Pseudodiffusive conducance and Landa level hierarchy in biased graphene bilayer

Grzegorz Rut and Adam Rycerz

Marian Smoluchowski Institute of Physics, Jagiellonian University, Reymonta 4, PL–30059 Kraków, Poland

We demonstrate, by means of mode-matching analysis for the Dirac equation, that splittings of the Landau-level (LL) degeneracies associated with spin, valley, and layer degrees of freedom, directly affect the quantum-limited conductance of ballistic graphene bilayer. For wide samples ($W \gg L$), the Landauer-Büttiker conductance reaches the maximum $G \simeq se^2/(\pi h) \times W/L$ at the resonance via each LL, with the prefactor varying from $s = 8$ if all three degeneracies are preserved, to $s = 1$ if all the degeneracies are split. In the absence of bias between the layers, the degeneracies associated with spin and layer degrees of freedom may be split by manipulating the doping and magnetic field; the conductance at the zeroth LL is twice as large, while the conductance at any other LL equals to the corresponding conductance of graphene monolayer. The presence of bias potential allows one also to split the valley degeneracy. Our results show, that the charge transfer at each LL has pseudodiffusive character, with the second and third cumulant quantified by $\mathcal{F} = 1/3$ and $\mathcal{R} = 1/15$ (respectively). In case the electrochemical potential is allowed to slowly fluctuate in a finite vicinity of LL, the resulting charge transfer characteristics are still quantum-limited, approaching $\mathcal{F} \simeq 0.7$ and $\mathcal{R} \simeq 0.5$ in the limit of large fluctuations.