QUANTUM SIMULATOR USING YTTERBIUM

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We will report our recent quantum simulation experiments using quantum degenerate Yb atoms loaded in an optical lattice. We have successfully created BEC of 3 isotopes, and Fermi degeneracies of 2 isotopes, and a Bose-Bose mixture, and two Bose-Fermi mixtures, as well as Fermi-Fermi mixture with spin-degree of freedom. The created Yb quantum gases were loaded into 3D optical lattices, and we successfully observed the superfluid-Mott insulator transition. The influence of fermion admixture on the superfluid-Mott insulator transition was investigated both for the repulsively-interacting and the attractively-interacting Bose-Fermi mixtures by observing the matter-wave interference and the photoassociation resonance.

The BEC in optical lattices were also studied by high-resolution laser spectroscopy using the narrow optical transition to reveal the important role of the mean field interaction.