Contribution ID: **12** Type: **Poster**

Strongly interacting lattice fermions with coherent state manipulation: from universal Hall response to Hall voltage measurement

Sunday, 10 September 2023 22:40 (20 minutes)

We report on the first quantum simulation of the Hall effect for strongly interacting fermions [1]. By performing direct measurements of current and charge polarization in an ultracold-atom simulator, we trace the buildup of the Hall response in a synthetic ladder pierced by a magnetic flux, going beyond stationary Hall voltage measurements in solid-state systems. We witness the onset of a clear interaction-dependent behavior, where the Hall response deviates significantly from that expected for a non-interacting electron gas, approaching a universal value [2]. Our system, able to reach hard to compute regimes also demonstrates the power of quantum simulation for strongly correlated topological states of matter.

As a further step, by implementing an additional potential gradient along the synthetic dimension, we have extended measurements of the Hall response to a study of the Hall voltage [3] in cold-atom systems. The observed dependence of the Hall voltage on the particle density will enable new benchmarks of recent theoretical predictions for the Hall effect in the strongly correlated regime.

References:
[1] T.-W. Zhou et al., Science (in press), arXiv:2205.13567 (2022)
[2] S. Greschner et al., Phys. Rev. Lett. 122, 083402 (2019)
[3] M. Buser et al., Phys. Rev. Lett. 126, 030501 (2021)

Primary authors: ZHOU, Tianwei (Department of Physics and Astronomy, University of Florence); CAPPELLINI, Giacomo (Istituto Nazionale di Ottica del Consiglio Nazionale delle Ricerche (CNR-INO)); TUSI, Daniele (European Laboratory for Non-Linear Spectroscopy (LENS)); FRANCHI, Lorenzo (Department of Physics and Astronomy, University of Florence); BELLER, Thomas (Department of Physics and Astronomy, University of Florence); MASINI, Gianmarco (Department of Physics and Astronomy, University of Florence); PARRAVICINI, Jacopo (Department of Physics and Astronomy, University of Florence); REPELLIN, Cécile (Univ. Grenoble Alpes, CNRS, LPMMC); GRESCHNER, Sebastian (Department of Quantum Matter Physics, University of Geneva); INGUSCIO, Massimo (Department of Engineering, Campus Bio-Medico University of Rome); GIAMARCHI, Thierry (Department of Quantum Matter Physics, University of Geneva); FILIPPONE, Michele (Univ. Grenoble Alpes, CEA, IRIG-MEM-L_SIM); CATANI, Jacopo (Istituto Nazionale di Ottica del Consiglio Nazionale delle Ricerche (CNR-INO)); FALLANI, Leonardo (Department of Physics and Astronomy, University of Florence)

Presenter: ZHOU, Tianwei (Department of Physics and Astronomy, University of Florence)

Session Classification: Poster Session I

Track Classification: Synthetic Gauge Fields and Topology