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Flavor hierarchy of jet quenching in relativistic heavy-ion collisions

Summary

Relativistic heavy-ion experiments have observed similar quenching effects for (prompt) D mesons compared to charged hadrons for transverse momenta larger than 6-8 GeV, which remains a mystery since heavy quarks typically lose less energies in quark-gluon plasma than light quarks and gluons. Recent measurements of the nuclear modification factors of B mesons and B-decayed D mesons by the CMS Collaboration provide a unique opportunity to study the flavor hierarchy of jet quenching. Using a linear Boltzmann transport model combined with hydrodynamics simulation, we study the energy loss and nuclear modification for heavy and light flavor jets in high-energy nuclear collisions. By consistently taking into account both quark and gluon contributions to light and heavy flavor hadron productions within a next-to-leading order perturbative QCD framework, we obtain, for the first time, a satisfactory description of the experimental data on the nuclear modification factors for charged hadrons, D mesons, B mesons and B-decayed D mesons simultaneously over a wide range of transverse momenta (8-300 GeV). This presents a solid solution to the flavor puzzle of jet quenching and constitutes a significant step towards the precision study of jet-medium interaction. Our study predicts that at transverse momenta larger than 30-40 GeV, B mesons also exhibit similar suppression effects to charged hadrons and D mesons, which may be tested by future measurements.

Reference:

[1] Wen-Jing Xing, Shanshan Cao, Guang-You Qin, and Hongxi Xing, arXiv:1906.00413

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