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Transient Relativistic Fluid Dynamics in a General Hydrodynamic Frame

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The formulation of a causal and stable theory of relativistic viscous hydrodynamics is an important field of current research, with direct applications to the modeling of ultrarelativistic heavy-ion collisions. While the theory of relativistic ideal fluids is well established, the incorporation of dissipation introduces qualitatively new challenges due to the need to maintain relativistic causality and stability. A paradigmatic example of how to ensure causality in the linearized regime and stability is the Mueller-Israel-Stewart (MIS) theory [1]. The key idea is that the dissipative contributions are promoted to new degrees of freedom, whose evolution is determined by additional relaxation-type equations coupled with the conservation laws. In a recent development, an alternative formulation of causal and stable first-order relativistic hydrodynamics was introduced by Bemfica, Disconzi, Noronha [2] and Kovtun [3] (BDNK) and proved to be causal in the nonlinear regime and stable. The basic observation of [2] was that the hydrodynamic variables do not have a unique definition out of equilibrium and one can formulate first-order hydrodynamics in a general hydrodynamic frame, which differs from Eckart and Landau's standard choices, without employing additional fields beyond those already found in ideal hydrodynamics. In this work [4], we propose a new theory of second-order viscous relativistic hydrodynamics in a general hydrodynamic frame. It differs from MIS by including additional degrees of freedom, and its first-order truncation reduces to BDNK. Causality and stability hold at the linearized level if suitable conditions on transport coefficients are met. Apart from its conceptual implications, this new theory has potential applications to the modeling of the physics of the quark-gluon plasma as well as viscous simulations of neutron star mergers. As an illustrative example we consider Bjorken flow solutions to our equations and identify variables which make an early-time attractor manifest.

[1] W. Israel and J. M. Stewart, Ann. Phys. 118 (1979) 341–372.

[2] F. S. Bemfica, M. M. Disconzi and J. Noronha, Phys. Rev. D 98 (2018), 104064; Phys. Rev. D 100 (2019) 10, 104020; arXiv:2009.11388.

[3] P. Kovtun, JHEP 10 (2019) 034.

[4] J. Noronha, M. Spalinski and E. Speranza, 2105.01034 (2021).

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