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Fluid-dynamic description of heavy-quark diffusion in the quark-gluon plasma

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Relativistic heavy-ion collisions are a powerful tool to explore the phase diagram of Quantum Chromodynamics (QCD). Under the extreme energy conditions reached within these experiments, nuclear matter undergoes a transition to a deconfined phase, in which the active degrees of freedom are quarks and gluons, known as quark-gluon plasma (QGP). The characterization of the QGP and its transport properties constitutes one of the main goals of the high-energy nuclear physics program worldwide. Heavy quarks, i.e., charm and beauty, have long been established as excellent probes to characterize the QGP. Due to their large mass, heavy quarks can be produced only via hard partonic scattering processes that take place at the very beginning of the collision, before the QGP is formed. In this talk, I will present a new way of describing heavy-quark dynamics in the QGP based on fluid dynamics. On the one hand, our model allows us to phenomenologically access QCD properties such as the heavy-quark spatial diffusion coefficient. Secondly, it pursues the idea of a universal effective description unifying light and heavy degrees of freedom. It poses the fundamental question of whether the behavior of a complex system like the QGP, which spans over three orders of magnitude in mass scales (from MeV to GeV), can be described by a few macroscopic thermodynamic quantities defined in local kinetic equilibrium.

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