Shubnikov - de Haas effect and spin-splitting in tilted magnetic fields in wide quantum well

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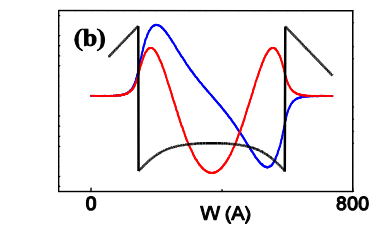
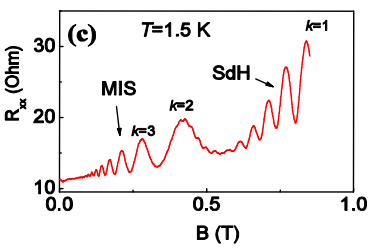
Bilayer two-dimensional electron system in double quantum wells demonstrated oscillations of the symmetric–antisymmetric energy gap in the presence of the in-plane magnetic field [1] which has been attributed to Aharonov-Bohm interference effect between cyclotron orbits in different layers [2]. The charge distribution in a wide single quantum well is more subtle than the one in the double quantum well. Here the Coulomb repulsion of the electrons in the well leads to a soft barrier inside the well, which in turn results in a bilayer electron system. Applying of the in-plane magnetic field can also lead to the charge redistribution inside of the well and distortion of the circular Fermi contour.

In the present work we have measured and calculated Shubnikov – de Haas effect in wide wells in the tilted magnetic field. We resolve spin-splitting that propotional to the total magnetic field.



(b) Calculated confinement potential profile of our wide quantum wells and wave functions of electrons for the first two subbands.



(c) The magnetoresistance R_{xx} as a function of the magnetic field at T=1.5 K. Magnetoresistance exhibits MIS oscillations together with SdH oscillations.

[1] G. M. Gusev, C. A. Duarte, T. E. Lamas, A. K. Bakarov, and J. C. Portal, Phys. Rev. B **78**, 155320 (2008)
[2] V.M.Yakovenko, B.K.Cooper, Physica E **34**, 128 (2006); J. Hu and A. H. MacDonald, Phys. Rev. B **46**, 12554 (1992).