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**Cavity-aided magnetic-resonance imaging of atoms in optical lattices** NATHAN BRAHMS, University of California, Berkeley, THOMAS PURDY, JILA, DANIEL W.C. BROOKS, THIERRY BOTTER, DAN M. STAMPER-KURN, University of California, Berkeley — Microscopic imaging is a powerful tool for measuring cold-atom systems, enabling the readout of ultracold atomic simulators and registers, the characterization of inhomogeneous environments, and the determination of spatially varying thermodynamic quantities. Single-optical-lattice-site microscopy has recently been demonstrated, using fluorescence and ionization imaging. However, these methods destroy the quantum states being measured and have limited dynamic range. Here we demonstrate single-lattice-site imaging using magnetic-resonance imaging, enabled by using a high-finesse cavity for spin measurement. The images are state sensitive and have 150 nm spatial resolution. We measure atoms with high dynamic range, sensing up to 1000 atoms in single lattice sites with a sensitivity of $\pm 10$ atoms, or a sensitivity of $\pm 2.4$ for up to 70 atoms. We apply this technique to measure the nonequilibrium transport dynamics of the atoms, observing the onset of interaction-inhibited transport in a nondegenerate gas.

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