Gate-induced Aharonov-Bohm interferometer in graphene nanoribbon

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In graphene it is possible to form regions of p- and n-type conductivity by electric gating [1], which allows for formation of n-p junctions that can be controlled by external voltages.

In the quantum Hall conditions the junction forms a waveguide [2] for the current due to the Lorentz force that in the adjacent n and p regions acts on the carriers in opposite directions.

We study an interference device, which exploits this effect, with a circular n-p region induced in a graphene ribbon by a tip of an atomic force microscope. We simulate the transport properties with the tight-binding Hamiltonian. The current along the junction forms localized states that enter into a Fano-type interference with the currents flowing along the edges of the ribbon. The interference induces conductance oscillations of the Aharonov-Bohm periodicity, and the voltage applied to the tip controls both the oscillation period and the lifetime of localized resonances.

We find that the states localized at the junction correspond to currents of the orientation which produces magnetic dipole moment opposite to the external magnetic field for which the snake orbits along the junction are stabilized by the Lorentz forces. Besides the periodic features of conductance, resonances with the currents constrained entirely under the tip are formed, with an opposite current circulation.

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