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Measurement of Light Nuclei Production in Au+Au Collisions at √sNN = 3 - 200 GeV from RHIC-STAR

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Light nuclei, as loosely bound objects with binding energies of a few MeV, provide a unique probe of the QCD phase structure and the nucleon coalescence mechanism in heavy-ion collisions. The systematic study of light nuclei production over a broad energy range enables insights into the properties of the dense baryonic matter created in such collisions. In the RHIC beam energy scan (BES) program, the STAR experiment has collected Au+Au collision data at $\sqrt{s_{\rm NN}}$ = 3.0 to 200 GeV in collider and fixed-target (FXT) modes, covering a wide range of collision energies. This dataset allows for the exploration of both high-temperature conditions (∼165 MeV) and high baryon density regions (∼750 MeV). It enables a systematic study of light nuclei production as a function of collision energy and centrality.

In this talk, we will report systematic measurements of protons and light nuclei (d, t, ^{3}He, and ^{4}He) production in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 3.0 - 200 GeV. The transverse momentum (p_T) spectra, coalescence parameters (B_A), particle yield ratios, and kinetic freeze-out parameters ($T_{\rm ch}$ versus $\langle\beta_{\rm T}\rangle$) will be reported. These results will be compared across different collision energies to investigate the energy dependence of light nuclei production. The comparisons will provide stringent constraints on coalescence and thermal models, thereby advancing our understanding of light nuclei formation in high-density QCD matter.

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