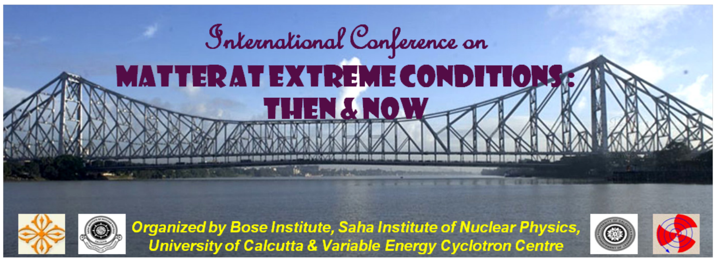

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Relativistic third-order viscous hydrodynamics from kinetic theory

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We present the derivation of a novel third-order hydrodynamic evolution equation for shear stress tensor from kinetic theory. Boltzmann equation with relaxation time approximation for the collision term is solved iteratively using Chapman-Enskog like expansion to obtain the non-equilibrium phase-space distribution function. Subsequently, the evolution equation for shear stress tensor is derived from its kinetic definition up-to third-order in gradients. We quantify the significance of the new derivation within one-dimensional scaling expansion and demonstrate that the results obtained using third-order viscous equations derived here provides a very good approximation to the exact solution of Boltzmann equation in relaxation time approximation. We also show that the time evolution of pressure anisotropy obtained using our equations is in better agreement with transport results when compared with an existing third-order calculation based on the second-law of thermodynamics.

Summary

We have derived a novel third-order evolution equation for the shear stress tensor from kinetic theory within relaxation time approximation. Instead of Grad's 14-moment approximation, iterative solution of Boltzmann equation has been used for the non-equilibrium distribution function and the evolution equation for shear tensor is derived directly from its definition. Within one-dimensional scaling expansion, we have demonstrated that the third-order hydrodynamics derived here provides a very good approximation to the exact solution of Boltzmann equation in relaxation time approximation. Our results also show a better agreement with the parton cascade BAMPS for the P_L/P_T evolution compared to those obtained from entropy derivation.

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