Quantum gas microscopy of ultracold fermions in optical lattices

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The normal state of high-temperature superconductors exhibits anomalous transport and spectral properties that are poorly understood. Cold atoms in optical lattices have been used to realize the celebrated Fermi-Hubbard model, widely believed to capture the essential physics of these materials. The recent development of fermionic quantum gas microscopes has enabled studying the normal state of Hubbard systems with single-site resolution. I will start by introducing the atomic platform and reviewing experiments that have been done on measuring spin and density correlations in half-filled systems [1]. Next, I will describe the development of a technique to measure microscopic diffusion, and hence resistivity, in doped Mott insulators. We have found that this resistivity exhibits a linear dependence on temperature and violates the Mott-Ioffe-Regel limit, two signatures of strange metallic behavior [2]. Finally, I will describe the development of angle-resolved photoemission spectroscopy (ARPES) for Hubbard systems and its application to studying pseudogap physics in an attractive Hubbard system, setting the stage for future studies of the pseudogap regime in repulsive Hubbard systems [3].

[1] Parsons et. al., *Science* 353, 1253 (2016), Boll et. al., *Science* 353, 1257 (2016), Cheuk et. al., *Science* 353, 1260 (2016), Brown et. al., 357, 1385 (2017).

[2] Brown et. al., *Science* 363, 379 (2019).

[3] Brown et. al., *Nature Physics* 16, 26 (2020).