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Continuous in situ fluorescence imaging of an ultracold Fermi gas in an optical lattice RHYS ANDERSON, GRAHAM EDGE, RYAN DAY, DANIEL NINO, STEFAN TROTZKY, JOSEPH THYWISSEN, University of Toronto — We demonstrate continuous in situ fluorescence imaging of ultracold fermionic ^{40}K atoms held in a three-dimensional optical lattice with 527nm periodicity. Using a 4S-4P$_{1/2}$ grey molasses cooling scheme with a coherent dark state, we obtain a photon scattering rate exceeding 1kHz while measuring a steady-state population of the vibrational ground state of 80%. Collecting the scattered photons through a 200μm thin sapphire vacuum window and into a microscope objective allows us to image the in situ density distribution of the lattice gas. Spatially selective state manipulation is used to reduce the number of occupied lattice planes along the imaging direction, as well as to create density patterns along the transverse direction. We characterize the performance of the imaging protocol over a wide range of parameters. For larger-than-unity site occupation we observe efficient removal of atoms due to light-assisted collisions. Singly occupied lattice sites can be continuously imaged for several seconds. This method is suitable for high-resolution imaging of a many-body system in the Fermi-Hubbard regime.

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