

PhD grant

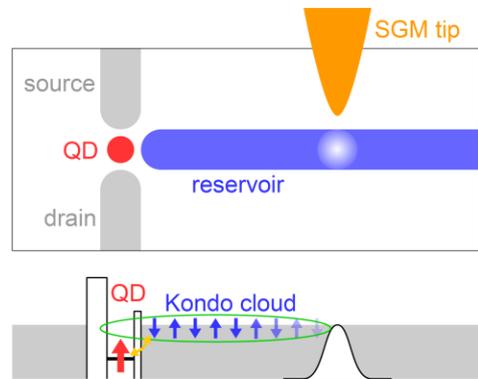
Kondo-cloud extension around quantum dots

Context :

Known for a long time in metals with magnetic impurities, the Kondo effect has shown a revival in the context of semiconductor quantum dots (QD). This many-body effect results from the dynamical screening of an unpaired electron spin by the conduction electrons of the reservoirs. Remarkably, the transmission through this coherent Kondo state is perfect and all the physical quantities are characterized by a single characteristic scale T_K . According to theory, the conduction electrons involved in this process should form a screening cloud around the localized spin with a characteristic length scale ξ_K . The objective of the project is to demonstrate the existence and to measure the spatial extension of this "Kondo cloud" which is predicted to extend over several microns.

Objectives :

The originality of the project is to use scanning gate microscopy (SGM) to vary continuously the size of the electron reservoir hosting the Kondo cloud of the QD. The modulations of the Kondo resonance due to interference in the tip-induced finite-size reservoir will be measured via two weakly-coupled leads. The dependence of these modulations with the reservoir size will provide an experimental determination of the Kondo length. This length will be studied as a function of temperature, parallel magnetic field, and tunnel coupling to the screening reservoir. The Kondo cloud extension will also be studied in other samples containing two distant QDs coupled to a common reservoir and sharing the same Kondo cloud.



Collaborations :

The PhD student will work in the QNES team of the Néel Institute and perform the SGM experiments with the support of a theoretical group. The student will closely interact with a post-doctoral researcher at the CEA-Grenoble for some of the transport measurements. The QD devices in GaAs/AlGaAs heterostructures will be fabricated by collaborators at C2N in Paris. A few SGM experiments at very-low temperature will be performed with collaborators at IMCN in Belgium to probe the Kondo cloud in the strong coupling regime.

Required profile :

Candidates should have a master in condensed matter physics, quantum physics, or nano-physics, with lectures on quantum transport and advanced quantum mechanics. They should be highly motivated by working on a fundamental research topic, and by performing delicate experiments at low temperature.

Foreseen start for the grant : in 2019 or 2020

Amount : ANR grant, 25 k€/year gross salary, 20 k€/year after deduction of charges

Duration : 36 months

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