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Towards quantum simulation of the Hubbard model with attractively interacting fermions DEBAYAN MITRA, PETER BROWN, MARK STONE, STANIMIR KONDOV, WASEEM BAKR, Princeton University — Ultracold atoms in optical lattices have emerged as a versatile platform for quantum simulations of condensed matter models. The single-band, two-dimensional repulsive Hubbard model is a simple model of electrons tunneling in a lattice with onsite interactions. The model may potentially capture the essential physics of the high critical temperature cuprate superconductors. Although some general features of the phase diagram of the model are known, quantitative predictions are notoriously difficult and many open questions remain, including whether it even supports d-wave superconductivity. We describe progress towards constructing an experiment for performing a quantum simulation of the attractive Hubbard model using ultracold Fermi gases in an optical lattice. While previous experiments have focused almost exclusively on the repulsive Hubbard model, there is an exact mathematical mapping between the physics of the repulsive and attractive models. However, it is experimentally established that attractively interacting fermions reach entropies that are an order of magnitude lower than repulsive fermions. Therefore, our experiments with attractive fermions should give access to a much larger part of the phase diagram and allow us to tackle quantitative questions.

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