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Coexistence of spin-triplet superconductivity with antiferromagnetism in orbitally degenerate system: Hartree-Fock approximation

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Spin-triplet pairing induced by the Hund′s rule exchange was proposed some time ago. Previously, we studied the coexistence of the spin triplet pairing with itinerant ferromagnetism. In this work we consider the coexistence of the paired phase with the antiferromagnetic ordering within the extended Hubbard model for a doubly degenerate band. We use the density of states appropriate for the square lattice and treat the problem with the help of the Hartree-Fock approximation. The temperature dependences of the superconducting gaps, of the magnetic moment, and of the chemical potential, are presented. For low temperatures nonzero values of superconducting gaps and of staggered magnetic moment have been obtained. This provides also the coexisting superconducting-antiferromagnetic phase. The free energy in the considered phase has been evaluated, as well as the corresponding free energies in four additional phases: paramagnetic, ferromagnetic, superconducting of type A and superconducting of type A_1 coexisting with ferromagnetism; they occur in the proper range of parameters: band filling n and the interaction parameters, U/W and J/W. By comparing the calculated free energies for the selected set microscopic parameters one can see, that the coexisting superconducting-antiferromagnetic phase is the stable one. The zero-temperature values of the superconducting gaps and of the magnetic moment are also analyzed as a function of the exchange interaction J, the Hubbard interaction U, and n.

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