Quantum transport in graphene p-n junctions in the quantum Hall regime

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Abstract

Graphene offers a unique system to investigate transport of Dirac Fermions at p–n junctions. In a magnetic field, combination of quantum Hall physics and the characteristic transport across p–n junctions leads to a fractionally quantized conductance associated with the mixing of electron-like and hole-like modes and their subsequent partitioning. The mixing and partitioning suggest that a p–n junction could be used as an electronic beam splitter. Here we report the shot noise study of the mode-mixing process and demonstrate the crucial role of the p–n junction length. For short p–n junctions, the amplitude of the noise is consistent with an electronic beam-splitter behaviour, whereas, for longer p–n junctions, it is reduced by the energy relaxation. Remarkably, the relaxation length is much larger than typical size of mesoscopic devices, encouraging using graphene for electron quantum optics and quantum information processing. N. Kumada, F. D. Parmentier, H. Hibino, D. C. Glattli, & P. Roulleau, Nature Communications 6, 8068 (2015)

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