Nuclear Theory

Heavy-Quark Diffusion and Hadronization in Quark-Gluon Plasma

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We calculate diffusion and hadronization of heavy quarks in high-energy heavy-ion collisions implementing the notion of a strongly coupled quark-gluon plasma in both micro- and macroscopic components. The diffusion process is simulated using relativistic Fokker-Planck dynamics for elastic scattering in a hydrodynamic background. The heavy-quark transport coefficients in the medium are obtained from non-perturbative T-matrix interactions which build up resonant correlations close to the transition temperature. The latter also form the basis for hadronization of heavy quarks into heavy-flavor mesons via recombination with light quarks from the medium. The pertinent resonance recombination satisfies energy conservation and provides an equilibrium mapping between quark and meson distributions. The recombination probability is derived from the resonant heavy-quark scattering rate. Consequently, recombination dominates at low transverse momentum (p_T) and yields to fragmentation at high p_T. Our approach thus emphasizes the role of resonance correlations in the diffusion and hadronization processes. We calculate the nuclear modification factor and elliptic flow of D- and B-mesons for Au-Au collisions at the Relativistic Heavy Ion Collider, and compare their decay-electron spectra to available data. We also find that a realistic description of the medium flow is essential for a quantitative interpretation of the data.

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