Impact of trigonal warping on the pseudodiffusive transport in bilayer graphene

Grzegorz Rut, Adam Rycerz

Marian Smoluchowski Institute of Physics, Jagiellonian University, Łojasiewicza 11,
PL-30348 Kraków, Poland
grzegorz.rut@uj.edu.pl

Abstract
A theoretical study of the pseudodiffusive transport in bilayer graphene (BLG) in the Corbino geometry is presented. Using the Landauer-Büttiker formalism together with the transfer matrix approach in the angular momentum space, we investigate the magnetotransport as well as size dependence of conductance [1].

The minimal conductivity scales with the system size from $\sigma=8e^2/\pi h$ up to $\sigma=24e^2/\pi h$ (see Fig. 1) [1,2]. Although the considered system is ballistic and interactions are not taken into account, the scaling flow reproduces the behavior expected from disordered systems of Dirac fermions with Coulomb repulsion [3].

The magnetoconductance is enhanced in weak magnetic fields up to a crossover field B_L proportional to the next-nearest neighbor intervalley hopping integral t'. For magnetic fields $B \gtrsim B_L$ the average magnetoconductivity asymptotically drops with increasing magnetic field as 1/B, approaching the pseudodiffusive value $\sigma=8e^2/\pi h$ [1,4].

In strong magnetic fields, the conductivity, as well as higher charge-transfer cumulants, show beating patterns with an envelope period proportional to $(B/B_L)^{1/2}$ (see Fig. 2). This provides a qualitative difference between the high-field ($B \gg B_L$) magnetotransport in the t' = 0 and in the t' ≠ 0 case [1], providing a finite-system analog of the Lifshitz transition.

References
[1] G. Rut and A. Rycerz, Phys. Rev. B **93** 075419 (2016), pp. 1-12.
[2] G. Rut and A. Rycerz, Europhys. Lett. **107** 47005 (2014), pp. 1-5.
[3] P.M. Ostrovsky, I.V. Gornyi and A.D. Mirlin, Phys. Rev. Lett., **105** 036803 (2010), pp. 1-7.
[4] G. Rut and A. Rycerz, Phys. Rev. B **89 (4)** 045421 (2014), pp. 1-12.

Figures

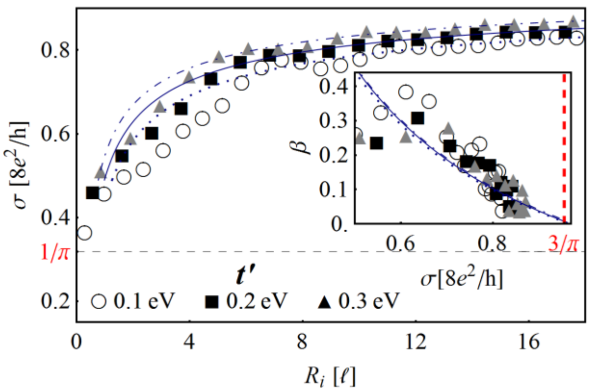

Figure 1. Conductance of an undoped BLG Corbino disk with inner radius R_i and outer radius R_o=2 R_i. The triangles, squares and circles represent the data obtained numerically for t'=0.3 eV, t'= 0.2 eV, and t'= 0.1 eV (respectively), the lines depict the asymptotic behavior (units *l* depend on *t'*). The inset presents the scaling function $\beta(\sigma)=d\log(\sigma)/d\log(R_o\text{-}R_i)$.

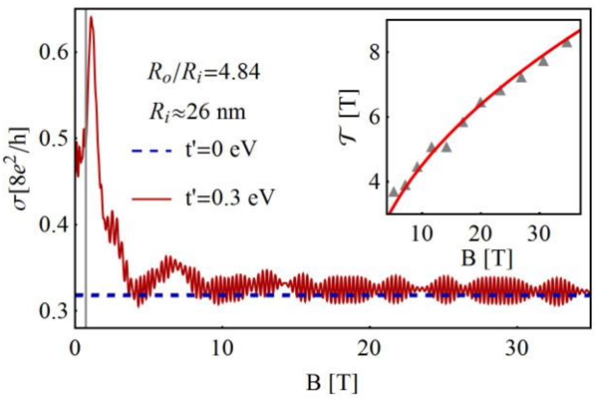

Figure 2. Magnetoconductance of BLG disk with R_i≈26 nm and R_o/R_i = 4.84 for t'=0 eV (dashed blue line) and t'=0.3 eV (solid red line). The vertical line marks the value of B_L. The inset presents the period T of the beating envelope. The solid line corresponds to an approximate dependence on B proportional to $(B/B_L)^{1/2}$.