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Free Expansion of ultracold fermions in an optical lattice ULRICH SCHNEIDER, LMU Munich, LUCIA HACKERMUELLER, JENS PHILIPP RONZHEIMER, SEBASTIAN WILL, SIMON BRAUN, THORSTEN BEST, MICHAEL SCHREIBER, KIN CHUNG FONG, IMMANUEL BLOCH — Recent experiments with ultracold fermions in optical lattices face two main challenges in the quest of realizing complex strongly-correlated states: While the need to realize low entropy samples resulted in several recent proposals of advanced cooling schemes there remains the problem of the unknown adiabaticity timescales in these inhomogeneous systems. In order to measure the characteristic timescales of density redistribution, we experimentally investigate the free expansion of fermionic ^{40}K atoms in an homogeneous optical lattice. In an initially non-interacting band-insulater, created in the combination of a blue-detuned optical lattice and a red-detuned optical dipole trap, interactions are introduced by use of a Feshbach resonance. Subsequently the expansion is initiated by quickly ramping down the dipole trap while retaining the optical lattice. In the case of negligible interactions, the atoms expand ballistically performing a continuous quantum walk. For interacting fermions, the expansion becomes diffusive with a density dependent diffusion constant that is independent of the sign of interactions. These measurements demonstrate previously unobserved transport dynamics and give insight into the characteristic timescales of density redistribution.

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