Andreev Bound-State Dynamics in Quantum-Dot Josephson Junctions:

A Washing-out of the 0-Pi Transition

R. Avriller[1], F. Pistolesi[1]

1 Laboratoire Ondes et Matière d'Aquitaine (LOMA), Univ. Bordeaux, CNRS UMR 5798, Talence, France

In this work, we investigate transport properties of a Josephson junction formed by a CNT quantum dot connected to two bulk superconductors. We describe Coulomb interaction for electrons populating the dot and coupling to both an electromagnetic environment and a finite density of electronic quasi-particles. In the limit of a large superconducting gap, we obtain a Born-Markov description of the relevant Andreev bound-states dynamics [1].

We calculate the current-phase relation and find that the experimentally unavoidable presence of quasi-particles can dramatically modify the 0-π standard transition picture [1]. We show that photon-assisted quasi-particle absorption allows the dynamic switching from the 0 to the π state and vice versa, washing out the 0-π transition predicted by purely thermodynamic arguments. Spectroscopic signatures of Andreev bound-states broadening are also investigated by considering microwave irradiation.

The results and the methods presented here are relevant for the understanding of the tunneling spectroscopy of Andreev bound states in systems where Coulomb interaction is present. The issue of the stability of Andreev bound states with respect to the quasi-particle scattering has also a strong relevance for the observation of Majorana states, which should be subject to a similar dynamics.

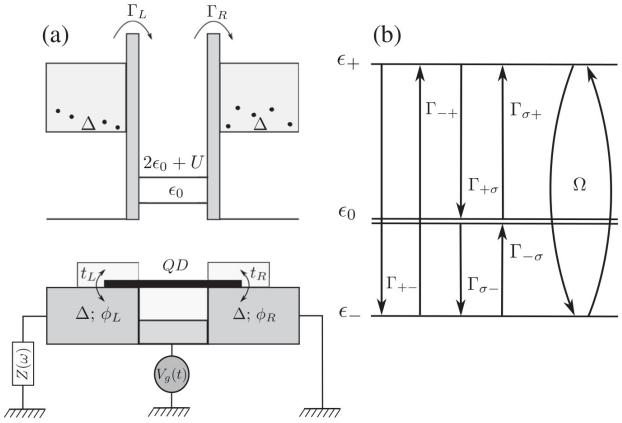

Figure adapted from Ref[1] : (a) Representation of the CNT Josephson junction studied.
(b) Representation of the transition rates ruling the dynamics of Andreev-bound states in presence of quasi-particles.

1. R. Avriller and F. Pistolesi, Phys. Rev. Lett. **114**, 037003 (2015).