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Far-from-equilibrium attractor in non-conformal plasmas

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We explore the far-from-equilibrium dynamics of a (0+1)-dimensionally expanding system of massive particles with Bjorken symmetry using kinetic theory and hydrodynamics. By comparing the decay of various initializations on the attractor in both frameworks, we test the effectiveness of hydrodynamics in providing an accurate description of the underlying kinetic theory in far-off-equilibrium regimes. We demonstrate that inclusion of even a small mass scale in units of the system's local temperature drastically alters the well-known attractor behavior of the shear Reynolds number as observed in a weakly-coupled gas with exactly massless excitations. For generic nonzero particle mass, neither shear nor bulk viscous pressure relaxes to a far-from-equilibrium attractor; universal hydrodynamic behavior is manifest only at small values of the inverse Reynolds numbers. In kinetic theory, we find that the scaled longitudinal pressure exhibits fast decay to an early-time attractor, driven by the rapid longitudinal expansion of the medium [1]. Second-order dissipative hydrodynamics, based on a gradient expansion around local thermal equilibrium, fails to accurately describe the attractor. These results will be discussed in the light of fixed lines and fixed points of non-conformal kinetic theory and hydrodynamics. A modified anisotropic hydrodynamic prescription that provides excellent agreement with kinetic theory and reproduces the attractor will be presented [2].

[1] Non-conformal attractor in boost-invariant plasmas, C. Chattopadhyay, S. Jaiswal, L. Du, U. Heinz, and S. Pal, arXiv: 2107.05500 (2021)

[2] On non-conformal kinetic theory and hydrodynamics for Bjorken flow, S. Jaiswal, C. Chattopadhyay, L. Du, U. Heinz, and S. Pal, arXiv: 2107.10248 (2021)

Authors: JAISWAL, Sunil (Tata Institute of Fundamental Research); CHATTOPADHYAY, Chandrodoy (North Carolina State University); DU, Lipei (McGill University); PAL, Subrata (Tata Institute of Fundamental Research); HEINZ, Ulrich (The Ohio State University)

Presenter: JAISWAL, Sunil (Tata Institute of Fundamental Research)

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