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Boson-Fermion resonance model for nonconventional superconductors

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A two-component model of coexisting local electron pairs (hard-core charged $2e$ bosons) and itinerant fermions coupled via the charge exchange mechanism is reviewed. The superconducting characteristics of this boson-fermion model are determined as a function of the position of the local pair level and the total particle concentration, for various pairing symmetries on 2D and quasi-2D lattices. We also discuss the BCS-BEC crossover in a 3D boson-fermion model, within the self-consistent T-matrix approach, which includes pairing fluctuations and boson self-energy effect. We focus on the evaluation of superfluid transition temperature from the pseudogap state and phase diagrams of a 3D boson-fermion model on a lattice. The results are discussed in connection with a two-component scenario of preformed pairs and unpaired electrons for high temperature superconductors. We also relate them to the resonance superfluidity in ultracold fermionic atomic gases with a Feshbach resonance.

Key words:
boson-fermion model, BCS-BEC crossover, resonance superfluidity, Feshbach resonance