Two-Particle Correlations of Light Nuclei and Hyperons in Heavy-Ion Collisions at STAR

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Heavy-ion collisions provide a unique environment to study nucleon-nucleon (N-N) and hyperon-nucleon (Y-N) interactions, as well as the production mechanisms and structure of light (hyper)nuclei. Two-particle correlations at small relative momenta serve as a powerful tool, carrying rich information about the space-time evolution of the particle-emitting source and the effects of final-state interactions (FSI). In particular, correlations involving light nuclei—such as deuteron (d), triton (t), helium isotopes (^{3}He)—and hyperons like Λ can shed light on both the internal structure and binding energies of (hyper)nuclei, as well as many-body interactions among baryons. These studies are crucial for understanding dense baryonic matter, including the equation of state of neutron stars.

In this talk, we present the first measurements of a broad set of two-particle correlation functions involving proton and light nuclei combinations (p-d, d-d) as well as hypernuclear correlations (d-Λ, t-Λ, ^{3}He-Λ), using high-statistics data from $\sqrt{s_{\mathrm{NN}}} = 3$ GeV (fixed-target mode) recorded by the STAR experiment at RHIC. The correlation functions are analyzed using the Lednicky–Lyuboshitz formalism to extract key parameters such as source size, scattering length, and effective range. The extracted parameters will be compared to those from other baryon correlations and various effective theory model calculations. Finally, the implications of these results for the production mechanisms of light nuclei and the final-state interactions involving hyperons—especially as they relate to the internal structure of light hypernuclei—will be discussed.

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