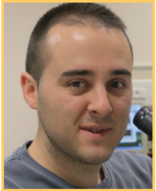

Spin-sensitive tunneling in Superconductor - Quantum Dot junctions

CONTACT
clemens.winkelmann@neel.cnrs.fr

Alvaro Garcia Corral (PhD student), Clemens Winkelmann (thesis supervisor), David van Zanten, Hervé Courtois, Denis Basko, Serge Florens

LABORATORIES : NEEL, LPMMC

When inserting a single quantum dot (QD, a molecule or a nanoparticle) between two superconducting (S) contacts, the resulting device has fascinating electronic conduction properties, which reflect the coupling of a discrete orbital quantum energy level to superconductivity. The host group has recently demonstrated applications of S-QD-S junctions as an on-chip and on-demand source of single monochromatic electrons. Building on these findings, the present PhD project explores in more depth the quantum dynamics at play in such devices, as well as the role of the spin degree of freedom.

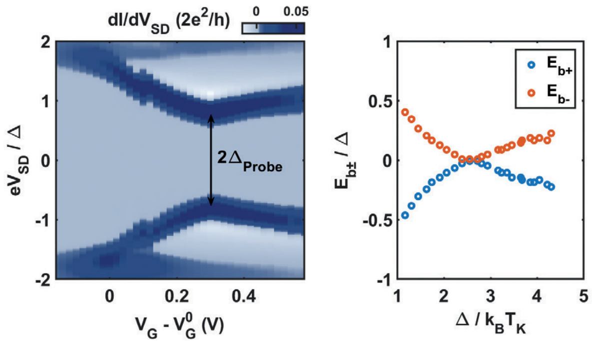

Fig. 1: (left) Mapping of sub-gap states versus gate voltage. (right) Extracted bound-state energy, displaying the phase transition for $\Delta/k_BT_K\approx 2.5$.

In the course of the above project, we have studied S-QD-S devices with stronger values of the tunnel coupling. These are not necessarily well suited for single electron injection, but give access to a rich physics: the competition of the leads' superconductivity and the magnetism of single unpaired electrons on the QD leads to bound sub-gap excitations in the superconductor. In particular, we are able to tune the S-QD hybrid precisely across the quantum phase transition between a magnetic and non-magnetic QD ground state (Fig1).

OUTCOMES

Oral presentation: LT28, Gothenborg, Sweden, 2017.

Collaborations: J. P. Pekola, Aalto University, Finland; K. J Franke, FU Berlin, Germany.

Awards: Best thesis presentation prize at Rencontres des Jeunes Physicien-ne-s for A. Garcia Corral, 2017.

Leverage: JOSPEC ANR (PRCI), 2017.