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Rashba spin–orbit coupling influence on the two–dimensional magnetoexciton–polaritons in microcavity

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The obtained results concern the electron–radiation and Coulomb electron–electron interactions in system of two–dimensional (2D) electron–hole pairs on the layer embedded into the microcavity and subjected to the action of a strong perpendicular magnetic field as well as of the electric field in the same direction giving rise to the Rashba spin–orbit coupling (RSOC) with the third order chirality terms and with a quartic term in the nonparabolic dispersion law of the heavy holes in the GaAs-type quantum well.

The magnetoexciton–polariton branches in these conditions have the nonmonotonous dependences on the magnetic field strength B with intersections and strong changing of the quantum transition probabilities.

The Rabi frequencies, which determine the spread of the polariton branches, are proportional to the dipole moment P_{cv} of the optical quantum transition between the valence and conduction bands, they increase as $B^{1/2}$ with the increasing of the magnetic field and obey to the selection rule following which the numbers of the Landau quantization levels of the electron and hole in the composition of the magnetoexciton coincide.

The coherent macroscopic state was introduced into the Hamiltonian following the Keldysh–Kozlov–Kopaev method in combination with the Bogoliubov theory of the quasiaverages. The equations of motion were deduced for the two–particle integral operators describing the optical and acoustical plasmons as well as for the creation and annihilation operators of the magnetoexciton and photon modes in the microcavity. Such possibility is due to the degeneracy of the Landau levels, which in Landau gauge do not depend on the one–dimensional wave vector. It was shown that the presence of the SOC is equivalent to take into account the influence of some excited Landau levels. It permits to obtain the energy spectrum of the collective elementary excitations, even when the ground state of the system is the Bose–Einstein condensation of the 2D magnetoexciton–polaritons on the lower polariton branch with the in-plane vector $k=0$. The calculations in this direction are continued.