DAMOP19-2019-000381

Abstract for an Invited Paper
for the DAMOP19 Meeting of
the American Physical Society

Probing dynamical properties of Fermi-Hubbard systems with a quantum gas microscope[1]

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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 Hubbard systems with single-site resolution. Most studies have focused on probing equal-time spin and density correlations. In this talk, I will report on using a microscope to probe response functions associated with unequal-time correlations relevant for understanding the pseudogap and strange metal regimes of Fermi-Hubbard systems. First, 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. Next, I will report on 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.

[1]I acknowledge support by the NSF (grant no. DMR1607277), the David and Lucile Packard Foundation (grant no. 2016-65128) and the AFOSR Young Investigator Research Program (grant no. FA9550-16-1-0269).