HK 9: Hadron Structure and Spectroscopy I

Time: Monday 14:00–15:30 Location: HK-H8

Group Report HK 9.1 Mon 14:00 HK-H8

Investigation of the Σ^0 production mechanism in p(3.5 GeV)+p collisions at HADES experiment — •Waleed Esmail[1,2] and James Ritman[1,2,3] for the HADES-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany — [2]Forschungszentrum Jülich, 52428 Jülich, Germany — [3]Ruhr-Universität Bochum, 44801 Bochum, Germany

The production of hyperons serves as a tool to investigate the strong interaction in the non-perturbative energy regime. This talk presents a study of the Σ^0 production mechanism via the exclusive reaction $pp \to pK^+\Sigma^0$ at a beam kinetic energy 3.5 GeV with the HADES detector. The dynamics of the reaction $pp \to pK^+\Sigma^0$ was investigated by studying the angular distributions in the CMS, Gottfried-Jackson and helicity frames. The angular distributions in the CMS frame supports the pion exchange mechanism. Furthermore, the helicity angular distributions are highly non-isotropic, which is a clear indication that there is a resonant component of the Σ^0 production. In order to provide a better description of the experimental angular distributions, the Bonn-Gatchina Partial Wave Analysis (Bo-Ga PWA) has been employed. However, due to the insufficient statistics, it was not possible to obtain an unambiguous determination of the relative contribution of each intermediate nucleon resonance to the overall final state. Nevertheless, significant contributions of nucleon resonances $N^*(1710)$ ($J^P=1/2^+$), $N^*(1900)$ ($J^P=3/2^+$) and $\Delta^*(1900)$ ($J^P=1/2^-$) are certainly preferred by the PWA fit.

HK 9.2 Mon 14:30 HK-H8

Status of the CALIFA Calorimeter and its performance at FAIR-Phase-0 experiments at R^{3}B — •Leyla Atar for the R3B-Collaboration — Technische Universität Darmstadt, Germany

CALIFA (the CALorimeter for In Flight detection of γ-rays and light charged pArticles) is one of the key detectors of the R^{3}B experiment at the GSI/FAIR facility. CALIFA is highly segmented and will consist of 2528 scintillation CsI(Tl) crystals after completion surrounding the reaction target area to facilitate measurement of the emission angle and energy of reaction products. CALIFA covers a huge dynamic range to allow a simultaneous measurement of γ-rays down to 100 keV and scattered light particles up to 300 MeV. A special feature of Califa is the digital Quick Particle Identification (QPID) enabling γ-rays and charged particle identification through Pulse Shape Analysis (PSA) of the scintillation light output.

I will shortly introduce the CALIFA calorimeter and its auxiliary detector systems and give an overview of the performance of CALIFA in the frame of FAIR-Phase-0 experiments performed at the R^{3}B/FAIR setup. Particularly first results, energy resolution and efficiency as well as QPID will be discussed for specific physics cases. The current development status of CALIFA and further enhancements will be presented.

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HK 9.3 Mon 14:45 HK-H8

Feasibility study of the reaction $\bar{p}p \to e^+e^-\pi^0$ with the PANDA experiment at FAIR — •Alaa Dbeyssi[1], Frank Maas[1,2,3], Luigi Capozza[1], Oliver Noll[1], David Rodriguez Pineiro[1], Christoph Rosner[1], Sahra Wolff[1], Alexander Greiner[1], Julian Moik[1], Samet Katilmis[1], and Dong Liu[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 feasibility of measuring the reaction $\bar{p}p \to e^+e^-\pi^0$ with the PANDA detector is investigated within the PANDARoot simulation framework. At high center of mass energy and high invariant mass squared of the lepton pair, a collinear factorisation description of the reaction amplitude, based on nucleon-to-meson transition distribution amplitudes, is predicted in the near forward and near backward regimes. At low lepton invariant mass squared, a parametrisation that assumes the exchange of dominant baryon Regge trajectories is suggested. Such a parametrisation will allow us to study the proton electromagnetic form factors in the so called "unphysical region". The collinear factorisation theorem for the nucleon-to-meson transition distribution amplitudes has not yet been proven experimentally. In addition, no data exist so far on the proton electromagnetic form factors in the unphysical region. The capability of PANDA to measure the differential cross sections for the reaction $\bar{p}p \to e^+e^-\pi^0$ and perform validity tests of the predicted QCD models will be shown in this talk.

HK 9.4 Mon 15:00 HK-H8

Accessing three-body strong interactions of p–p–π^+ and p–p–π^- with ALICE at the LHC — •Marcel Lesch for the ALICE-Collaboration — TUM

In the quest of understanding the nuclear equation of state, which is linked to the modelling of neutron stars, the QCD axion might play a crucial role. The properties of axions are expected to change in systems at finite baryonic densities and in particular they can be related to the in-medium properties of pions. Constraining these properties is thus crucial for the study of the QCD axion and its impact on the description of neutron stars.

The in-medium pion properties can be accessed by the measurement of interactions between pions and many nucleons produced in pp and p-Pb collisions at the LHC. These small systems produce particles at distances of ~ 1 fm, mimicking a large density environment. This talk will present the first experimental three-body correlations of the p–p–π^+ and p–p–π^- triplets by using the three-body femtoscopy technique. The results have been obtained by analysing high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV measured by ALICE. The three-body effects are probed by employing the Kubo cumulant formalism to subtract the lower order contributions from the measured triplet correlation functions.

HK 9.5 Mon 15:15 HK-H8

LHCspin: towards a polarized gas target for the LHC — •Erhard Steffens[1], Paolo Lenisa[2], Vito Carassiti[2], Giuseppe Ciullo[2], Pasquale Di Nezza[3], Luciano L. Pappalardo[2], and Marco Santimaria[3] — [1]FAU, Erlangen, Germany — [2]U. Ferrara and INFN, Italy — [3]INFN Lab. Nat. di Frascati, Italy

The LHCspin project aims at unpolarized (SMOG2) and polarized fixed-target measurements by means of a gas target upstream of the LHCb detector, close to the vertex detector VELO. The forward geometry of the LHCb spectrometer ($2 < \eta < 5$) allows for the reconstruction of particles produced in fixed-target collisions, with center-of-mass energies ranging from $\sqrt{s_{NN}} = 72$ GeV with Pb beam to $\sqrt{s} = 115$ GeV in pp collisions. The use of H and D targets, polarized transversely to the beam will allow to study the quark TMDs in pp collisions at unique kinematics. In addition, with LHCb being specifically designed for heavy-flavor physics, final states with c- or b-quarks will be efficiently reconstructed as demonstrated in detailed simulations, thus providing access to the so-far unknown gluon TMDs.

The design and status of the study will be presented. An openable storage cell with wake field suppressor and unpolarized gas feed system (SMOG2) is installed and ready to be tested during early 2022. A similar target with transverse B-field plus atomic beam source and diagnostics is being designed. The 7 TeV/1 A beam traversing the target might cause instabilities, which must be suppressed. This is studied in close collaboration with the LHC machine group.