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Investigation of NN and NY interaction using femtoscopy at HADES

Relativistic heavy-ion collisions in the few-GeV energy range provide an opportunity to investigate the properties of nuclear matter at high net-baryon densities, similar to the conditions in Neutron Stars (NS) and Neutron Star mergers. In recent decades, significant attention has been given to the presence of hyperons in NS and their influence on the Equation of State (EoS), which describes the dense nuclear matter, lies at the core of the so-called "hyperon puzzle."The absence of precise measurements of nucleon-nucleon (NN), nucleon-hyperon (NY), and hyperon-hyperon (YY) interactions has hindered progress in resolving this enigmatic contradiction and constructing the universal EoS.

The femtoscopy technique is a method used to study interparticle interactions. It also provides a way to extract the space-time properties of the expanding fireball created in heavy-ion collisions. The interaction between two particles can be described using the Lednicky-Lyuboshitz equation, which constrains two essential parameters: the scattering length (f_0) and the effective range (d_0). The definitive knowledge about those parameters for NN, NY, and YY systems may be the missing piece of the "hyperon puzzle."

In this talk, the preliminary HADES results on femtoscopic observables of proton-proton (in Au-Au collisions at $\sqrt{s_{NN}}$ = 2.4 GeV), proton-lambda, and deuteron-lambda (in Ag-Ag collisions at $\sqrt{s_{NN}}$ = 2.55 GeV) will be presented. We introduce the one-dimensional femtoscopic radii dependence on pair transverse momentum and collision centrality. Additionally, the parameters describing the strong interaction for the femtoscopic systems (proton-proton, deuteron-lambda) under study will be outlined for the first time using the data collected by the HADES collaboration. We intend to compare the obtained values with past studies, including the spin-separated proton-lambda results shown at QM2023.

Category

Experiment

Collaboration (if applicable)

The HADES Collaboration

Author: Mr KOŁAŚ, Jędrzej (Warsaw University of Technology)

Presenter: Mr KOŁAŚ, Jędrzej (Warsaw University of Technology)

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