Microscopy of two-dimensional atomic Fermi-Hubbard systems in new regimes

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Quantum gas microscopes have taken the study of Hubbard physics in optical lattices to a new level, enabling site-resolved detection of strongly correlated states like Mott insulators and antiferromagnets. So far, experiments have focused on spin-balanced gases of repulsively interacting atoms with the hope of elucidating phenomena in the high-temperature superconductors. Here we present two experiments where we use a lithium-6 quantum gas microscope to study the two-dimensional Hubbard model in new regimes. In a first experiment we investigate the spin correlations of the repulsive Hubbard model in the presence of spin-imbalance [1]. We observe short-range canted antiferromagnetism by measuring the anisotropy of the spin correlations. Away from half-filling, the polarization of the gas exhibits non-monotonic behavior with doping, resembling the behavior of the magnetic susceptibility in the cuprates. In another experiment, we observe charge density wave correlations in the attractive Hubbard model at half filling [2]. These correlations constitute a low-temperature thermometer for the attractive Hubbard model and provide indirect evidence for s-wave pairing correlations in this system.

[1] P. T. Brown, *et. al.* arXiv:1612.07746 (2016).
[2] D. Mitra, *et. al.* arXiv:1705.02039 (2017).
[3] D. Mitra, *et. al.* Phys. Rev. Lett. **117**, 093601 (2016).