Local and non-local effects in charge and spin transport through graphene-based junctions

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We investigate the local and nonlocal charge and spin transport through graphene-based junctions in which two ferromagnet regions are connected with a conventional singlet superconductor region. Spin polarization and superconductivity in a graphene sheet are assumed to be created by proximity effects induced by a superconducting electrode and ferromagnetic electrodes placed on the top of the graphene. In order to investigate all the possible reflection processes, we include the potential barriers which separate the ferromagnetic and superconducting regions. The system is described by the Dirac-Bogoliubov-de-Gennes equation. Adopting the Blonder-Tinkham-Klapwijk formalism we solve the equation and obtain transport coefficients, by imposing the continuity conditions for the wave functions at the interfaces. The coefficients describe processes consisting of quasiparticle cotunneling, and normal reflection as well as local and crossed Andreev reflections. We discuss how the chiral nature of low-energy excitations influences these transport processes. In particular, we calculate and discuss tunneling conductance and magnetoresistance as functions of bias voltage, incident angle and the model parameters.