Spin-orbit driven phenomena in Dirac fermions with Rashba spin-orbit interaction – transport characteristics at finite temperatures

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Spin-orbit driven phenomena, such as the spin Hall effect or current-induced spin polarization, enable electrical control of the spin degree of freedom and efficient spin-to-charge interconversion. Using the Matsubara Green function's formalism and the linear response theory, we considered the spin-orbit driven transport properties of Dirac fermions in the presence of weak Rashba spin-orbit interaction. Such a model may be used to describe transport properties of graphene and graphene-like 2D crystals beyond the zero-temperature limit. In the regime of weak Rashba coupling, we obtained analytical formulas describing the spin Hall effect and current-induced spin polarization and their thermal counterparts at arbitrary temperature. The considered model can be adapted easily to study many-body physics in Dirac-Rashba systems.

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