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Heavy-quark energy loss in the QGP and non-photonic single-electron observables at RHIC

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I will give a general overview about our current theoretical understanding of the thermalization and flow of c- and b-quarks in a Quark-Gluon Plasma (QGP), as believed to be produced in ultra-relativistic heavy-ion collisions. First I will summarize the assessment of heavy-quark-energy loss in the medium through perturbative QCD. Recently, due to the experimental findings about the transverse-momentum (p_T) spectra and elliptic flow (v_2) of non-photonic single electrons ($e^{\pm}$) at the BNL Relativistic Heavy Ion Collider (RHIC), the importance of elastic quark rescattering in addition to the gluon-radiative processes for parton-energy loss has become evident. However, to explain the $e^{\pm}$ data the corresponding effects have to be enhanced by either tuning up the transport coefficient for quark-energy loss, $\hat{q}$, or the gluon density of the medium. Thus also non-perturbative effects have to be considered. We evaluate resonant elastic c- and b-quark rescattering as a non-perturbative mechanism for the thermalization of heavy quarks with the QGP. We describe the interactions of heavy quarks with light quarks within a field theory with light and heavy quarks as well as heavy-light meson resonances as effective degrees of freedom within the QGP. The model is based on chiral and heavy-quark symmetry, taking into account pseudo-scalar D (B) and vector D^* (B^*) mesons and their chiral partners. Within this model, we evaluate drag and diffusion coefficients to assess the flow properties of c- and b-quarks within the QGP, as produced in URHIC's, using a relativistic Langevin simulation. We find that the survival of the resonances at temperatures $T \lesssim 2T_c$ ($T_c \simeq 180$ MeV: critical temperature for the deconfinement transition) accelerates the equilibration of c- and (to less extent) b- quarks significantly compared to the use of perturbative-QCD elastic scattering processes only. Using the such obtained heavy-quark p_T-spectra and elliptic flow, v_2, we employ a coalescence model for hadronization to D- and B mesons for the pertinent non-photonic electron observables and compare to the data from the PHENIX and STAR collaborations at RHIC.