Highlights

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Quantum transport in Rashba spin–orbit materials: a review

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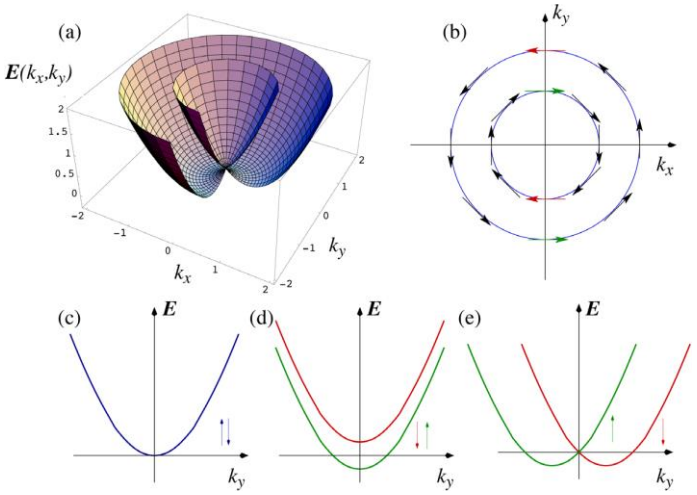
In this review article we have described spin-dependent transport in materials with spin–orbit interaction of Rashba type. We mainly focused our attention on semiconductor heterostructures, however we have considered topological insulators, graphene and hybrid structures involving superconductors as well. Starting from the Rashba Hamiltonian in a two dimensional electron gas we have then described transport properties of two- and quasi-one-dimensional systems. The problem of spin current generation and interference effects in mesoscopic devices is described in detail. We have addressed also the role of Rashba interaction on localisation effects in lattices with nontrivial topology, as well as on the Ahronov–Casher effect in ring structures. In the end, we have included a brief section describing also some related topics including the spin-Hall effect, the transition from weak localisation to weak anti localisation and the physics of Majorana fermions in hybrid heterostructures involving Rashba materials in the presence of superconductivity.



Properties of the Rashba energy spectrum. (a) Portion of the energy spectrum of the Hamiltonian. (b) The Fermi contours relative to the Hamiltonian, the spin states are shown as well. (c) section of the energy spectrum for a free electron. (d) section of the energy spectrum for an electron in presence of a magnetic field, e.g. Zeeman splitting. (e) section of the energy spectrum for an electron in presence of RSOI.