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Many-Body Localization Characterized from a One-Particle Perspective

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Abstract:

We show that the single particle density matrix can be used to characterize the interaction-driven many-body localization transition in closed fermionic systems. The occupation spectrum (the set of eigenvalues of density-matrix) reveals the distinctive Fock-space structure of the many-body eigenstates, exhibiting a step like 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.