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Transport dynamics of fermions in an optical lattice RHYS ANDERSON, DARBY BATES, FRANK CORAPI, CORA J. FUJIWARA, VIJIN VENU, FUDONG WANG, PEIHANG XU, University of Toronto, FREDERIC CHEVY, Laboratoire Kastler Brossel, ENS-PSL Research University, CNRS, UPMC-Sorbonne Universite, College de France, JOSEPH H. THYWISSEN, University of Toronto — We measure the conductivity spectrum of ultracold fermionic atoms in an optical lattice through high-resolution imaging in a quantum gas microscope. By applying a time-varying force to atoms confined to the lattice, we sample their current response at multiple frequencies. We observe that the current response scales linearly with the forcing, providing an experimental demonstration of Ohm's Law for neutral atoms. Broadening of the conductivity spectrum under varying external parameters elucidates how the dissipation of current is affected by fermion-fermion collisions. Furthermore, the spectral weight of the response satisfies a sum rule in the limit of small lattice depth, but diminishes as the depth or temperature increase, reflecting an increase in the band-averaged effective mass. This spectral weight characterizes the strength of the current response to an impulse, and therefore underpins the resistivity. As our measurements approach a high-temperature regime, its inverse is shown to approach T-linear behaviour. The recent implementation of a DMD in the system allows for further flexibility in studying and probing the dynamics. This tool enables the creation of customizable local potentials for both initiating and modifying current response.

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