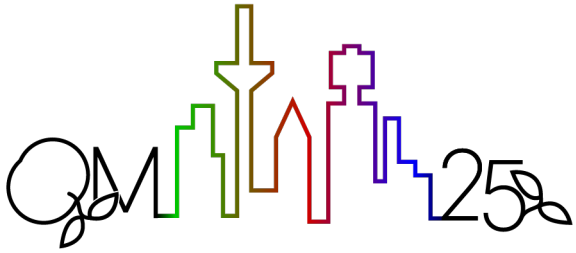

Contribution ID: **880** Type: **Oral**

Stochastic Hydrodynamics and the Density Frame

Tuesday 8 April 2025 17:50 (20 minutes)

We describe a unique formulation of relativistic viscous fluid dynamics based on the *density frame*. The equations of motion are strictly first order in time and have no non-hydrodynamic modes. The only fields are the energy and momentum densities $T^{0\mu}$ and the only parameters are the equilibrium equation state and the shear and bulk viscosities. We compare numerical results to QCD kinetic theory simulations for a set of one dimensional tests – we find excellent agreement within the regime of applicability of hydrodynamics, and the simulation is well behaved outside of this regime. The results are compared to a second-order formulation developed by Bemfica, Disconzi, Noronha, and Kovtun (BDNK) as well as to second-order hydrodynamics as implemented in MUSIC.

In the density frame we propose a strikingly simple algorithm to simulate stochastic relativistic fluid dynamics based on the Metropolis updates. Each step of the algorithm begins with an update based on ideal hydrodynamics. Then random (three) momentum transfers between fluid cells are proposed. These proposals are then accepted or rejected using the change in entropy as the Boltzmann weight. On average the algorithm reproduces viscous hydrodynamics in the density-frame. The algorithm can be generalized to general coordinates and space-time foliations by parallel transporting the proposed momentum transfers.

References:

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Category

Theory

Collaboration (if applicable)

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