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A new stable and causal theory of viscous chiral hydrodynamics

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Over the past decade, considerable research effort has focused on investigating macroscopic consequences of anomalies in quantum field theories. In particular, chiral matter is expected to exhibit novel transport phenomena arising from the interplay between quantum anomalies and electromagnetic and vortical fields [1]. In order to study these effects in fluid systems like the quark-gluon plasma formed in heavy-ion collisions, it is important to develop consistent theories of relativistic chiral hydrodynamics which capture the underlying anomaly and include dissipation. Attempts to develop such theories–even their dissipationless counterparts–have suffered from fundamental issues of acausality, instability, and ill-posedness of the initial value problem [2]. Following an effective field theory approach [3-7], we have constructed a first-order relativistic chiral hydrodynamic theory which is stable and causal within a range of values of transport coefficients. This is the first viscous theory of relativistic chiral hydrodynamics that can be used in numerical simulations of heavy-ion collisions.

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Category

Theory

Collaboration (if applicable)

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