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Hydrodynamization and thermalization in heavy-ion collisions from a kinetic theory perspective

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Understanding the applicability of fluid-dynamical models to describe the hot and dense matter produced in the early stages of hadronic collisions is a fundamental problem in the field. In particular, it is not clear to what degree this *hydrodynamization* process requires proximity to a local equilibrium state. In this contribution, we study this problem in kinetic theory considering an ultrarelativistic gas undergoing strong longitudinal expansion, assuming Bjorken flow. We solve the Boltzmann equation using a relativistic generalization of the method of moments [1], where the single-particle distribution is reconstructed via a moment expansion. We first demonstrate that this traditional moment expansion actually diverges for this system and that this series must be resummed [2]. We then compare the exact resummed solution of the single-particle distribution function with solutions of the Boltzmann equation in the hydrodynamic limit and verify that the system displays considerable deviations from local equilibrium, even though the energy-momentum tensor is well described by fluid dynamics. We further show the 14-moment approximation [3], widely employed in simulations of heavy ion collisions, does not provide a good approximation for the momentum distribution of this system. We quantity this effect computing the emission of photons in the quark-gluon plasma [4] and verify if this deviation from equilibrium can be observed.

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Category

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