Shot noise on chaotic chiral devices

Marilia Santos Barros[1], Ivana Carneiro de Lucena[1], Adson Silva[1], Anderson Barbosa[2], and Jorge Gabriel Gomes Ramos[1]

[1]*Departamento de Física, Universidade Federal da Paraíba, 58297-000 João Pessoa, Paraíba, Brazil*
[2]*Departamento de Física, Universidade Federal Rural de Pernambuco, 52171-900 Recife, Pernambuco, Brazil*

We investigate both the conductance and the shot-noise power of a confined chiral device that engenders subtle embedded backscattering mechanisms. We present analytical results and the correspondent numerical confirmation of the chiral electronic sublattice signal. Examples of quantum dots generating chiral symmetries include graphene sheets and topological insulators. The analytical results are universal and exhibit a robust and peculiar signal for an arbitrary number of open scattering channels. We also demonstrate a tunable mechanism of the valleytronics shot-noise power signal through perpendicular magnetic fields and/or the device symmetry edges. The results also indicate a "Fano factor" associated with the main quantum interference term with a universal value of 1/4 for a quantum dot with symmetric contacts, regardless of external fields and the number of open channels.

[1] C. Kittel, Introduction to Solid State Physics, 8th ed. (Wiley, 2012).

[2] N. W. Ashcroft and N. D. Mermin, Solid State Physics (Harcourt, 1976).

[3] P. W. Anderson, Science 177, 393 (1972).

[4] C. W. J. Beenakker, Rev. Mod. Phys. 69, 731 (1997).

[5] Y. Alhassid, Rev. Mod. Phys. 72, 895 (2000).

[6] Ya. M. Blanter and M. Büttiker, Phys. Rep. 336, 1 (2000).

[7] M. Büttiker, A. Prêtre, and H. Thomas, Phys. Rev. Lett. 70, 4114 (1993).

[8] Yu. V. Nazarov and Ya. M. Blanter, Quantum Transport: Introduction to Nanoscience (Cambridge University Press, 2009).

[9] E. Akkermans and G. Montambaux, Mesoscopic Physics of Electrons and Photons (Cambridge University Press, 2007).

[10] K. A. Ritter and J. W. Lyding, Nat. Mater. 8, 235 (2009).

[11] A. D. Güçlü, P. Potasz, and P. Hawrylak, Phys. Rev. B 84, 035425 (2011).

[12] A. H. Castro Neto, F. Guinea, N. M. R. Peres, K. S. Novoselov, and A. K. Geim, Rev. Mod. Phys. 81, 109 (2009).

[13] S. Das Sarma, Shaffique Adam, E. H. Hwang, and E. Rossi, Rev. Mod. Phys. 83, 407 (2011).