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Phase space methods for studying the disordered Hubbard model

SEAN R. MULEADY, JILA, NIST, University of Colorado, Boulder, ITAMAR KIMCHI, RAHUL NANDKISHORE, Department of Physics and Center for Theory of Quantum Matter, University of Colorado, Boulder, ANA MARIA REY, JILA, NIST, University of Colorado, Boulder — Ultracold atoms in optical lattices provide a platform for studying localization and relaxation dynamics in isolated quantum systems, offering insight into the interplay between disorder and interactions. However, very little is known about the nonequilibrium behavior of such systems, especially in higher dimensions where the physics is often beyond the reach of numerical and analytical tools. Here, we theoretically study doublon decay in the strongly-repulsive, disordered Hubbard model, characterizing the dynamics in different regimes in terms of experimentally accessible quantities. We develop and apply extensive numerical simulations based on the discrete truncated Wigner approximation (dTWA) which allows us to access excited-state dynamics and long-time relaxations for large systems in higher dimensions. This work is relevant for current optical lattice experiments in disordered, interacting systems.

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