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Ground state of the electron–hole liquid in quantum wells

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The study of the properties of electron-hole systems is one of the rapidly developing areas of modern condensed matter physics. At present, most attention is paid to low-dimensional electron-hole systems, in which the role of the Coulomb interaction increases. Recently, electron-hole liquid (EHL) was found in SiO₂/Si/SiO₂ quantum wells [1] and in Si/Si_{1-x}Ge_x/Si heterostructures [2].

The aim of this work is to find the energy and equilibrium density of a quasi-two-dimensional EHL. The ground states of quasi-two-dimensional EHL are studied by the density functional theory. The nonlinear Schrödinger equations for electrons and holes are numerically solved. The wave functions and energy levels of electrons and holes field are found. The binding energy of the electron and hole for different surfaces of silicon is calculated. The calculated values of the equilibrium density are in good agreement with the experimental values [2].

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2. S.N. Nikolaev, V.S. Krivobok, V.S.Baga, et al., Pisma Zh. Exp. Teor. Fiz., 194, 61 (2016).

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