SEMINARIO
Departamentos de Física Teórica I y II
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TITULO: Long-Range Transport Through Quantum Dot Arrays

LUGAR: FACULTAD DE CIENCIAS FÍSICAS UCM
DÍA: 18 de junio, 2015 (Jueves)
HORA: 14:30
AULA: Seminario Depto. Física Teórica I, Planta 3ª

ABSTRACT:

Tunneling in a quantum coherent structure is not restricted to only nearest neighbors. Hopping between distant sites is possible via the virtual occupation of otherwise avoided intermediate states [1-3].
In this talk I will report the observation of long-range transitions in the transport through three quantum dots coupled in series. A single electron is delocalized between the left and right quantum dots, while the center one remains always empty. Superpositions are formed, and both charge and spin are exchanged between the outermost dots. The delocalized electron acts as a quantum bus transferring the spin state from one end to the other. Spin selection is enabled by spin correlations.[3].
I will also discuss configurations in TQDs coupled in series where two paths with different virtual intermediate states lead to quantum interference. We have found conditions where the destructive interference of these transitions completely cancels the transport, giving rise to current blockade [4]. The system thus works as a one dimensional interferometer with branches defined by two different virtual intermediate states. Spin correlations due to the Pauli exclusion principle also play an essential role by avoiding certain transitions. This effect, known as spin blockade, leads to the suppression of certain resonances whose observation gives a measure of spin decoherence times.

Finally, I will show recent theoretical results on long-range transport through ac driven triple quantum dots coupled in series[5]. Resonant transitions between separated and detuned dots are mediated by the exchange of n photons with a time-dependent field. We analyze the interplay between real transitions through the central dot and virtual long-range tunneling. We find configurations where the two paths interfere and totally block the current. Our results will be compared with those obtained for an undriven triangular arrangement. In this last case there are two possible ways to get from one dot to another , the same happens in the linear driven system, where one of the transitions however is virtual and, importantly, it is easily manipulated by changing the phase and amplitude of the applied field.

[1] M. Busl et al., Nature Nanotechnol. **8**, 261 (2013).
[2] F. Braakman et al., Nat. Nanotechnol.,8,432 (2013).
[3] R. Sánchez et al., Phys. Rev. Lett., **112**, 176803 (2014).
[4] R. Sánchez, F. Gallego-Marcos and G. Platero, Phys Rev. B, **89**, 16140 (RC) (2014).
[5] F. Gallego-Marcos, R. Sánchez and G. Platero, Journal of App. Phys. 117, 112808 (2015); F. Gallego-Marcos et al., submitted.