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The QCD phase transition in nonequilibrium chiral fluid dynamics

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In thermodynamics system the correlation length of fluctuations of the order parameter diverges at a critical point. This is the basis of expecting large event-by-event fluctuations for heavy-ion collisions that reach in the critical region. Heavy-ion collisions are however very small and dynamic systems, which at most reach local thermal equilibrium. The effect of critical slowing down is further expected to limit the size of the fluctuations. We present a fully dynamic nonequilibrium model of the evolution of the fluctuations of the order parameter of chiral symmetry, the sigma field. It is propagated by a Langevin equation and couples to an expanding fluid of quarks and antiquarks. The entire system evolves under energy- and momentum conservation.
Nonequilibrium effects, like supercooling and reheating, are observed.
At a critical point the dynamic correlation length grows. As a consequence we find an enhancement of event-by-event fluctuations for a scenario with a critical point compared to a first order phase transition.

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