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A quantum-gas microscope for fermionic 40-potassium

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Single-atom-resolved detection in optical lattices using quantum-gas microscopes has enabled a new generation of experiments in the field of quantum simulation. Here we demonstrate single-site- and single-atom-resolved florescence imaging of fermionic potassium-40 atoms in a quantum-gas microscope setup using electromagnetically-induced-transparency cooling [E. Haller et al., Nature Physics 11, 738 (2015)]. We detected on average 1000 fluorescence photons from a single atom within 1.5s, while keeping it close to the vibrational ground state of the optical lattice. Our fermionic quantum-gas microscope will provide the possibility to probe quantities that are difficult to access in bulk systems, such as spin-spin-correlation functions or string-order. It would allow the study of, e.g. the Fermi-Hubbard Model and allow for the direct observation of band insulators, metallic phases and Mott insulators at the single-atom level. Future studies could include out-of-equilibrium dynamics, and the direct observation of entanglement build-up of in many-particle fermionic quantum systems.