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Data-driven extraction of heavy quark diffusion in quark-gluon plasm

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Heavy flavor production provides a unique probe for studying the transport properties of the quark-gluon plasma (QGP) formed in high-energy nuclear collisions. Experimental observables like the nuclear modification factor R_{AA} and elliptic anisotropy v_2 of heavy flavor mesons are sensitive to the heavy quark diffusion coefficient. There now exist an extensive set of such measurements, which allow a data-driven extraction of this coefficient. In this work[1], we make such an attempt within our recently developed heavy quark transport modeling framework (Langevin-transport with Gluon Radiation, LGR[2-4]). A question of particular interest is the temperature dependence of the diffusion coefficient, for which we test a wide range of possibilities and draw constraints by comparing relevant charm meson data with model results. We find that a relatively strong increase of diffusion coefficient from crossover temperature T_c toward high temperature is preferred by data.

Furthermore, We have made predictions for Bottom meson observables down to the low momentum region for further experimental tests[5]. It is found that our calculations can describe simultaneously R_{AA} and v_2 data for the prompt and non-prompt D^0 mesons in central $(0-10\%)$ and semi-central $(30-50\%)$ Pb–Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV. Recently, we employ a soft-hard factorized model, which combines a thermal perturbative description of soft scatterings and a perturbative QCD-based calculation for hard collisions, we check the energy and temperature dependence of the heavy quark diffusion coefficients in Langevin dynamics[6]. With the parameter-optimized model, we find that a small value of the spatial diffusion coefficient at transition temperature is preferred by data $2\pi T D_s(T_c) \simeq 6$.

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Present via

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