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A quantum gas microscope for the simulation of condensed matter systems[1] WASEEM BAKR, JONATHON GILLEN, AMY PENG, SIMON FOELLING, MARKUS GREINER, Harvard University — Ultracold atoms in optical lattices provide an exciting new opportunity to study condensed matter physics. These systems allow for the implementation of idealized theoretical models with high fidelity. Compared to typical real crystals, the lattice spacings of the optical potential are increased by at least three orders of magnitude, bringing optical single site addressability within reach. Imaging atoms on single lattice sites will allow direct detection of quantum states such as the Mott insulator and antiferromagnetic states. We present our implementation of a quantum gas microscope to experimentally realize high resolution imaging and spatial addressability of a rubidium atom ensemble loaded into an optical lattice. Very good optical access to the atoms combined with solid immersion-like geometry is expected to provide an imaging resolution of about 0.5 microns. We realize a long lived two-dimensional quantum gas inside a novel opto-magnetic surface trap using an evanescent wave potential. To create the lattice potential we developed a projection approach using holographic phase masks. We have loaded a quantum gas into the lattice potential and are working on resolving single atoms on the lattice sites.

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