Seminar Schedule

Dr. Jan Martinek

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Date: Aug. 25, (Mon.) 14:30～

Room: Seminar room, 2nd floor, prefab bldg

Interaction-driven spin precession in quantum-dot spin valves

We analyze spin-dependent transport through spin valves composed of an interacting quantum dot or magnetic quantum impurity coupled to two ferromagnetic leads using a nonequilibrium Keldysh Green function formalism and a real-time transport theory developed in Ref.[1]. The average spin on the quantum dot and the linear conductance as a function of the relative angle of the leads' magnetization directions is derived to lowest order in the dot-lead coupling strength. Due to the applied bias voltage spin accumulates on the quantum dot, which for finite charging energy experiences a torque due to an effective exchange interaction between the spin in the dot and the ferromagnetic leads, which in turn generates spin precession, detectable in the conductance. What is important, this precession is a pure Coulomb interaction effect and appears even in the absence of an external magnetic field. The effect of this spin precession is predicted to be clearly visible in the linear conductance as a reduction of the spin-valve effect and a nontrivial angular dependence. For any non-parallel configuration, transport is reduced as compared to the parallel one (spin-valve effect). In the absence of Coulomb interaction, the angular dependence follows simply cosine low. The presence of a finite charging energy, however, leads to a reduction of the spin-valve effect. Our prediction may be applied to quantum dots attached to ferromagnetic leads or magnetic impurities inside the tunnel barrier of the magnetic tunnel junction.

[1] J. Koenig, H. Schoeller, and G. Schoen, Phys. Rev. Lett. 76, 1715 (1996); J. Koenig, et al., Phys. Rev. B 54, 16820 (1996).

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