Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Conductivity of Ultracold Fermions in an Optical Lattice PEIHANG XU, VIJIN VENU, RHYS ANDERSON, FRANK CORAPI, DARBY BATES, CORA J. FUJIWARA, 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 discuss our recent measurements of the dynamics of global mass currents of ultracold ^{40}K in a cubic optical lattice using a quantum gas microscope [1]. A periodic force is applied by sinusoidally displacing a harmonic optical potential. In the linear response regime, the ratio between current and force gives the conductivity, through Ohm's law. For various lattice depths, temperatures, interaction strengths, and fillings, we measure both the real and imaginary conductivity, up to a frequency sufficient to capture transport dynamics within the lowest band, and well below the band gap. 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. We also discuss measurements in progress on applying this experimental technique to a strongly correlated regime of large on-site interactions, one-dimensional systems, and disordered systems.

[1] R. Anderson *et al.*, Phys. Rev. Lett. **122**, 153602 (2019).

Peihang Xu
University of Toronto

Date submitted: 31 Jan 2020

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