NON-ERGODIC STATES IN QUANTUM SPIN CHAINS

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The time evolution of non-equilibrium states in interacting quantum systems is discussed. In the thermodynamic limit, the fundamental assumption of quantum ergodicity asserts that arbitrary initial states should relax to equilibrium at asymptotically long times [1]. But the above assumption is not completely universal, and a number of quantum systems, including experimental demonstrations, have been proposed for non-ergodic behavior [2]. In the present contribution, we discuss an illustrative example for the preparation of non-ergodic states. We found that underlying properties of the energy spectrum are essential to get the above behavior, with the presence of a continuous branch plus localized levels. The interplay of the continuous and discrete parts of spectrum, determines the way that the system evolves at very long times. The semi-infinite XY spin chain with an impurity at the boundary has been chosen as a prototype system to test our working hypothesis. In the thermodynamic limit, the model is exactly solvable and the spectrum has a mixed character, with a continuous band and localized levels [3]. After the preparation of an arbitrary initial state, we portray the dynamics of this system by observing the site magnetization along the chain. Its long-time behavior is estimated using the stationary phase method. When two impurity states exist, the quantum interference between them leads to magnetization oscillations which settle over very long times with the absence of damping, the system being never stationary, nor homogeneous. The frequency of the remanent oscillation is recognized as being the Rabi frequency of the localized levels.

[1] S. Goldstein, J. L. Lebowitz, R. Tumulka, N. Zanghì, Eur. Phys. J. H **35**, 173 (2010).

[2] T. Kinoshita, T. Wenger, D. S. Weiss, Nature **440**, 900 (2006), and references there in.

[3] A. O. García Rodríguez and G. G. Cabrera, arXiv:1703.03446 [cond-mat.stat-mech].