Orbital ordering of ultracold alkaline-earth atoms in optical lattices

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The impressive development of experimental techniques in ultracold quantum degenerate gases of alkaline-earth-like (e.g., ^{173}Yb) atoms in recent years has allowed investigation of strongly correlated multiorbital systems. Long-lived metastable electronic states in combination with decoupled nuclear spin give the opportunity to study the Hamiltonians beyond the possibilities of current alkali-based experiments. Motivated by recent experimental progress, by means of dynamical mean-field theory allowing for complete account of SU(2) rotational symmetry of interactions between spin-1/2 particles, we study ultracold quantum gases of alkaline-earth-like atoms loaded into three and quasi-two dimensional optical lattices. In particular, we focus on the fermionic mixture of ytterbium-173 atoms due to their unique properties which allow to realize and investigate in detail strongly-correlated many-body physics and emerging low-temperature phases in these mixtures. We focus on the recent realization of the two-band Hubbard model and study potential long-range ordered states. The theoretical analysis is performed in the region of applicability of the tight-binding approximation at different lattice depths and different band filling. We obtain dependencies for relevant physical observables, in particular magnetization, particle density in each band, double occupancy, compressibility and entropy. We construct phase diagrams at finite temperature and various lattice depths.

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