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Bi-layer Fermi gas Microscope THOMAS HARTKE, BOTOND OREG, NINGYUAN JIA, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — Quantum gases loaded into optical lattices with single site resolution have emerged as one of the most powerful quantum simulators for investigating exotic many-body physics related to condensed matter systems. Here, we demonstrate the ability to extract the full information of a single-band Fermi-Hubbard model in the charge base without parity projection. By harnessing the power of Feshbach enhanced interactions between two atoms in a single well, we coherently load doubly occupied lattice sites into a double-well trap, preventing light assisted atom loss during the imaging process. With the full charge occupation, we measure the compressibility of the cloud and show that the temperature can be measured from the density-density correlations according to a fluctuation-dissipation theorem. Furthermore, we observe the strong correlation between doublons and holons, a signature of spin-ordering due to super-exchange interactions. This work establishes the possibility to extract both the spin and charge information of a two-component Fermi gas, and provides a route to studying Hubbard physics beyond two dimensions by enabling transverse dynamics.

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