Contribution ID: **148** Type: **Oral report**

Production of the heavy-flavour decay lepton in high-energy nuclear collisions

Wednesday, 14 August 2024 16:40 (15 minutes)

In this talk, We will present a theoretical study on the production of the heavy-flavour decay lepton (HFL) in high-energy nuclear collisions at the LHC. The pp-baseline is calculated by the FONLL program, which matches the next-to-leading order pQCD calculation with the next-to-leading-log large-p_T resummation. The in-medium propagation of heavy quarks is driven by the modified Langevin equations, which consider both the elastic and inelastic partonic interactions. We propose a method to separate the respective influence of the five factors, such as pp-spectra, the cold nuclear matter (CNM) effects, in-medium energy loss (E-loss), fragmentation functions (FFs), and decay channels, which may contribute to the larger R_{AA} of HFL $\leftarrow b$ compared to that of HFL $\leftarrow c$ in nucleus-nucleus collisions. Based on quantitative analysis, we demonstrate that different decay channels of charm- and bottom-hadrons play an essential role at p_T <5 GeV, while the mass-dependent E-loss dominates the higher p_T region. It is also found that the influences of the CNM effects and FFs are insignificant. At the same time, different initial pp-spectra of charm and bottom quarks have a considerable impact at $p_T > 3$ GeV. Furthermore, we explore the path-length dependence of jet quenching by comparing the HFL R_{AA} in two different collision systems. Our investigations show smaller HFL R_{AA} in Pb+Pb than in Xe+Xe within the same centrality bin, consistent with the ALICE data. The longer propagation time and more effective energy loss of heavy quarks in Pb+Pb collisions play critical roles in the stronger yield suppression of the HFL compared to that in Xe+Xe. In addition, we observe a scaling behaviour of the HFL R_{AA} in Xe+Xe and Pb+Pb collisions.

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Session Classification: 分会场三

Track Classification: 重离子物理