Quantum simulation with ytterbium atoms in optical lattices

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Abstract

Ultracold atoms in optical lattices have been attracted much interest for its application to quantum simulation. For their defect-free periodic potentials, highly controllable kinetic and interaction energies and experimental access to various physical quantities, optical lattices provide a unique opportunity to simulate strongly correlated solid electrons, especially those described by the Hubbard model.

The SU(N) Hubbard model which is a simple extension of the spin SU(2) symmetry in the Hubbard model to general SU(N). The SU(N) Hubbard model has long history of theoretical study such as large-N approach for deeper understanding of the physically important SU(2) case, and simple models for transition metals with orbital degeneracy. Recently SU(N) physics gained much more practical interests due to the possibility of its quantum simulation with laser-cooled alkaline-earth-metal atoms, which possess natural SU(N) spin symmetry due to the decoupling of nuclear spin from inter-atomic interactions.

In this talk, we present our experimental progress on simulating the SU(N) Hubbard model with ultracold ytterbium atoms. Especially, we focus on short-range antiferromagnetic behavior observed in optical lattices and thermometry performed by the detailed comparison with state-of-the-art many-body theory.