Detecting the topological insulating state in double-slit silicene interferometer

Bartłomiej Rzeszotarski[1], Alina Mreńca-Kolasińska[1], Bartłomiej Szafran[1]

[1] *AGH University of Science and Technology,*
Faculty of Physics and Applied Computer Science,
al. Mickiewicza 30, 30-059 Krakw, Poland

Topologically protected currents in two-dimensional topological insulators produce the quantum spin Hall (QSH) effect [1]. We investigate the current flow in silicene for which the QSH state occurs at the Fermi energy near the charge neutrality point [2-4] and the spin currents are confined by opposite edges of the sample. This effect has been widely examined for possible applications in silicene spin sources and spin filters [5,6]. In this work we propose silicene interference nanodevices for detection of the QSH transport conditions. Our devices are based on the idea of the double-slit interference where the spin separation is provided by the split of silicene ribbon [6]. In the normal phase - where the current flows through the full channel width - the smooth Aharonov-Bohm conductance oscillations are observed, while in the QSH regime only sharp conductance peaks occur due to localized resonances with circular current loops. Additional potential from local electric field (controllable by the gate) introduces energy gap at the one of the arms that can intentionally switch off the Aharonov-Bohm oscillations as well as localized resonances.

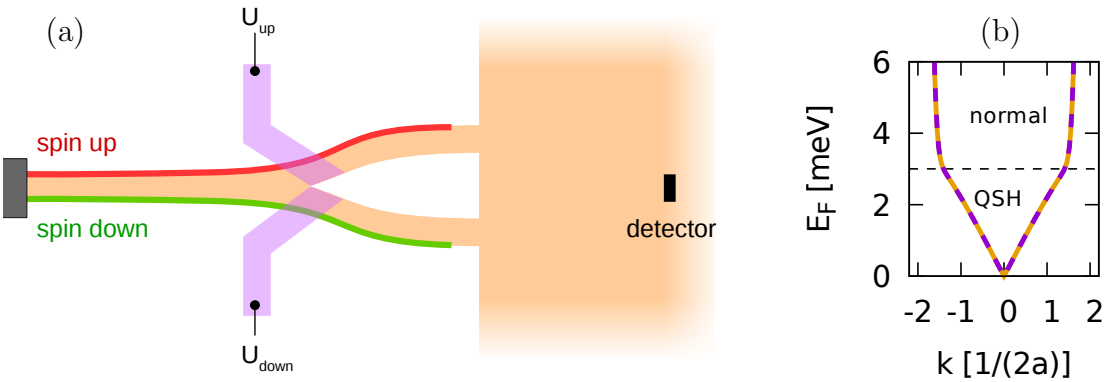

Figure 1: (a) Scheme of a double-slit silicene topological state detector. (b) Band structure for the first conductive subbands in the silicene zigzag nanoribbon.

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