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Onset of non-conformal hydrodynamics and non-conformal hydrodynamic attractor in expanding ultra-relativistic plasmas

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Hydrodynamic attractor behavior plays a key role in the pre-equilibrium evolution of expanding quark-gluon plasmas. Especially, the early-time hydrodynamic attractor allows for early-time initialization of hydrodynamic modelings, which strongly supports the applications of fluid dynamics to small colliding systems.

The hydrodynamic attractor has been well-established in conformal fluids, where initial fluctuations around the attractor evolution follow a power-law decay at early times. Nonetheless, in this talk, by solving 2nd order non-conformal fluid dynamics for out-of-equilibrium systems, we find that early-time attractor behavior is absent in non-conformal fluids. The absence of early-time attractor behavior can be proven to be generic in non-conformal fluids, as a consequence of the instability exhibited in the evolution of initial fluctuations, with a power-law growth. Although the mixing between the shear and the bulk modes can be tuned stable, to fully restore the early-time hydrodynamic attractor, and thus to be conceptually consistent with experimental observations, constraints on the second-order transport coefficient $\delta_{\Pi\Pi}$ can be deduced.

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