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## Adiabatic hydrodynamization in rapidly-expanding quark-gluon plasma

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We propose a new scenario characterizing the transition of the quark-gluon plasma (QGP) produced in heavy-ion collisions from a highly non-equilibrium state at early times toward a fluid described by hydrodynamics at late times. In this scenario, the bulk evolution is governed by a set of slow modes, after an emergent time scale  $\tau_{\text{Redu}}$  when the number of modes that govern the bulk evolution of the system is reduced. These slow modes are “pre-hydrodynamic” in the sense that they are initially distinct from, but evolve continuously into, hydrodynamic modes in hydrodynamic limit. This picture is analogous to the evolution of a quantum mechanical system that is governed by the instantaneous ground states under adiabatic evolution, and will be referred to as “adiabatic hydrodynamization”. We shall illustrate adiabatic hydrodynamization using a kinetic description of weakly-coupled Bjorken expanding plasma. We first show the emergence of  $\tau_{\text{Redu}}$  due to the longitudinal expansion. We explicitly identify the pre-hydrodynamic modes for a class of collision integrals and find that they represent the angular distribution (in momentum space) of those gluons that carry most of the energy. We use the relaxation time approximation for the collision integral to show quantitatively that the full kinetic theory evolution is indeed dominated by pre-hydrodynamic modes. We elaborate on the criterion for the dominance of pre-hydrodynamic modes and argue that the rapidly-expanding QGP could meet this criterion. Based on this discussion, we speculate that adiabatic hydrodynamization may describe the pre-equilibrium behavior of the QGP produced in heavy-ion collisions.

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