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Repulsively Interacting Fermi-Fermi Mixtures in 3D Optical Lattices SEBASTIAN WILL, ULRICH SCHNEIDER, LUCIA HACKERMÜLLER, THORSTEN BEST, SIMON BRAUN, IMMANUEL BLOCH, Johannes Gutenberg-University Mainz — Fermionic atoms in optical lattices can model quantum systems known from condensed matter physics: They form an implementation of the Hubbard model with high experimental control of the relevant parameters. In our experiment we study the properties of ultracold Fermions in different regimes, ranging from metallic and band-insulating states in the non-interacting case, to complex metals and the fermionic Mott-insulator for strongly repulsive interactions. In the experiment, spin mixtures of fermionic ^{40}K at T/T_F of about 0.15 are loaded into a combination of a blue-detuned three dimensional optical lattice and a red-detuned optical dipole trap. With this combination of potentials we gain independent control of lattice depth and harmonic confinement. Together with in-situ phase contrast imaging this allows us to measure the response of the system to varying external confinement. In addition to measurements of the in-situ cloud size, the compressibility and the fraction of doubly occupied lattice sites we report on the current status of our efforts.

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