Influence of Initial Kinetic Energy Distributions on the Metastability of the Classical Inertial Infinite-Range-Interaction Heisenberg Ferromagnet

Fernando D. Nobre

Centro Brasileiro de Pesquisas Físicas
Rua Xavier Sigaud 150 , 22290-180 Rio de Janeiro - RJ Brazil

A system of N classical Heisenberg-like rotators, characterized by infinite-range ferromagnetic interactions, is studied numerically within the microcanonical ensemble through a molecular-dynamics approach. Such a model, known as the classical inertial infinite-range-interaction Heisenberg ferromagnet, exhibits a second-order phase transition within the standard canonical-ensemble solution. The time evolution of the kinetic temperature exhibits a metastable state, whose duration diverges as $N \to \infty$, before attaining the terminal thermal equilibrium [1,2]. Such a metastable state is observed for a whole range of energies, which starts right below criticality and extends up to very high energies (in fact, the gap between the kinetic temperatures associated with the metastable and the terminal equilibrium states is expected to disappear only as one approaches infinite energy). To our knowledge, this has never been observed on similar Hamiltonian models, in a noticeable way, for such a large range of energies. For example, in the XY ($n = 2$) version of the present model, such behavior was observed only near criticality. We show that this metastable state depends on both initial conditions for the spin variables, as well as on how the initial kinetic energy is partitioned among the components of angular velocities.

[1] F.D. Nobre and C. Tsallis, Phys. Rev. E **68**, 036115 (2003).

[2] F.D. Nobre and C. Tsallis, Physica A **344**, 587 (2004).