Quantum Simulation Using Two-electron Atoms

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The two-electron atom of ytterbium (Yb) is very attractive for the study of a quantum gas because it offers many unique possibilities. The two valence electrons result in singlet and long-lived triplet states connected by extremely narrow intercombination transitions which are useful for probing and manipulating the gas. The existence of rich varieties of isotopes of five bosons and two fermions will allow us to study various interesting quantum gases. In particular, a fermionic isotope of 173Yb offers unique possibility of SU(6) enlarged spin symmetry.
In this talk, I report our recent experiments on quantum degenerate Yb atoms loaded in an optical lattice. We describe our recent study on the interaction and filling induced quantum phases of dual Mott insulator of bosons and fermions by measuring various site occupancies both in attractively- and repulsively-interacting mixtures. A Bose-Einstein condensate in optical lattices is also studied in detail by high-resolution laser spectroscopy.

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