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Kinematics dependent jet transport coefficient in cold nuclear matter

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Extracting the non-perturbative transport coefficient $\hat{q}$ is an important approach to quantify the nuclear medium property probed by the jets traversing the medium. Electron-nucleus (eA) and proton-nucleus (pA) collisions provide a clean environment to delicately study the jet transport coefficient in cold nuclear matter and to test the theoretical framework of jet-medium interaction, and may in turn be instructive for the study of quark-gluon plasma (QGP).

Within the theoretical framework of the higher-twist expansion, we perform the first global extraction of the $\hat{q}$ in cold nuclear matter from the experimental data mainly on various types of transverse momentum broadening in eA and pA collisions. Our global analysis suggests a universal $\hat{q}$ in cold nuclear matter as a function of Bjorken x and probing scale Q^2. Moreover, this kinematic dependence can be converted into the jet energy dependence, which is of great interest in the study of jet quenching in QGP.

Utilizing the extracted $\hat{q}(x, Q^2)$ and its uncertainty determined from a Hessian analysis, we further study relevant observables in future experiments of electron-ion collisions (EIC), including the transverse momentum broadening for single hadron and heavy-quarkonium (J/ψ) productions, as well as the nuclear enhancement of the transverse momentum imbalance for di-hadron and heavy-meson ($D\bar{D}$) pair productions. The future EIC is expected to provide a more precise understanding of the kinematic dependence of the $\hat{q}$ in cold nuclear matter due to the wide kinematic coverage and high-precision measurements.

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No

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