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Trions and quatrons in Semiconductor Coupled Quantum Wells
ROMAN YA. KEZERASHVILI, OLEG L. BERMAN, New York City College of Thechnology, City University of New York — The three-body restricted problem for trions, when a spatially separated exciton and electron or hole are located in the parallel quantum wells (QW), is reduced to the 2D two body problem for the exciton and the projection of the electron or hole on the plane of the excitonic QW. In the limit of a large spatial separation of the QWs the eigenfunctions and energy spectrum for the trions are obtained analytically. It is shown that the Schrödinger equation for the trion can be reduced to the 2D two-body problem with Coulomb electron-hole interaction for the 2D direct exciton and the Schrödinger equation for the 2D harmonic oscillator for the relative motion of the exciton and the image of the projection of the electron or hole on the plane of the quantum well with the exciton. The 2D Wigner crystallization of the trions in the coupled QWs is discussed. The four-body restricted problem for spatially separated exciton and electron and hole, located in the in three parallel QWs, is reduced to the 2D three body problem for the exciton and the projection of the electron and hole on the plane of the excitonic QW. In the limit of a large spatial separation of the QWs the eigenfunctions and energy spectrum for quatron formed by the exciton and electron and a hole are obtained analytically. The 2D superfluidity and Kosterlitz-Thouless phase transition in the dilute Bose gas of quatrons is discussed.

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