Superconductivity due to Charge Fluctuation in Organic Conductors

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Superconductivity in organic compounds has opened a new field of research of superconductivity, in which charge fluctuation plays an essential role compared to the phonon- or spin-fluctuation mechanisms. We will make a review about the charge-fluctuation mechanism in organic conductors.

Compared with the half-filled systems and doped Mott insulators, many organic conductors are quarter-filled, in which there is a strong tendency towards charge ordering [1]. The superconductivity mediated by charge fluctuation in such cases was pointed out first by Merino and McKenzie [2] using a square-lattice model. In this case, the obtained pairing symmetry is d_{xy}-wave in contrast to the $d_{x^2-y^2}$-wave symmetry for the half-filled case. On the other hand, in many cases, organic conductors form anisotropic triangular lattices, which induce frustration between nearest-neighbor repulsive interactions, V. Motivated by various interesting properties observed in θ-(BEDT-TTF)$_2$X, for example, the charge ordered states and possible superconducting states have been studied in the extended Hubbard model on anisotropic triangular lattices at 3/4-filling within mean-field theory and variational Monte Carlo method [3,4]. It is found that several kinds of charge-ordered states are energetically competing with each other (Fig. 1). A typical example will be θ-(BEDT-TTF)$_2$CsZn(SCN)$_4$. In such a case, frustration in V enhances charge fluctuation and possibly induces triplet next-nearest-neighbor f-wave superconductivity [4].

Another interesting superconductivity is that realized inside a charge-ordered phase, e.g, in the case of α-(BEDT-TTF)$_2$I$_3$. RPA calculation showed that the pairing mechanism is mainly given by spin fluctuation in the newly formed Fermi surface with small hole- and electron-pockets [5].

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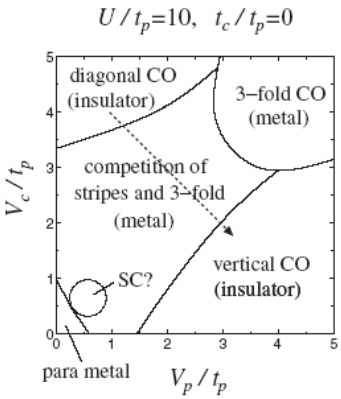

Fig.1 Phase diagram of the triangular lattice with frustration between the nearest-neighbor interactions, V [4].