Light nuclei production in Au+Au collisions at BES-II energies using the STAR detector

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In heavy-ion collisions, the production mechanism of light (anti-)nuclei can be explained by either the thermal model or the coalescence model. By studying the yields and ratios of these nuclei, we can gain a better understanding of their production mechanisms and the properties of the expanding system during freeze-out. Additionally, it has been proposed that the enhancement of light nuclei compound ratios, e.g. $N_t N_p / N_d^2$ and $N_{^4He} N_p / N_{^3He} N_d$, from the coalescence baseline could serve as a probe for searching for critical phenomena in the QCD phase diagram.

In the first phase of the Beam Energy Scan (BES-I) program at RHIC, an enhancement relative to the coalescence baseline of the 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 precision of the new measurements will be significantly improved by the large data sets ($\sim 10\times$ BES-I) obtained by the STAR BES-II with upgraded detector capabilities.

In this talk, we will present the centrality and energy dependence of transverse momentum (p_T) spectra of p, $\bar{p}$, d, $\bar{d}$, and ^3He in Au+Au collisions at BES-II energies of $\sqrt{s_{NN}}$ = 7.7 – 27 GeV. We will also report on the centrality and energy dependence of integrated particle yields (dN/dy) and mean p_T ($\langle p_T \rangle$) of light nuclei. Furthermore, we will discuss the centrality and p_T dependence of the coalescence parameters ($B_2(d)$ and $B_3(^3He)$). The physics implications of these results will be discussed.