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Attractively Interacting Fermions in an Optical Lattice LUCIA HACKERMUELLER, ULRICH SCHNEIDER, MARIA MORENO-CARDONER, Johannes-Gutenberg-University Mainz, Germany, TAKUYA KITAGAWA, Department of Physics, Harvard University, THORSTEN BEST, SEBASTIAN WILL, SIMON BRAUN, Johannes-Gutenberg-University Mainz, Germany, EUGENE DEMLER, Department of Physics, Harvard University, BELEN PAREDES, IMMANUEL BLOCH, Johannes-Gutenberg-University Mainz, Germany — Mixtures of ultracold fermionic species in optical lattices can serve as a tool to test condensed matter physics models, a prominent example being the Fermi-Hubbard-Hamiltonian. We study a balanced spin mixture of ^{40}K in $|F, m_F\rangle = |\frac{9}{2}, -\frac{9}{2}\rangle$ and $|\frac{9}{2}, -\frac{7}{2}\rangle$ in a three dimensional blue detuned optical lattice, where the interaction between the spin states can be tuned via a Feshbach resonance. Changing the scattering length allows us to go from non-interacting to attractive states and finally to a strongly paired system. For small attractive interactions, the cloud size shrinks upon increasing the interactions, but surprisingly we find a minimal cloud size for medium attractive interactions. For stronger interactions the cloud size increases again. This anomalous increase can be understood with a straightforward entropy argument. We compare the experimental data with the prediction of an exact calculation in the zero-tunneling limit and with a high temperature expansion theory.

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