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Diffusion of heavy quarks in the early stages of high-energy nuclear collisions

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We study the diffusion of heavy quarks in the early stages of high-energy nuclear collisions. The pre-equilibrium stage of relativistic heavy-ion collisions, commonly known as Glasma, evolves according to the classical Yang-Mills (CYM) equations. Heavy quarks are coupled to the evolving Glasma fields via relativistic kinetic theory. We compute the momentum broadening as well as the angular momentum fluctuations of charm and beauty quarks in the early stage, which turn out to be anisotropic due to the anisotropy of the background gluon fields. We observe that σ_p ∝ t². This non-Markovian diffusion of heavy quarks in the early stages is explained by the memory effect present in the gluon fields. Furthermore, we also estimate the HQ spatial diffusion coefficient 2πTD_x in the pre-equilibrium phase. The D_x obtained in the pre-equilibrium phase is quite close to the value obtained within pQCD in the QGP phase. Notably, D_x follows a continuous evolution from the pre-equilibrium phase to the QGP phase.

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