Negative magnetoresistance in ultraquantum graphite

Yakov Kopelevich[1], Robson R. da Silva[1], Bruno C. Camargo[1], and Walter Escoffier[2]

[1]Instituto de Fisica "Gleb Wataghin", Universidade Estadual de Campinas (UNICAMP), Sao Paulo, Brazil

[2]Laboratoire National des Champs Magnétiques Intenses, INSA UPS, CNRS UPR 3228, Université de Toulouse, 143 avenue de Rangueil, 31400 Toulouse, France

We report the results of c-axis interlayer magnetoresistance (ILMR) measurements performed on highly oriented pyrolytic graphite (HOPG) graphite samples with FWHM ranging from ~ 0.2˚ to 3˚, in magnetic fields up to 55 T applied parallel to the c-axis (B ‖ I ‖ c-axis), and in the temperature interval 400 mK < T < 300 K. We have observed a large (up to ~ 60 %) negative ILMR ($dR_c/dB < 0$) for all samples above a certain field $B_m(T)$ that depends on both temperature and the sample mosaic angle. The obtained results can be understood consistently by assuming that ILMR is related to the tunneling between zero-energy Landau levels of quasi-two-dimensional Dirac fermions, in a close analogy with the behavior reported for α-(BEDT-TTF)$_2$I$_3$, another multilayer Dirac electron system [1]. We also briefly discuss the alternative understanding of the negative ILMR assuming the existence of bound electron pairs (2e-charge bosons) in graphite [2].

[1] N. Tajima et al., Phys. Rev. Lett. **102**, 176403 (2009).
[2] Y. Kopelevich, B. Raquet, M. Goiran, W. Escoffier, et al. Phys. Rev. Lett. **103**, 116802 (2009).