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Fermionic Many-Body States Under the Microscope ANTON MAZURENKO, DANIEL GREIF, MAXWELL F. PARSONS, CHRISTIE S. CHIU, SEBASTIAN BLATT[1], FLORIAN HUBER[2], GEOFFREY JI, MARKUS GREINER, Harvard University — We demonstrate the site-resolved observation of two component, fermionic Mott insulators, band insulators and metals of ultracold ^{6}Li in a single layer of a three-dimensional optical lattice. Site-resolved imaging enables measurements of local observables, including the local occupation variance. A comparison with predictions of the high temperature series expansion of the Fermi-Hubbard model is consistent with thermally equilibrated samples, with local entropies as low as $0.7k_\mathrm{B}$ per particle in the Mott insulator, and $0.5k_\mathrm{B}$ per particle in the band insulator. The phase diagram in the Mott regime is studied, exploiting the fact that the underlying harmonic potential enables measurements across a wide range of chemical potentials in a single experimental shot. Our experiments provide a starting point for implementing entropy redistribution based cooling schemes. Furthermore, we report on our recent progress towards measuring site-resolved spin correlations for low temperature samples, opening the door for studying many-body systems in theoretically intractable regimes.

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