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Nonequilibrium effects at the phase transition in chiral fluid dynamics including dissipation and noise

We present a dynamic study of nonequilibrium fluctuations and correlations at the chiral phase transition starting from the linear sigma model with constituent quarks.
Within the formalism of the two-particle irreducible (2PI) effective action the nonequilibrium dynamics of the sigma field coupled to the fluid dynamic expansion of quarks is obtained consistently. We derive the Langevin equation for the sigma field with the explicit damping coefficient and the noise terms, which are similar to those we obtain from the influence functional method. The 2PI effective action in addition contains information about the local equilibrium properties of the quark fluid like the energy density and the pressure, which are needed for the equation of state. We go beyond existing studies of Langevin dynamics at the chiral phase transition by putting special emphasis on the properties and the evolution of the heat bath. The damping in the dynamics of the sigma field leads to energy dissipation from the field to the fluid. In the exact formalism of the 2PI effective action a conserved energy-momentum tensor can be constructed.
Investigating the coupled dynamics of the sigma field and the expansion of the quark fluid we present results on the intensity of sigma fluctuations and the correlations at the critical point and the first order phase transition observing strong nonequilibrium fluctuations and correlations.

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