Stark many-body localization in the J_1-J_2 Heisenberg model

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Abstract

Stark many-body localization (SMBL) is a phenomenon observed in interacting systems with a nearly uniform spatial gradient applied field. Contrasting to the traditional many-body localization phenomenon, SMBL does not require disorder [1]. We have investigated SMBL in a spin-1/2 described by a Heisenberg model including a next-nearest-neighbor exchange coupling [2]. By employing an exact diagonalization approach and time evolution calculation we analyze both level spacing ratio (LSR) statistics of the Hamiltonian model as well as the dynamics of the system from a given initial state. Our results reveals that for zero field in our finite system, LSR statistics suggest localization while the dynamics shows thermalization, which has been attributed to a finite size effect. Slightly nonuniform field gradient, LSR statistic predictions agree very well with the dynamics of the physical quantities indicating delocalization and localization for small and large field gradient, respectively. More interestingly, we find that localization is robust in the presence of next-nearest-neighbor coupling in the Hamiltonian. Moreover, this coupling can be tuned to enhance SMBL in the system, meaning that localized regimes can be obtained for smaller field gradient as compared to the traditional nearest-neighbor isotropic Heisenberg model [3].

References

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