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Sub-Sharvin conductance and enhanced shot noise in doped graphene

Ideal Sharvin contact in a multimode regime shows the conductance $G \approx G_{\text{Sharvin}} = g_0 k_F W/\pi$ (with g_0 the conductance quantum, k_F the Fermi momentum, and W the contact width) accompanied by strongly suppressed shot-noise quantified by small Fano factor $F \approx 0$. For ballistic graphene away from the charge-neutrality point the sub-Sharvin transport occurs, characterised by suppressed conductance $G \approx (\pi/4)G_{\text{Sharvin}}$ and enhanced shot noise $F \approx 1/8$. All these results can be derived from a~basic model of quantum scattering, involving assumptions of infinite height and perfectly rectangular shape of the potential barrier in the sample. Here we have carried out the numerical analysis of the scattering on a family of smooth barriers of finite height interpolating between parabollic and rectangular shapes. We find that tuning the barrier shape one can modify the asymmetry between electron- and hole-doped systems. For electronic dopings, the system crosses from Sharvin to sub-Sharvin transport regime (indicated by both the conductance and the Fano factor) as the potential becomes closer to the rectangular shape. For hole dopings, the conductivity is strongly suppressed when the barrier is parabolic and slowly converges to $G \approx (\pi/4)G_{\text{Sharvin}}$ as the potential evolves towards rectangular shape. In such a case the Sharvin transport regime is inaccessible, shot noise is generically enhanced comparing to the electron-doped case, and aperiodic oscillations of both G and F are prominent due to the formation of quasibound states.

References

1. A. Rycerz, P. Witkowski, Phys. Rev. B **104**, 165413 (2021).