

Quantum mechanical softening of the hypertriton transverse momentum spectrum in heavy-ion collisions

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We have investigated hypertriton production in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV using the coalescence model with kinetic freeze-out nucleons and Λ hyperons from a microscopic hybrid approach [1] based on the MUSIC hydrodynamic model [2,3] and the UrQMD hadronic transport model [4]. We have found that the halo structure of hypertriton with a large $\Lambda - d$ distance of approximately 10 fm leads to not only a suppression of ${}^3_{\Lambda}\text{H}$ yield but also a softening of its transverse momentum spectrum with a weak centrality dependence as shown in Fig. 1. In particular, the mean transverse momentum of ${}^3_{\Lambda}\text{H}$, shown in Fig. 2, is found to be significantly smaller than that of helium-3 even in the most central

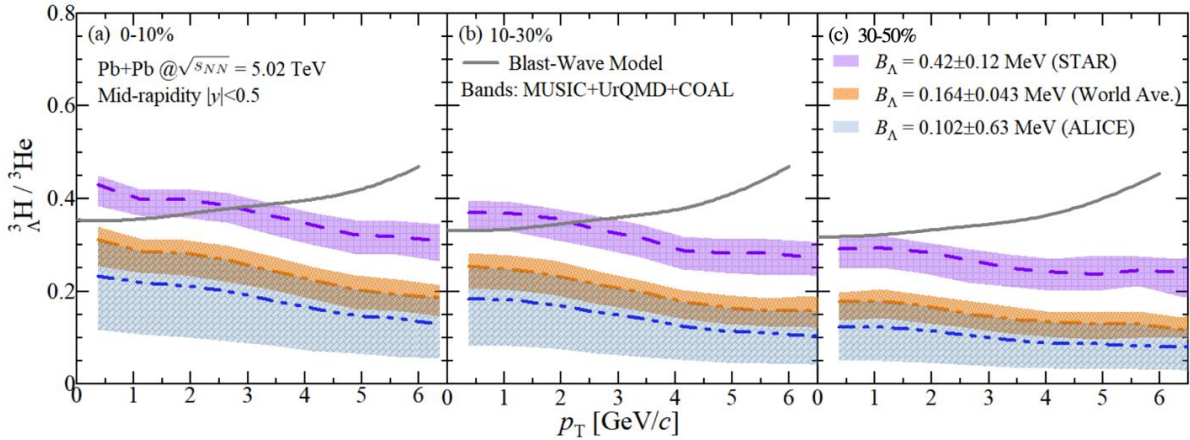


FIG. 1. The yield ratio of hypertriton to helium-3 as a function of transverse momentum in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV for 0-10% (a), 10-30% (b), and 30-50% (c) centralities. Results from the coalescence approach (MUSIC+UrQMD+COAL) and blast-wave model are denoted by shaded regions and solid lines, respectively.

collisions, which is in sharp contrast with the prediction of the blast-wave model [5]. Such a quantum mechanical softening of the (anti-)hypertriton spectrum is a general feature and a natural outcome of the hypertriton wave function used in the final-state coalescence model, which can be readily tested in high-energy experiments with different beam energies and collision systems, providing thus a good opportunity to unravel the production mechanism of (anti-)hypernuclei in high-energy nuclear collisions and also to obtain constraints on the Λ -nucleon interaction.

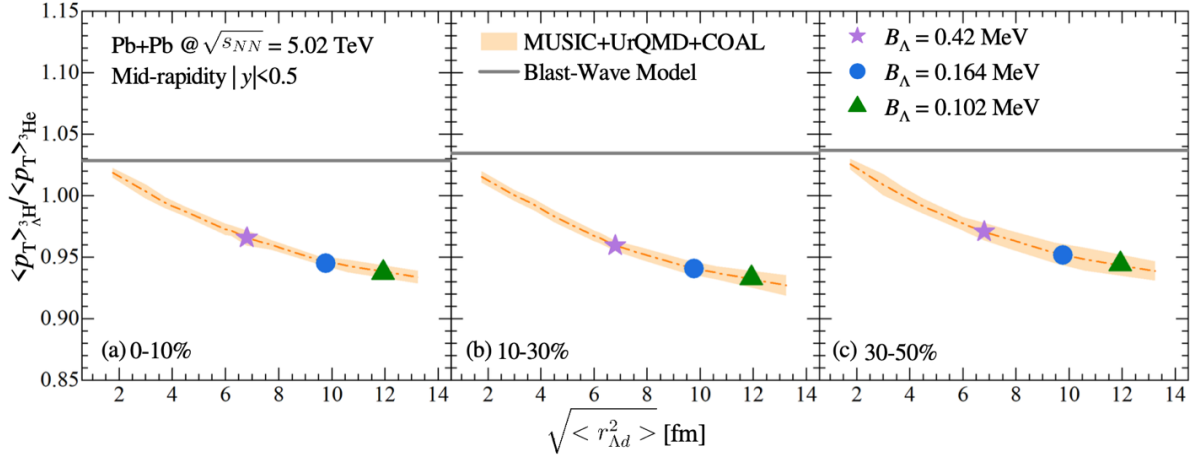


FIG. 2. Ratio of hypertriton to helium-3 mean transverse momentum as a function of $\Lambda - d$ distance in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV for 0-10% (a), 10-30% (b), and 30-50% (c) centralities. The solid lines denote the prediction of the blast-wave model, whereas the shaded bands denote the prediction from the coalescence model. The solid symbols correspond to results obtained for various values of the Λ separation energy B_Λ .

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