Oscillatory persistent currents in quantum dots

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The system of Kohn-Sham equations for quantum dots in strong magnetic field with the number of spin-polarized electrons N from 3 to 40 was solved numerically. Many-body effects are taken approximately into account by the use of local exchange energy.

The calculations have been performed for different sets of the angular moment of electrons. We found that the dependence of the total angular moment M on magnetic field represents a series of a plateau. Change of the angular momentum of the electrons leads to a jump in the persistent current.

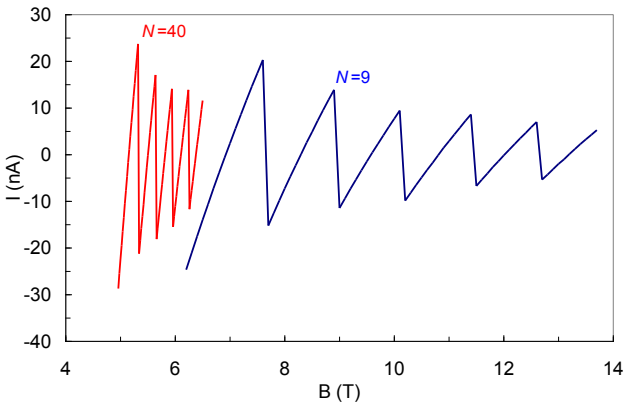

FIG. 1. The persistent current versus the magnetic field in quantum dots with N =9 and N =40 electrons.

The results of calculations for GaAs quantum dots are shown in Fig. 1. Persistent current has an oscillatory form with almost linear segments. The period of oscillations of persistent current is well described by the formula

$$\Delta B = 2B_1/(N+1),$$

where B_1 corresponds to the middle of the plateau with $M = N(N\text{-}1)/2+N$.

Different segments correspond to different value of M which increases as the magnetic field increases. The oscillation period decreases slightly as the magnetic field increases. The amplitude of the oscillations decreases due to the fact that for large M diamagnetic current compensates paramagnetic one.

This work was supported by Ministry of Education and Science of the Russian Federation.