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Measuring Optical Conductivity of Atoms in a Lattice VIJIN VENU, RHYS ANDERSON, FUDONG WANG, PEIHANG XU, STEFAN TROTZKY, University of Toronto, FREDERIC CHEVY, Ecole Normale Superieure, JOSEPH H. THYWISSEN, University of Toronto — We discuss how to measure the global conductivity of ultracold atoms through center-of-mass dynamics [1]. The system under study is a quantum degenerate gas of fermionic potassium in a cubic optical lattice. We realize the proposal of Wu et al. [2], wherein a periodic force is applied to the cloud by dynamic displacement of the trapping beam. The steady state bulk current due to the periodic modulation is deduced from the center of mass position of the cloud, measured in-situ with high-resolution fluorescence imaging. A complex conductivity $\sigma(\omega)$ is measured as the ratio of particle current to the applied force as a function of the drive frequency ω. The observed response differs from the Kohn response of a gas because of the presence of a lattice. The breaking of translational invariance manifests as a shift in the peak response, a loss of spectral weight and a broadening. Comparing the response to force applied along two in-plane axes, we determine both on-axis and off-axis conductivity, which allows a direct measure of the Hall conductivity.

[1]R. Anderson *et. al.*, arXiv:1712.09965 (2017).
[2]Z. Wu, E. Taylor, and E. Zaremba, Europhys. Lett. **110**, 26002 (2015).

Vijin Venu
Univ of Toronto

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