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Test of Particle-Assisted Tunneling for Strongly Interacting Fermions in an Optical Superlattice TIM GOODMAN, LUMING DUAN, FOCUS Center and MCTP, Department of Physics, University of Michigan — Fermions in an optical lattice near a wide Feshbach resonance are expected to be described by an effective Hamiltonian which is equivalent to the general Hubbard model (GHM), with particle-assisted tunneling rates resulting from the strong atomic interaction. [Phys. Rev. Lett. 95, 243202 (2005).] Here, we propose a scheme to unambiguously test the predictions of this effective Hamiltonian through manipulation of ultracold atoms in an inhomogeneous optical superlattice. The superlattice potential separates the lattice into an array of independent double wells, allowing an exact solution of the GHM which can be compared with experimental observations. In practical experimental configurations the presence of a global harmonic trap makes each double well slightly different, and the measured time-of-flight images involve signals that are averaged over all potential wells. In spite of this complication, we show that under appropriate manipulation of the lattice barrier and the! external magnetic field, one can reconstruct precisely the two-site dynamics from the time-of-flight images. This provides a quantitative testbed to compare theory with experiments in the strongly interacting region. The proposed measurement also allows us to infer the structure of the low energy Hilbert space, directly testing a key assumption in the derivation of the effective Hamiltonian, and it allows a complete empirical determination of all the parameters in the effective GHM, including the particle-assisted tunneling rates.

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