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Interacting Bose-Fermi Mixtures in 3D Optical Lattice Potentials SEBASTIAN WILL, THORSTEN BEST, SIMON BRAUN, PHILIPP RONZHEIMER, ULRICH SCHNEIDER, MICHAEL SCHREIBER, KIN CHUNG FONG, LUCIA HACKERMÜLLER, TIM ROM, DIRK-SÖREN LÜHMANN, IMMANUEL BLOCH, LMU Munich — Mixtures of quantum gases in optical lattices form novel quantum many-body systems, whose properties are governed by the interplay of quantum statistics, inter- and intraspecies interactions, as well as the relative number of atoms of the components. In particular, degenerate Bose-Fermi mixtures have only recently come within experimental reach and stimulated theoretical investigations. A variety of quantum phases have been predicted including perturbed Mott insulating states, polaron-like quasi-particles or supersolid ordering. In our experiment we cool bosonic ^{87}Rb and fermionic ^{40}K down to simultaneous quantum degeneracy and investigate this Bose-Fermi mixture with tunable interspieces interactions in a three dimensional optical lattice. By studying the quantum phase evolution in an array of coherent states of ^{87}Rb, we have been able to establish a tool to measure absolute interaction energies on lattice sites with high precision. In the presence of ^{40}K, this technique reveals the marked influence of varying interspecies interactions on the atomic density distribution as well as the Bose-Bose and the Bose- Fermi interaction energies, quantitatively elucidating the role of interactions in the mixture.

Sebastian Will
Ludwig-Maximilians-Universität München

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