Nonstandard quantum interference in magnetotransport through graphene rings and disks

Adam Rycerz and Grzegorz Rut

Marian Smoluchowski Institute of Physics, Jagiellonian University,
Łojasiewicza 11, 30-348 Kraków, Poland
e-mail: rycerz@th.if.uj.edu.pl
www: http://th.if.uj.edu.pl/~adamr/

Abstract. Graphene rings were considered theoretically as possible building blocks for a solid-state quantum computer, as each quantum state appears in two copies (on per each valley in the dispersion relation), link by the time-reversal symmetry (TRS) [1]. Therefore, *weak* magnetic field breaking the TRS can be used to lift out the valley degeneracy, and to control a valley qubit. The robustness of the valley pseudospin were further investigated by computer simulation of quantum transport through the ring (depicted in Fig 1a), displaying Aharonov-Bohm oscillations [2]. In *strong* magnetic field, Aharonov-Bohm effect disappears, as the two arms of the ring are no longer equivalent due to the Lorentz force. Instead, one can consider the Corbino geometry, in which a disk-shaped sample area is attached to circular leads (see Fig. 1b), for which periodic magnetoconductance oscillations are predicted to appear on each Landau level [3]. The so-called *quantum relativistic Corbino effect* have a direct analog in bilayer graphene (BLG) [4]. We find that some peculiar features of magnetoconductance patterns in BLG can also be used to determine the value of skew-interlayer hopping [5], a tight-binding model parameter difficult to determine with available experimental techniques.

References

[1] P. Recher, B. Trauzettel, A. Rycerz *et al.*, Phys. Rev. B **76**, 235404 (2007), pp 1-6.
[2] A. Rycerz, Acta Phys. Polon. A **115**, 322-325 (2009).
[3] A. Rycerz, Phys. Rev. B **81**, 121404(R) (2010), pp. 1-4.
[4] G. Rut and A. Rycerz, J. Phys.: Condens. Matter **26**, 485301 (2014), pp. 1-12.
[5] G. Rut and A. Rycerz, unpublished.

Figures:

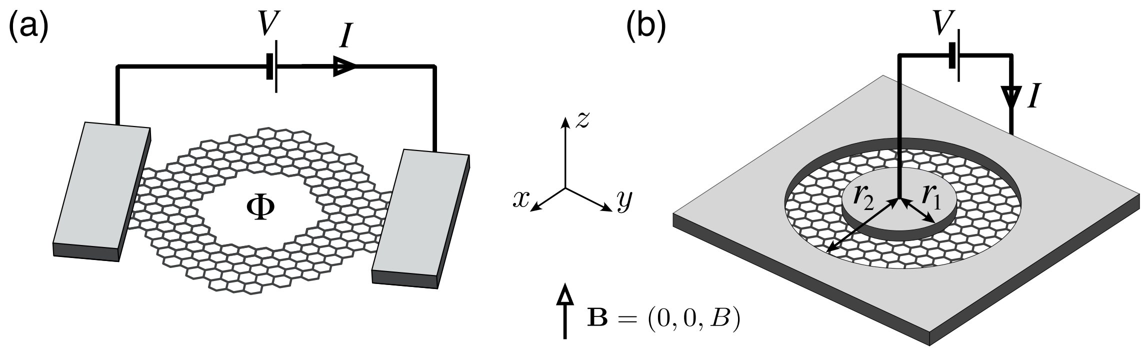

Figure 1. Devices considered in the presentation (schematic). Voltage source passes the current from the right to the left lead in case of the Aharonov-Bohm ring (a) or from the outer circular lead to the inner one in case of the Corbino disk (b) in graphene. Additional gate elec- trodes (not shown) may be used to tune dopings or to induce transverse electric fields. [Reprinted from: A. Rycerz, *Acta Phys. Polon. A* **121**, 1242-1245 (2012).]