Shot noise in ballistic single walled carbon nanotubes and in graphene

Pertti Hakonen

Low Temperature Laboratory, Helsinki University of Technology, 02015 Espoo, Finland

We have measured shot noise in single walled carbon nanotubes (SWNT) with good contacts at 4.2 K over frequencies $f = 600 - 850$ MHz [1]. We find a strong modulation of shot noise over the Fabry-Perot pattern ; in terms of differential Fano factor the variation ranges over 0.4 - 1.2. The shot noise variation, in combination with differential conductance, can be analyzed using two (spin-degenerate) modes with different, energy-dependent transmission coefficients. Our results indicate that orbital degeneracy may be strongly affected by detailed contact conditions. No power law dependence of shot noise, as expected for Luttinger liquids, was found in our measurements. In graphene, our shot noise measurements yield [2] that for samples with large width to length ratio W/L, the Fano factor $\mathfrak{F}$ reaches a maximum $\mathfrak{F} \sim 1/3$ at the Dirac point and that it decreases strongly with increasing charge density. For smaller W/L, the Fano factor at the Dirac point is significantly lower. Our results are in good agreement with the theory describing that transport at the Dirac point in clean graphene arises from evanescent electronic states.

[1] F. Wu, P. Queipo, A. Nasibulin, T. Tsuneta, T. H. Wang, E. Kauppinen, P. J. Hakonen, Shot Noise with Interaction Effects in Single Walled Carbon Nanotubes, Phys. Rev. Lett. 99, 156803 (2007).

[2] R. Danneau, F. Wu, M.F. Craciun, S. Russo, M.Y. Tomi, J. Salmilehto, A.F. Morpurgo, P.J. Hakonen, Shot Noise in Ballistic Graphene, arXiv :0711.4306.