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Many-Body Localization Characterized from a One-Particle Perspective

mardi 14 juin 2016 12:15 (45 minutes)

We show that the one-particle density matrix ρ can be used to characterize the interaction-driven many-body localization transition in closed fermionic systems. The natural orbitals (the eigenstates of ρ) are localized in the many-body localized phase and spread out when one enters the delocalized phase, while the occupation spectrum (the set of eigenvalues of ρ) reveals the distinctive Fock-space structure of the many-body eigenstates, exhibiting a steplike discontinuity in the localized phase. The associated one-particle occupation entropy is small in the localized phase and large in the delocalized phase, with diverging fluctuations at the transition. We analyze the inverse participation ratio of the natural orbitals and find that it is independent of system size in the localized phase. We furthermore study the dynamical properties of the natural orbitals after a) a global quantum quench from a product state, and b) after adding or removing a natural orbital quasiparticle from an eigenstate.

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