE Germany-Collaboration — TU Munich, Germany

Recent theoretical models propose that the QCD axion might have a crucial impact on the equation of state of dense nuclear matter, consequently affecting the study of neutron stars. While the QCD axion has not been directly observed yet, its properties at finite baryonic densities can be linked to the in-medium properties of pions. Constraining the latter is thus crucial for studying the QCD axion and its impact on the description of neutron stars. In this talk, we present recent results of femtoscopic correlations between pions and protons in high-multiplicity pp collisions at $\sqrt{s}$ = 13 TeV measured by ALICE. These small systems produce particles at relative distances of about 1 fm. Therefore, the emission of multiple hadrons can be used to mimic a large-density environment. Firstly, results on p–$\pi^\pm$ are discussed. These two-body correlations play an important role in understanding the lower-order contributions present in the three-body system. Using recently developed three-body femtoscopic techniques, we present the first measurements of p–p–$\pi^\pm$ correlations. These results provide new insights on the in-medium properties of pions relevant to the study of the QCD axion.

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

HK 57.5 Wed 18:45 HBR 62: EG 18

K^0_S production in p+p interactions measured by NA61/SHINE — •Marjan Cirkovic — Spasovdanska 6, 11032 Belgrade, Serbia

NA61/SHINE (SPS Heavy Ion and Neutrino Experiment) is a fixed-target experiment at the CERN Super Proton Synchrotron. One of its research projects is the systematic measurement of hadron production in proton+proton, proton+nucleus and nucleus+nucleus interactions. These studies are performed in particular to study the predicted signals of the onset of deconfinement and search for the critical point of strongly interacting matter. For this investigation, a two-dimensional scan in beam momentum (13A -150A GeV/c) and nuclear mass number of colliding nuclei was performed.

K^0_S are detected and measured by NA61/SHINE by means of their weak decays into $\pi^+ + \pi^-$ with a branching ratio of 69.2%. This contribution reviews recent NA61/SHINE measurements on the production of K^0_S in p+p interactions. The rapidity and transverse momentum distributions of K^0_S will be presented and compared to transport model predictions. The mean multiplicity of studied K^0_S mesons will be compared with the available data in the range $\sqrt{s_{NN}}$ = 3 - 32 GeV.