Two-dimensional electron gas in magnetic field

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The probability density current in states of charged particle in magnetic field is always not identically equal to zero because the vector potential of magnetic field cannot be equal gradient of wave function phase. A necessary condition for wave function of stationary states is closure of all streamlines in the area under investigation. Then axially symmetrical two-dimensional system is a simplest one for consideration. Thus, eigenfunctions are not localized in the vicinity of classical orbits as coordinates of orbit center do not commutate. The magnetic moment of eigenstate consists of an addend proportional to the orbital moment and an addend, which is always negative. An average magnetic moment of electronic gas cannot be equal to zero, as it is equal to a sum of products of magnetic moments of states and occupation numbers of these states. The derivative of the thermodynamic potential with respect to magnetic field does not coincide with this expression. The reason is that occupation numbers are proportional to degeneracy multiplicities of energy eigenvalues, which depend on magnetic field. The method is proposed which enables one take into consideration an angular momentum conservation law when deriving the probability density. Thus, this density depends on the effective Hamiltonian describing quasi-particles in the harmonic potential which intensity determines the magnetic field. Then degeneracy multiplicities do not depend on magnetic field and the paradox mentioned above is removed. The nonuniform electronic density and potential of the self-consistent field allowing for Coulomb interaction are determined by the density functional method. The energy spectrum of quasi-particles consists of two bands. The lower one, magnetic, is formed by the widened discrete levels, the conduction band is located above, and states in this one are similar to electronic states in the absence of magnetic field. The diamagnetic moment of gas is proportional to magnetic field, an area of circle and number of electrons. It is many times higher than Pauli paramagnetism. The diamagnetic current is disturbed over the area, therefore magnetization is nonuniform. Inhomogeneity of electrons density creates an electric field, which can be measured.