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Dynamics of a Hole Dopant in a Fermi Hubbard Antiferromagnet

MUQING XU, GEOFFREY JI, MARTIN LEBRAT, LEV KENDRICK, CHRISTIE CHIU, MARKUS GREINER, Harvard University — Ultracold fermions in optical lattices have opened new perspectives in the study of strongly correlated systems and have been used to realize the Fermi Hubbard model, which is believed to exhibit many quantum phases and to capture the essential physics of cuprate high-temperature superconductivity. The site-resolved readout and manipulation offered by quantum gas microscopy allows detailed exploration of the interplay between charge and spin, which underlies much of the phenomena of the Fermi Hubbard model with doping. On this platform we study the dynamics upon releasing an initially pinned hole dopant. We first prepare a two-component ultracold fermi gas with Lithium-6 loaded into a 2-dimensional square optical lattice at half-filling, which exhibits strong antiferromagnetic correlations. We use a digital micromirror device to create a pinned hole dopant while loading the lattice potential. We then release the dopant by quenching off the pinning potential and probe its motion and how it interacts with and scrambles the spin environment. The microscopic dynamics of dopants may provide further insights into understanding the quantum phases in the doped Hubbard model.

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