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The Paired Electron Crystal: order from frustration in the quarter-filled band¹ S. DAYAL, R.T. CLAY, Mississippi State University, H. LI, S. MAZUMDAR, University of Arizona — The effect of lattice frustration on two dimensional (2D) quantum spin models and the 2D half-filled Hubbard model has been intensively studied in order to understand the connections between antiferromagnetism (AFM), valence-bond ordered states, candidate spin-liquid states, and unconventional superconductivity. For several classes of unconventional superconductors, including the organic charge-transfer solids and superconducting spinels such as LiTi_2O_4 , the correct starting point is however the quarter-filled rather than $\frac{1}{2}$ -filled band. We present a study of the effect of frustration on the 2D $\frac{1}{4}$ -filled interacting band. We demonstrate that in addition to the well known AFM state occurring with lattice dimerization, and Wigner crystal (WC) state, a paired insulating state occurs in the frustrated region of the phase diagram. This paired electron crystal (PEC) state has coexisting charge order and bond order and a spin-gap due to the formation of nearest-neighbor singlets in the pairs. We investigate fully the phase diagram, including effects of varying the strength of on-site and nearest-neighbor Coulomb interactions as well as electron phonon coupling strength. We present the full phase diagram showing the extent of AFM, PEC and WC phases.

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