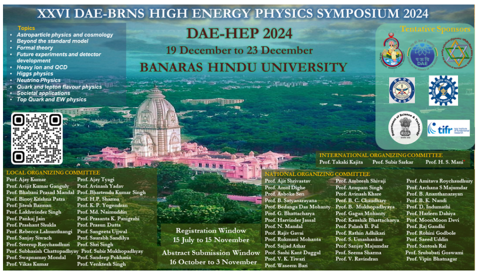

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Stochastic relativistic advection diffusion equation from the Metropolis algorithm

We study an approach to simulating the stochastic relativistic advection-diffusion equation based on the Metropolis algorithm. We show that the dissipative dynamics of the boosted fluctuating fluid can be simulated by making random transfers of charge between fluid cells, interspersed with ideal hydrodynamic time steps. The random charge transfers are accepted or rejected in a Metropolis step using the entropy as a statistical weight. This procedure reproduces the expected stress of dissipative relativistic hydrodynamics in a specific (and noncovariant) hydrodynamic frame known as the density frame. Numerical results, both with and without noise, are presented and compared to relativistic kinetics and analytical expectations. An all order resummation of the density frame gradient expansion reproduces the covariant dynamics in a specific model. In contrast to all other numerical approaches to relativistic dissipative fluids, the dissipative fluid formalism presented here is strictly first order in gradients and has no nonhydrodynamic modes. The physical naturalness and simplicity of the Metropolis algorithm, together with its convergence properties, make it a promising tool for simulating stochastic relativistic fluids in heavy ion collisions and for critical phenomena in the relativistic domain.

Field of contribution

Theory

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