Fermi superfluid on the Lieb lattice

C. Sato[a], H. Iramina[b], S. Tsuchiya[a], and T. Nikuni[a]

[a]Department of Physics, Tokyo University of Sciences, Japan
[b]Department of Engineering, Kyoto University, Japan

We investigate the superfluid state of ultracold fermions on the Lieb lattice. A unique feature of this system is that the single-particle energy band has a flat band crossing the Dirac point. We study the attractive Hubbard model on the Lieb lattice within the BCS-Leggett type of mean-field theory. We find non-uniform superfluid states with the three-sublattice structure, which arises from the lattice geometry. In the strong coupling BEC regime, we give a simple picture of the three-sublattice superfluid state based on the effective model for tightly-bound molecular bosons, or an equivalent pseudo-spin 1/2 system. In addition, we discuss the influence of the flat band and Dirac point on the superfluidity.