

Spin orbit interactions, time reversal symmetry and spin filtering

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Quantum computing requires the ability to write and read quantum information on the spinors of electrons. Here we discuss writing information on mobile electrons, which move through mesoscopic (or molecular) quantum wire networks. When such a network is connected to one source and one drain then time-reversal symmetry and unitarity imply no spin polarization. Tunable spin filtering can be achieved by adding a magnetic field, which breaks time-reversal symmetry, or by leakage, which breaks unitarity. Alternatively, filtering is also achieved with more than one drain. Specific examples include transport through a mesoscopic Aharonov-Bohm interferometer and through a helical molecule.

Filtering can also be achieved for a single one-dimensional wire which has spin-orbit interactions, when the chain vibrates in the transverse direction. Such a single wire can also change the Josephson current between two superconductors.

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