Beam-energy dependence of the production of light nuclei in Au + Au collision

Wenbin Zhao,[1,2,3,4] Chun Sen,[5,6] Che Ming Ko, Quangshen Liu,[1,2] and Huichao Song[1,2,3]

[1] *Department of Physics and State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing 100871, China*

[2] *Collaborative Innovation Center of Quantum Matter, Beijing 100871, China*

[3] *Center for High Energy Physics, Peking University, Beijing 100871, China*

[4] *Institute of Particle Physics, Key Laboratory of Quark and Lepton Physics (MOE), Central China Normal University, Wuhan, Hubei 430079, China*

[5] *Department of Physics and Astronomy, Wayne State University, Detroit, Michigan 48201, USA*

[6] *RIKEN BNL Research Center, Brookhaven National Laboratory, Upton, New York 11973, USA*

We have used the nucleon coalescence model to study light-nuclei production in the most central Au + Au collisions at $\sqrt{s_{NN}}$ = 7.7, 11.5, 19.6, 27, 39, 62.4, and 200 GeV [1]. The input phase-space distributions of protons and neutrons at kinetic freeze-out for the coalescence calculations are generated from the iEBE-MUSIC hybrid model [2] using three-dimensional dynamical initial conditions and a crossover equation of state. These comprehensive simulations can nicely reproduce the measured p_T spectra of pions, kaons, and (anti-)protons in Au + Au collisions at $\sqrt{s_{NN}} = 7 - 200$ GeV. We have found that the coalescence model calculations can reproduce the measured p_T spectra and dN/dy of (anti-)deuterons and (anti-)tritons and the particle ratio *t/p* within 10% of accuracy. However, the deviations between the calculated and measured particle ratios of *d/p*, $\bar{d}/\bar{p}$, and *t/d* increase to 15%, 20%, and 10%, respectively. Although the coalescence model reasonably describes the p_T spectra and yields of light nuclei at various collision energies, the predicted coalescence parameters of (anti-)deuterons and tritons, $B_2(d)$, $B_2(\bar{d})$, and $\sqrt{B_3(t)}$ decrease monotonically with increasing collision energy (left window of Fig.1),

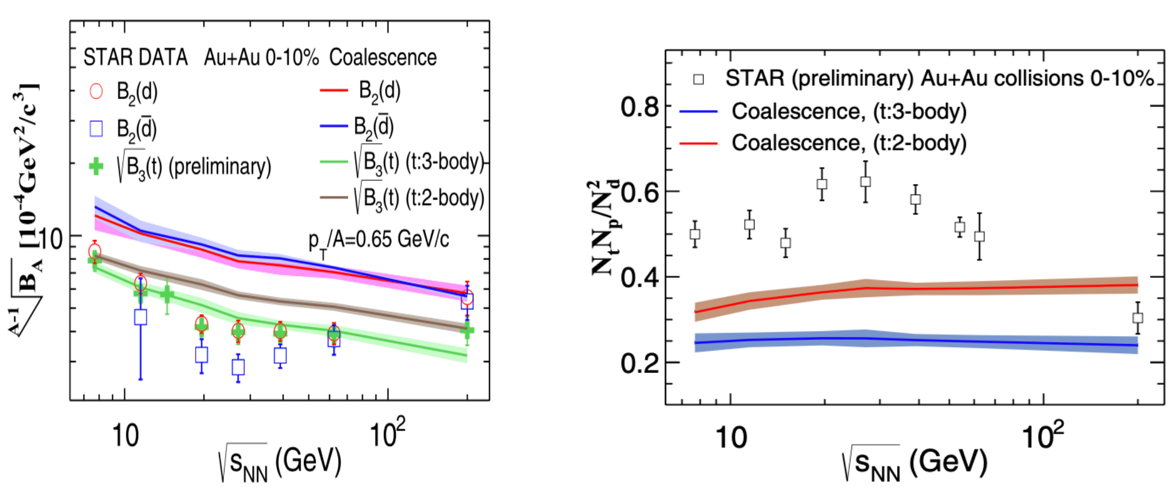

Fig. 1. Collision energy dependence of the coalescence parameters $B_2(d)$, $B_2(\bar{\boldsymbol{d}})$, and $\sqrt{\boldsymbol{B_3(t)}}$ at p_T/A = 0.65 GeV (left window) and the yield ratio $NtNp/\boldsymbol{N_d^2}$ in 0-10% Au + Au collisions, calculated by the coalescence model. Data are taken from Refs. [3,4].

[1] W.B. Zhao, C. Sen, C.M. Ko, G.S. Liu, and H.C. Song, Phys. Rev. C **102**, 072301 (2020).
[2] G.S. Denicol, C. Gale, S. Jeon, A. Monnai, B. Schenke, and C. Shen, Phys. Rev. C **98**, 034916 (2018).
[3] D. Zhang (STAR Collaboration), in *Proceedings of 13th International Conference on Nucleus-Nucleus Collisions, Omiya (Saitama), Japan, 2019* (JPS, Tokyo 2019).
[4] J. Adam *et al.* (STAR Collaboration), Phys. Rev. C **99**, 064905 (2019).
[5] K.-J. Sun, L.-W. Chen, C.M. Ko, and Z. Xu, Phys. Lett. B **774**, 103 (2017).
[6] K.-J. Sun, L.-W. Chen, C.M. Ko, J. Pu, and Z. Xu, Phys. Lett. B **781**, 499 (2018).