Universidad Carlos III de Madrid

Seminario del Instituto Gregorio Millán

Spin dynamics in Quantum Dots under dc and ac magnetic fields

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Resumen

In the last years a large number of experiments has been devoted to the analysis of the electronic current through double quantum dots (DQD's) in the spin blockade (SB) regime. Hyperfine interaction in DQD's releases spin blockade allowing the flux of current and inducing nuclei spin polarization. This interaction gives rise to a feedback mechanism between the spins of the electrons and nuclei, which dynamically modifies the electronic charge occupation and the energy of the electronic levels. In this talk, we propose a model which accounts for hyperfine interaction, as the main spin-flip source, and which allows to obtain the nuclei spin dynamical polarization and its interplay with the electron spin dynamics. We will show how this interplay brings the current to perform self-sustained current oscillations, as experimentally observed. We have considered molecular states as the basis and, from non linear rate equations for the electronic charge occupations and nuclei spin polarization, we obtain the non linear electronic current and dynamical nuclear polarization. As we will discuss, there are different spin flip processes which induce nuclear spin polarization with opposite polarization. We have analyzed their interplay and we have calculated the tunneling current as a function of time, effective exchange interaction (interdot tunneling) and magnetic field.

The second part of this talk will be devoted to analyze spin dynamics in double and triple dots under crossed dc and ac magnetic fields. Recent transport experiments in DQD's under crossed dc and ac magnetic fields show coherent spin rotations of one single electron spin. We will discuss the electron spin dynamics in this configuration and we will extend this analysis to triple quantum dots (TQD's). TQDs in linear o triangular configuration have been investigated, both experimentally and theoretically. TQDs have been proposed as solid-state-entanglers or charging rectifiers.They also motivate fundamental research, because their electronic properties present a rich variety of physical phenomena as spin blockade or electron spin resonance (ESR). Also, TQD's in triangular configuration present Aharonov-Bohm (AB) oscillations. We have analyzed the interplay between AB-phase and coherent spin rotations

induced by crossed DC and AC fields in TQD in triangular configuration, filled with up to three extra electrons. We investigate different configurations, i.e. equal or different Zeeman splittings within the three dots. We discuss how coherent population trapping, which occurs in TQD's filled with one electron, is affected by the AC field. The presence of a second extra electron leads to new interesting features in the spin dynamics due to the interplay between spin blockade, AB-interference and coherent spin rotations induced by the AC magnetic field. Current through the system can be blocked either by coherent population trapping or by spin blockade. We will discuss how ESR modifies the spin dynamics in both cases and how it depends on the magnetic flux through the sample induced by the dc field. Finally, we predict that, for certain sample configurations, bichromatic magnetic fields are able to induce electron coherent trapping in the TQD. Our results indicate that not only electron spin coherence but also electron spin rectification properties in transport can be tuned with AC and DC magnetic fields.

- DÍA: **Miércoles 15 de abril de 2009**
- HORA: **12:30**
- LUGAR: **Edificio Sabatini. Aula 2.1.D04**