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Extending the fluid dynamic description to times before the collision

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Over the past two decades, research has shown that various observables measured in heavy-ion collisions can be effectively described using relativistic fluid dynamics across different collision systems and energies. However, a common challenge in these studies is the modeling of the transition from the initial state to the fluid-dynamic phase. While the collision likely involves complex, far-from-equilibrium dynamics, it is possible that a second-order fluid theory can adequately capture its softer features. In our work (arXiv:2410.08169), we investigate this possibility. We discuss how to characterize the state prior to the collision within this framework, the implications of relativistic causality on the equations of motion, the entropy production from shear and bulk viscous dissipation during the initial longitudinal dynamics, and how this can inform sensible initial conditions for subsequent transverse expansion. If successfully completed, this approach could lead to a comprehensive dynamical description of a heavy-ion collision, where the only free parameters are related to the thermodynamics and the transport properties of quantum chromodynamics.

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