Freie Universität Berlin

Colloquium
Dahlem Center for Complex Quantum Systems

Failure of the Generalized Gibbs Ensemble Hypothesis

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Recently, mostly triggered by the spectacular progress of experiments on cold atomic systems, considerable attention has been devoted to the equilibration of closed interacting quantum systems. In this talk, I will review some of the most basic concepts of thermalization in closed quantum systems, such as the eigenstate thermalization hypothesis (ETH) and the generalized Gibbs ensemble (GGE) hypothesis. I will present numerical as well as analytical results for the non-equilibrium time evolution of the spin-1/2 anisotropic Heisenberg spin chain, with a choice of dimer product and Néel states as initial states. We find for various short-ranged spin correlators that they deviate significantly from predictions based on the generalized Gibbs ensemble hypotheses in the long-time limit. Computing the asymptotic spin correlators within the recently proposed quench-action formalism, however, excellent agreement is found with the numerical data. These results lead us to the conclusion that the GGE cannot give a complete description of the equilibration of a closed quantum system even for local observables [Phys. Rev. Lett. 113 (2014) 117203], while the quench-action formalism captures correctly the steady state in this case.