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A study of open-heavy-flavor, heavy-jet, and correlations using the LIDO transport model

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Understanding heavy-flavor transport properties and energy loss inside a quark-gluon plasma (QGP) is a major interest of the heavy-ion phenomenology. In this work, we combine both open-heavy and heavy-flavor jet observables to study the average heavy quark energy loss as well as its fluctuations. Low-momentum heavy quark interacts with QGP mainly through elastic collisions; for high-momentum heavy quark, elastic collisions also induce radiative energy loss. Both energy loss mechanisms can be related to the heavy-quark momentum diffusion coefficient ($\hat{q}$). Recently, we have extracted a temperature and momentum-dependent $\hat{q}$ by comparing to open-heavy-flavor observables (R_{AA} and v_2) using the LIDO transport model [1,2]. We find that even after the parameter calibration, the model still has a large degree of freedom to switch between a Boltzmann equation with large-angle perturbative scattering and a diffusion equation with effective transport coefficients. The reason is that inclusive open-heavy flavor observables are more sensitive to the average energy loss, but they are less efficient in discriminating models with different energy-loss fluctuations (e.g. large-angle scattering and diffusion). We argue that the fluctuation information can be studied using the heavy-flavor jet. First, we use the calibrated model to predict the charmed- and bottom-jet nuclear modification factor. Then, we study traces of the heavy-quark energy-loss fluctuations encoded in the angular and transverse momentum correlations between heavy flavor particles and jets. These observables help to understand heavy-quark-medium interaction in greater detail.

[1] W. Ke, Y. Xu, and S. A. Bass, Phys. Rev. C 98, 064901 (2018).
[2] W. Ke, Y. Xu, and S. A. Bass, Phys. Rev. C 100, 064911 (2019).

Collaboration (if applicable)

Track

Heavy Flavor and Quarkonia

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