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Extended hydrodynamics regime and jet-medium interaction

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In the context of jet-medium interaction, we consider the response of QCD-like plasma to energy/momentum disturbance as a function of the gradient. For both $N=4$ super-Yang Mills theory in strong coupling limit and kinetic theory under relaxation time approximation, we find that hydrodynamic modes continue dominating medium's response even in the region where Knudsen number is large. However, in this extended hydrodynamic regime, both the first-order and second-order hydrodynamics fail to characterize medium's behavior. We construct a simple yet not trivial extension of the Muller-Israel-Stewart theory, namely MIS, and show this novel framework can quantitatively describe hydrodynamic modes in both hydrodynamic and extended hydrodynamic regimes with a suitable choice of model parameters for representative microscopic theories with and without quasi-particle descriptions. We apply MIS to study how a Bjorken-expanding QGP responds to a moving energetic parton.

[1] Weiyao Ke and Yi Yin, 2208.01046 .

Experiment/Theory

Theory/Phenomenology

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