QUANTUM WIRES AND TWO-DIMENSIONAL ELECTRON GASES WITH INHOMOGENEOUS RASHBA INTERACTION

Ll. Serra

Institut de Fsica Interdisciplinar i Sistemes Complexos IFISC (CSIC-UIB)
Departament de Fsica, Universitat de les Illes Balears, E-07122 Palma de Mallorca, Spain

E-mail: llorens.serra@uib.es, http://ifisc.uib.es/

We discuss the physical properties of localized Rashba interactions in semiconductor quantum wires and two-dimensional electron gases. In quasi-one-dimensional semiconductor wires we show how the existence of quasibound states leads to Fano-Rashba resonances in the linear conductance. We investigate intersubband mixing effects in multichannel quantum wires attached to two magnetic contacts, the spin transistor geometry. When the contacts are ferromagnetic and their magnetization direction is perpendicular to the Rashba field, the spin-transistor current is expected to depend in an oscillatory way on the Rashba coupling strength due to spin coherent oscillations of the travelling electrons. Nevertheless, we find that the presence of many propagating modes strongly influences the spin precession effect, leading to (i) a quenching of the oscillations and (ii) strongly irregular curves for high values of the Rashba coupling. We also observe that in the case of leads' magnetization parallel to the Rashba field, the conductance departs from a uniform value as the Rashba strength increases. We also discuss the Rashba interaction induced current polarization effects when the contacts are not magnetic and investigate how this mechanism is affected by the presence of several propagating channels. The limit of the two-dimensional-electron-gas, when the transverse confinement vanishes and the system becomes translationally invariant in y direction is described. Our results [1] are discussed in the context of recent measurements [2] and calculations [3,4].

References

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