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Charm and Bottom hadron production with a coalescence plus fragmentation hadronization approach: AA system size scan down to pp collisions

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Heavy baryon production in pp, pA, and AA collisions from RHIC to top LHC energies presents a challenge for the theoretical understanding of heavy-quark hadronization. An hybrid approach of coalescence plus fragmentation has been successful in accurately predicting the large baryon-to-meson ratio $\Lambda_c/D^0 \sim O(1)$ observed in both AA collisions at RHIC and LHC [1], as well as in pp collisions at 5.02 and $13; \mathrm{TeV}$ [2]. Generally, the obtained ratio is significantly larger than those measured and expected in e^+e^- and ep collisions. Additionally, the same approach predicts a significant $\Xi_c/D^0 \sim 0.15$ and $\Omega_c/D^0 \sim 0.05$ enhancement in pp collisions at $5.02; \mathrm{TeV}$, showing promising agreement with early ALICE measurements [2]. Furthermore, we discuss the extension of the hadronization approach to provide the first predictions for the multi-charmed baryon: Ξ_{cc}, Ω_{cc} and Ω_{ccc}. Furthermore, we explore the evolution of the yield over a wide system size scan from $PbPb$ to $KrKr$, $ArAr$ and OO as planned by ALICE3 [3].

This study allow to investigate the impact on the production coming from non-equilibrium in the charm quark distribution. We find that, generally, the predicted yield in $PbPb$ collision are quite similar to SHM if full thermalization is assumed, but on the other hand multi-charmed baryon, especially Ω_{ccc}, are particularly sensitive to the degree of thermalization of the charm quark distribution. Finally, we present the predictions of the hybrid hadronization via coalescence and fragmentation for bottom hadrons B meson Λ_b and $\Xi_b$baryons and their ratios for PbPb and pp collision at top LHC energies [4].

The comparison between charm and bottom hadron production will provide a novel and more powerful insight not only into the hadronization mechanism but also into the charm and bottom quark equilibration dynamics versus the system size of colliding nuclei.

[1] S. Plumari, V. Minissale, S.K. Das, G. Coci and V. Greco, Eur.Phys.J. C 78 (2018) no.4, 348

[2] V. Minissale, S. Plumari and V. Greco, Physics Letters B 821 (2021) 136622.

[3] V. Minissale, S. Plumari, Y. Sun and V. Greco, arXiv:2305.03687.

[4] V. Minissale, S. Plumari and V. Greco, in preparation.

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