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Dynamical Attractors in a Full Transport Approach

In the description of the heavy-ion collisions, the success of hydrodynamics even when the system is far from equilibrium has raised some questions about the applicability of this theory and about the evolution of the medium itself, especially for smaller systems like p-A and p-p collisions. It has been found that, well before equilibrium is reached, systems with different initial conditions show a universal behavior in several physical quantities: this universality is evident in the appearance of dynamical attractors. We investigate the existence of far-from equilibrium attractors in momentum moments of the one particle distribution function by means of a 3+1D Boltzmann transport approach at fixed η/s with the full collision integral. Attractors are found in the normalized moments of the distribution function and in the evolution of the distribution function itself. We show the results in systems with Bjorken symmetry, for which analytical relaxation-time approximation and hydrodynamic solutions are available, by simulating a 1D boost-invariant system and compare our outcomes with the analytical ones. Afterwards, we find that attractors still exist when the boost-invariance is explicitly broken by the initial particle distribution. Finally, we show that attractors appear also if we consider various temperature dependencies for η/s. The results that will be discussed prove that the universal behavior of the distribution function is more general than as so far explored in literature.

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