Production of light nuclei in Au+Au collisions from STAR BES-II

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Light (anti-)nuclei production in heavy-ion collisions can be described by two different mechanisms: the thermal and coalescence models. By analyzing the yields and ratios of the light (anti-)nuclei, we can gain valuable insights into their formation processes and the properties of the system at freeze-out. The enhancement in the compound ratios of light nuclei, such as $N_t N_p / N_d^2$ from the expected coalescence baseline, has been proposed as a tool to probe critical phenomena in the Quantum Chromodynamics phase diagram. In the first phase of the RHIC Beam Energy Scan (BES-I), a notable increase in the compound light nuclei yield ratio $N_t N_p / N_d^2$ was observed in the most central Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6 and 27 GeV, with a combined significance of 4.1σ. The larger datasets ($\sim 10\times$ BES-I) collected by the STAR during the second phase of the BES program (BES-II) and improved detector capabilities are expected to provide more precise measurements.

In this talk, we will explore the centrality and energy dependence of the transverse momentum (p_T) spectra of p, $\bar{p}$, d, $\bar{d}$, and ^3He in Au+Au collisions across BES-II energies $\sqrt{s_{NN}}$ = 7.7 – 27 GeV. Additionally, we will report the centrality and energy dependence of the p_T integrated yields (dN/dy) and the mean p_T ($\langle p_T \rangle$) of light nuclei. Furthermore, we will discuss the centrality and p_T dependence of the coalescence parameters, B_A, with their broader physics implications.