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Out-of-equilibrium contributions to charm hadrons in a fluid-dynamic approach

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The charm quark serves as a powerful probe for investigating the properties of the hot and dense QCD medium, the quark-gluon plasma (QGP), created in high-energy heavy-ion collisions. Building on previous studies that demonstrated the applicability of a fluid-dynamic description of charm quarks in the quark-gluon plasma, the present work (https://arxiv.org/abs/2510.25601) extends this framework by computing the out-of-equilibrium contributions to the distribution function of charm hadrons. The analysis accounts corrections arising from the initial out-of-equilibrium distribution of charm quarks following a free-streaming phase, from the freeze-out hypersurface within the fluid dynamic evolution. These results enable the exact computation of integrated yields and transverse momentum distributions of charm hadrons for different values of the spatial diffusion coefficient, thereby providing the basis for a systematic determination of the charm transport coefficients. In addition, the limits of applicability of the approach are identified by determining the transverse-momentum region in which charm hadrons are described by a well-defined, positive distribution function.

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