Prethermalization and thermalization of weakly interacting quantum systems

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Abstract:
When a quantum many-body system is suddenly forced out of equilibrium, it is expected to relax to the thermal state predicted by statistical mechanics, which depends only on energy and particle number. However, integrable systems usually relax instead to a nonthermal state, because a detailed memory on the initial conditions persists due to the many constants of motion. On the other hand generic, nonintegrable systems are expected to relax to a thermal state, as observed, e.g., for quenches to intermediate Hubbard interaction [1]. A special situation arises for weakly interacting systems: due to the proximity of an integrable, noninteracting Hamiltonian they can at first be trapped in a so-called prethermalized state [2]. This prethermalization regime is again due to a large number of - now only approximate - constants of motion and can be represented by a generalized Gibbs ensemble [3]. A weak-coupling kinetic theory [4] can then be used to describe both the initial prethermalization regime as well as the subsequent crossover towards the thermal state.

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[2] M. Moeckel and S. Kehrein, PRL 100, 175702 (2008).
[3] M. Kollar, F. A. Wolf, and M. Eckstein, PRB 84, 054304 (2011).
[4] M. Stark and M. Kollar, arXiv:1308.1610.