Mesoscopic valley filter in graphene Corbino disk containing p-n junction

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The Corbino geometry allows one to investigate the propagation of electric current along a p-n interface in ballistic graphene in the absence of edge states appearing for the familiar Hall-bar geometry. Using the transfer matrix in the angular-momentum space we find that for sufficiently strong magnetic fields the current propagates only in one direction, determined by the magnetic field direction and the interface orientation, and the two valleys, K and K', are equally occupied. Spatially-anisotropic effective mass may suppress one of the valley currents, selected together with the direction of propagation, transforming the system into a mesoscopic version of the valley filter. The filtering mechanism can be fully understood within the effective Dirac theory, without referring to atomic-scale effects which are significant in proposals operating on localized edge states.

Figures

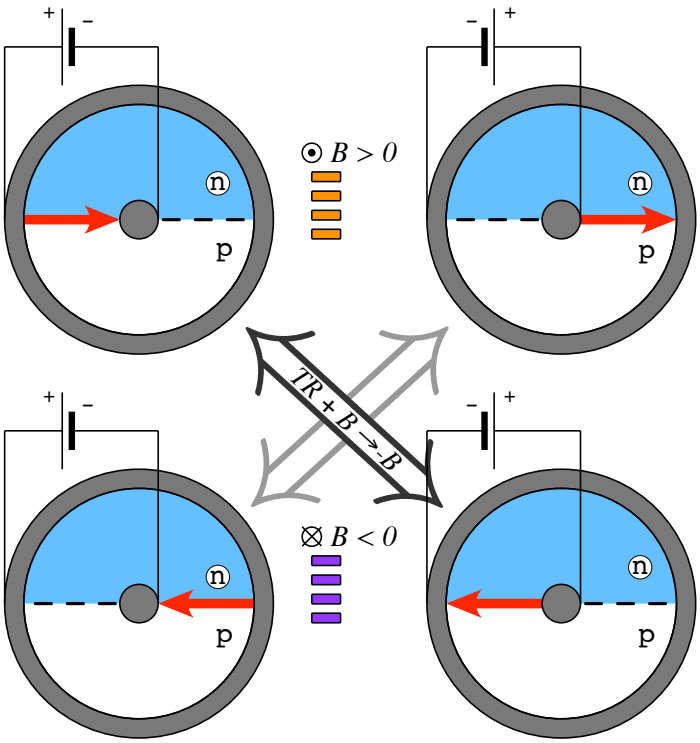

Figure 1. Quantum Hall states propagating along a p-n junction in the strong-field limit, for B > 0 (top) and B < 0 (bottom). Diagonal double arrows indicate the system symmetry upon a simultaneous time reversal and magnetic field inversion.