Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Intraband conductivity of fermions in an optical lattice PEIHANG XU, RHYS ANDERSON, FUDONG WANG, VIJIN VENU, STEFAN TROTZKY, University of Toronto, FREDERIC CHEVY, Laboratoire Kastler Brossel, ENS-PSL Research University, CNRS, UPMC-Sorbonne Universite, College de France, JOSEPH THYWISSEN, University of Toronto — We discuss how to measure the conductivity spectrum in low frequency regime of neutral fermionic ^{40}K in a cubic optical lattice. A periodic force is applied to the atoms by sinusoidally displacing the trapping potential. The centre of mass response of the atoms, which can be treated as the mass current, is captured in-situ by a high-resolution fluorescence imaging system. In the linear response regime, the ratio between current and force gives the conductivity, through Ohm's law. With the ability to detect both on-axis and off-axis conductivity, the full conductivity tensor is obtained. Joule heating is also observed through measurements of the energy absorption rate, and compared to the real conductivity. For various lattice depths, temperatures, interaction strengths, and fillings, we measure both real and imaginary conductivity, up to a frequency sufficient to capture transport dynamics within the lowest band. The spectral width of the real conductivity reveals the current dissipation rate, and the integrated spectral weight is related to thermodynamic properties of the system through a sum rule. We observe that a finite lattice depth causes relaxation of current due to the breaking of Galilean invariance, which enables damping through collisions between fermions.

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Date submitted: 01 Feb 2019 Electronic form version 1.4