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Thermalization and prethermalization in the soft-wall AdS/QCD model

The real-time dynamics of chiral phase transition is investigated in a two-flavor soft-wall anti–de Sitter/QCD model. To understand the dynamics of thermalization, we quench the system from initial states deviating from the equilibrium states. Then, we solve the nonequilibrium evolution of the order parameter (chiral condensate). It is shown that the system undergoes an exponential relaxation at temperatures away from the critical temperature Tc. The relaxation time diverges at Tc, presenting a typical behavior of critical slowing-down. Numerically, we extract the dynamic critical exponent z and get $z\approx2$ by fitting the scaling behavior. More interestingly, it is remarked that, for a large class of initial states, the system would linger over a quasi-steady-state for a certain period of time before the thermalization. It is suggested that the interesting phenomenon, known as prethermalization, has been observed in the framework of holographic models. In such prethermal stage, we verify that the system is characterized by a universal dynamical scaling law and described by the initial-slip exponent $\theta=0$.

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