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Covariant formulation of spinodal decomposition for simulating first-order QCD phase transition

We expect to probe the QCD phase diagram in the region beyond the critical point at the beam energy scan program at Relativistic Heavy-Ion Collider (RHIC) and at the upcoming Facility for Antiproton and Ion Research (FAIR). In this region, the heavy-ion collision systems will undergo a first-order phase transition. This phase transition is expected to proceed via spinodal decomposition as the system explores the metastable and unstable areas of the equation of state. To conclusively claim the discovery of the first-order phase transition curve, it is crucial to include spinodal effects in phenomenological simulations of these collisions and identify their experimental signatures. For the first time, we present a covariant formulation of relativistic hydrodynamics including spinodal decomposition [1]. These equations account for surface effects between the two phases and can be used in hydrodynamic models of heavy-ion collisions. We solve them for a nearly boost invariant flow and discuss the effects of phase separation on system evolution.

[1] J. I. Kapusta, M. Singh and T. Welle; arXiv:2407.16963

Category

Theory

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Primary authors: KAPUSTA, Joseph (University of Minnesota); SINGH, Mayank (Vanderbilt University); WELLE, Thomas

Presenter: SINGH, Mayank (Vanderbilt University)

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