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Localization detection based on quantum dynamics

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Abstract

In disordered quantum many-body systems, strong disorder can lead to localization. Recent advancements in quantum technologies have enabled the probing of such localization phenomena through quantum dynamics. This work explores the observation of localization in a quantum spin chain. Numerical simulations using exact diagonalization demonstrate that magnetization and twist overlap, measured after short evolution, are promising indicators of disorder-induced localization. Furthermore, localization can be detected experimentally on a noisy quantum computer. While both observables can be easily measured by examining qubits at the end of the time evolution, computations reveal that twist overlap is more susceptible to noise-induced errors than magnetization. Despite this, twist overlap offers greater insight into the system's behavior than magnetization alone.