Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Imaging magnetic polarons in the doped Fermi-Hubbard model
JOANNIS KOEPSELL, JAYADEV VIJAYAN, PIMONPAN SOMPET, Max-Planck-Institute for Quantum Optics, FABIAN GRUSDT[1], Department of Physics, Harvard University, TIMON HILKER, Max-Planck-Institute for Quantum Optics, EUGENE DEMLER, Department of Physics, Harvard University, GUILLAUME SALOMON, IMMANUEL BLOCH[2], CHRISTIAN GROSS, Max-Planck-Institute for Quantum Optics — Polarons are among the most fundamental quasiparticles emerging in interacting many-body systems, forming already at the level of a single mobile dopant. In the context of the two-dimensional Fermi-Hubbard model, such polarons are predicted to form around charged dopants in an antiferromagnetic background in the low doping regime close to the Mott insulating state. Here we report the first microscopic observation of magnetic polarons in a doped Fermi-Hubbard system, harnessing the full single-site spin and density resolution of our ultracold-atom quantum simulator. We reveal the dressing of mobile doublons by a local reduction and even sign reversal of magnetic correlations, originating from the competition between kinetic and magnetic energy in the system. The experimentally observed polaron signatures are found to be consistent with an effective string model at finite temperature. We demonstrate that delocalization of the doublon is a necessary condition for polaron formation by contrasting this mobile setting to a scenario where the doublon is pinned to a lattice site.

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Date submitted: 29 Jan 2019 Electronic form version 1.4