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Charge and heat transport in an atomic Fermi-Hubbard system[1]

ELMER GUARDADO-SANCHEZ, BENJAMIN M. SPAR, WASEEM S. BAKR, Princeton University — Strongly interacting quantum systems frequently exhibit unusual transport properties that are poorly understood. In previous experiments, we used quantum microscopy to study diffusive charge transport in a Fermi Hubbard system [1], revealing a strange metal phase. We imposed density modulations on a uniform system of ^6Li atoms in a 2D lattice and observed their decay due to charge diffusion as a function of wavelength and temperature. In our most recent work, we added an external linear potential (a "tilt") and observe subdiffusive charge dynamics. The tilt couples mass transport to local heating through energy conservation. Due to this coupling the system quickly heats up to near infinite temperature in the lowest band of the lattice. We study the high-temperature transport and thermalization in our system as a function of tilt strength and find that the associated decay time τ crosses over as the tilt strength is increased from characteristically diffusive to subdiffusive with $\tau \propto \lambda^4$. In order to explain the underlying physics and emphasize its universal nature we develop a hydrodynamic model that exhibits this crossover. [1] P. T. Brown et al, Science 363, 379-382 (2019)

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