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Radial profile of heavy quarks in jets in high-energy heavy-ion collisions

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Heavy flavor physics in high-energy heavy-ion collisions is a promising and active area to study the " jet quenching " effects both at the RHIC and the LHC. The recent reported D^0 meson radial profiles in jets measured by CMS collaboration provide new experimental constraints on the mechanisms of heavy flavor production in proton-proton collisions and give new insights into the in-medium interaction mechanisms of heavy quarks inside the quark-gluon plasma (QGP). In this talk, we present the first theoretical calculations of the charm and bottom radial distributions relative to the jet axis both in p+p and Pb+Pb collisions at $\sqrt{s_{NN}} = 5.02$TeV. In our work, the in-medium parton propagations are described by a Monte Carlo transport model which uses the next-to-leading order (NLO) plus parton shower (PS) event generator SHERPA as input and includes elastic (collisional) and inelastic (radiative) interaction for heavy quarks as well as light partons, the cold nuclear matter(CNM) effects are also taken into accout. Our simulated results show that, at low D^0 p_T, the radial distribution shifts to larger radius indicating a strong diffusion effect of charm quarks due to the in-medium interactions, but no significant modification observed at high D^0 p_T, which are consistent with the experimental data. In the further study, we estimate the net effect on the heavy quark diffusion from collisional and radiative mechanism, and demonstrate the p_T dependence of this diffusion effect. We find that collisional process has significant effects at low p_T, especially dominates at $0 - 5$GeV, and the radiative process has a non-zero effect even at high $p_T \sim 50$GeV. The total diffusion effect decreases with charm p_T which explains the significant modification at low D^0 meson p_T observed in experiment. As for the bottom quarks, no significant modification on their radial profile in jets is observed in A+A collisions. Actually, due to the mass effect, the in-medium diffusion effects of bottom quarks are smaller both in collisional and radiative interaction relative that of charm quarks. Our study suggests more precise measurements on the charm and bottom radial distributions in jets in heavy ion collisions to disentangle the contributions from collisional and radiaive energy loss, especially at $p_T^Q < 20$GeV.

Collaboration (if applicable)

Track

Heavy Flavor and Quarkonia

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