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Valence Bond Theory of Correlated-Electron Superconductivity[1]
TIRTHANKAR DUTTA, SUMIT MAZUMDAR, Univ of Arizona, TORSTEN CLAY, Mississippi State Univ — Whether or not the weakly doped Mott-Hubbard semiconductor is superconducting remains controversial. We present a new valence bond theory of correlated-electron superconductivity, that has overlap with the original RVB approach, and yet is substantively different. Superconductivity within the theory emerges from a correlated-electron state in which there is a strong tendency to spin-singlet formation, and where the bandwidth due to pair-tunneling is very large. We show that such a situation occurs far away from the 1/2-filled band, at or near banfilling of 1/4. In the presence of electron-phonon interactions the 1/4-filled band can form a spin-paired CDW state that we have called a paired-electron crystal, and that is a Wigner crystal of pairs. In the presence of frustration the spin-paired bonds become mobile to give a paired-electron liquid, which is a precursor to superconductivity. The superconducting state here is reached from a co-operative effect between electron-electron and electron-phonon interactions, and the theory thus has overlap also with the bipolaron theory of superconductivity. We will present exact numerical calculations on a 4x4 lattice using the valence bond basis to substantiate our conjectures.

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