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Low-Entropy Mott Insulators in the Quantum Gas Microscope PHILIPP PREISS, JONATHAN SIMON, WASEEM BAKR, RUICHAO MA, ERIC TAI, MARKUS GREINER — Ultracold atoms in optical lattices are a promising candidate for the simulation of condensed matter systems due to the exquisite control over interactions and geometries. Of particular interest is the study of quantum magnetic interactions with possible insights into high-temperature superconductivity. Progress in this direction has been hindered by the difficulty of extracting local observables and attaining the requisite temperatures and entropies. Here we present the experimental realization of a low-entropy Mott insulator of ultracold atoms. Using a quantum gas microscope, we project a square lattice onto a two-dimensional ^{87}Rb BEC. Single-site resolution of the microscope allows measurements of local number statistics. We observe 15x15-site Mott insulator domains with 95(2)% fidelity. The low-entropy Mott insulator domains are excellent starting points for the exploration of condensed matter phenomena, including a mapping of dipole excitations onto an antiferromagnetic Ising Hamiltonian. We expect the combination of high-fidelity initialization and single-site read-out of a cold-atom system to trigger progress in the crossover between atomic and condensed matter physics.

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