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Dynamical Evolution, Hadronization and Angular De-correlation of Heavy Flavor in Hot and Dense QCD Matter at RHIC and LHC

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Heavy flavor serves as a valuable probe of the transport properties of the quark-gluon plasma created in relativistic heavy-ion collisions. Within the framework of a Langevin equation coupled to a (2+1)-dimensional viscous hydrodynamic model, we introduce an algorithm that incorporates not only collisional, but also radiative energy loss for heavy quarks by treating the medium-induced gluon radiation as a recoil force term for heavy quarks traversing the QGP matter. The subsequent hadronization process is calculated using a hybrid recombination plus fragmentation model. Within this improved transport framework, our calculation shows significant contributions from gluon radiation to heavy quark energy loss at high energies; the recombination mechanism is found important for heavy flavor meson production at intermediate energies. Our numerical results provide a good description of D meson suppression and flow measured at both RHIC and LHC, as well as predictions for the future measurements of B mesons. In addition, a new observable – the angular correlation function of heavy flavor pairs – is explored in our study and found to be a potential candidate for distinguishing different energy loss mechanisms of heavy quarks inside a QGP.

Keywords

Heavy flavor, Langevin equation, radiative energy loss, hadronization, angular correlation function.

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