Abstract:

Strongly interacting ultracold atoms provide a promising platform for studying quantum many-body systems. We confine ultracold fermionic atoms in optical lattices to realize the Fermi-Hubbard model, and use a microscope to image each individual atom with a spatial resolution of single lattice site. We observe metallic, Mott insulating and band insulating states, and measure the nearest-neighbor antiferromagnetic spin correlations. In addition to equilibrium properties, we study transport phenomena of the Fermi-Hubbard model and observe spin diffusion in a Mott insulator. This work can be extended to further investigate the interplay between spin and charge transport, as a function of temperature, doping and driving frequency.