

# Perturbative and non-perturbative properties of heavy quark transport in a thermal QCD medium

Monday, 27 October 2025 08:40 (20 minutes)

At leading order in QCD coupling constant, we compute the energy loss per traveling distance of a heavy quark  $dE/dz$  from elastic scattering off thermal quarks and gluons at a temperature  $T$ , including the thermal perturbative description of soft scatterings and a perturbative QCD-based calculation for hard collisions. We re-derive the analytic formula for  $dE/dz$  in the high-energy approximation, resulting in a logarithmic behavior from both the soft and hard contributions. The mass hierarchy is observed as  $dE/dz(bottom) > dE/dz(charm)$  at a given velocity. Our full results are crucial for a better description of heavy quark transport in QCD medium, in particular at low and moderate transverse momentum.

Furthermore, we investigate the nonperturbative effects on the heavy quark transport in a semi-quark-gluon-plasma. The relevant results show that  $dE/dz$  is significantly suppressed due to a background field that is self-consistently generated in the effective theory. The comparisons with the results from the perturbative approach are implemented for both charm and bottom quarks. By utilizing the Langevin dynamics, we also perform the model-data comparisons at RHIC and LHC energies, in particular for the nuclear modification factor and flow coefficients of various heavy-flavor hadrons.

[1] Jiazhen Peng, et al., Unraveling the collisional energy loss of a heavy quark in a quark-gluon plasma, PhysRevD.109.096028 (2024)

[2] Shuang Li, et al., Langevin dynamics of heavy quarks in a soft-hard factorized approach, Eur. Phys. J. C 81, 536 (2021)

[3] Jiazhen Peng, et.al., Perturbative and non-perturbative properties of heavy quark transport in a thermal QCD medium, in preparing

**Primary authors:** LI, Shuang (China Three Gorges University); WANG, Sa (China Three Gorges University); SUN, Fei (CTGU); XIE, Wei (China Three Gorges University)

**Presenter:** LI, Shuang (China Three Gorges University)

**Session Classification:** Parallel II

**Track Classification:** 重味与奇异粒子 (heavy flavor and strangeness)