Strong-coupling effects in a ultra-cold Fermi gas loaded on an optical Lattice

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Interacting ultra-cold Fermi atom gases in optical lattices are very important systems in cold atom physics, as well as in condensed matter physics. In a lattice Fermi atom gas, the height of the lattice potential, sign and strength of an interaction between atoms, and particle density are all experimentally tunable. Using this unique property, we can study physical properties of strongly correlated fermion systems in a wide parameter region. Very recently, superfluidity has been realized in a ^{6}Li Fermi gas loaded on a cubic optical lattice.

In this talk, we discuss physical properties of a bound molecule consisting of attractively interacting two Fermi atoms in an optical lattice. We calculate the molecular binding energy and effective mass, fully taking into account a realistic cosine-shape periodic potential produced by the standing wave of laser light. When the strength of the lattice potential is strong to some extent, the system is effectively described by a single-band (attractive) Hubbard model in the unitarity regime, as expected. In the strong-coupling regime, however, the Hubbard model is found to be not a good model for the lattice Fermi gas. Our results would be useful in considering the BCS-BEC crossover in a superfluid Fermi gas loaded on an optical lattice.