Coupled singlet–triplet superconducting state in a non–centrosymmetric system

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We present a weak–coupling study of the onset of the mixed singlet–triplet superconductivity which emerges from the uncoupled singlet and triplet states due to the antisymmetric spin–orbit coupling. We establish the general constraints concerning the symmetry of the singlet and triplet counterparts as well as the range of the spin–orbit coupling energy which allow for a development of the mixed singlet–triplet state [1].

We find that the coupled singlet–triplet state can be formed exclusively by the singlet state belonging to the identity representation of the system symmetry point group and the triplet state determined by the vector order parameter which is not orthogonal to the spin–orbit coupling vector.

The computations are performed for the square lattice nearest neighbor tight–binding system with the Rashba spin–orbit coupling and for the mixed singlet–triplet state emerging from the s–wave and p–wave states. We show that the phase transition to the mixed singlet–triplet state is limited to very low rates of the spin–orbit coupling for nearly degenerate singlet and triplet states and extends to a wide range of magnitude of the spin–orbit coupling energy for the singlet and triplet components whose critical temperatures significantly differ.

[1] D. Grzybowska and G. Harań, Eur. Phys. J. B **90**, 47 (2017).