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Interacting Mixtures of Bosons and Fermions in Optical Lattices
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Mixtures of ultracold atomic quantum gases in optical lattices form novel quantum many-body systems offering unique controllability. In particular, degenerate Bose-Fermi mixtures have only recently come into experimental reach and are the topic of fruitful theoretical investigation. Among the most prominent predictions are the formation of charge-density waves, polaron-like quasi-particles and even supersolid ordering. We have prepared a mixture of bosonic ^{87}Rb and fermionic ^{40}K in a 3D optical lattice potential and investigated its properties depending on the interspecies interaction. We found a marked shift in the superfluid to Mott-insulator transition and were able to fully explain our findings in terms of an effective Bose-Hubbard model, employing renormalized Hubbard parameters. In recent measurements of the absolute intra- and interspecies interaction energies on individual lattice sites, we were able to further elucidate the effects of interaction in the optical lattice a thorough understanding of which may be an important step on the way towards complex quantum many-body states.

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