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Combining sideband cooling schemes for fluorescence imaging of fermions in an optical lattice RHYS ANDERSON, GRAHAM EDGE, PEI-HANG XU, VIJIN VENU, FUDONG WANG, STEFAN TROTZKY, JOSEPH THYWISSEN, University of Toronto — Quantum gas microscopes offer a unique tool with which to study strongly interacting cold atom systems. We report on the combination of Raman sideband cooling and electromagnetically-induced transparency (EIT) cooling of potassium-40 for this purpose. EIT cooling is performed in the plane perpendicular to the imaging axis via the D_1 transition, and provides the fluorescence necessary for imaging. Other laser beams detuned by 25 GHz from the D_2 line drive Raman transitions to lower energy states, enabling an additional cooling mechanism. The scheme is implemented in a 1200 Er lattice, with a bias magnetic field, and beam polarization keeps the atoms confined to stretched states. Collection of scattered photons through a 0.8 NA microscope objective results in detection of 600 photons per atom in a two second exposure, which is sufficient to resolve individual atoms with a PSF of FWHM 600 nm. The combination of these two cooling schemes resulted in a five-fold improvement in photon collection rate relative to either individual scheme for our system, while still allowing for 94 % of the atoms to remain pinned between two successive exposures. Fluorescence imaging of samples will allow for characterization of the dynamics of interacting fermions in periodic potentials.

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