Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 25/11/2015

Responsable du stage / *internship supervisor*:

Nom / *name*: POTHIER Prénom/ *first name* : Hugues

Tél : 01 69 08 55 29 Fax : 01 69 08 74 42

Courriel / *mail*: hugues.pothier@cea.fr

Nom du Laboratoire / *laboratory name*: Quantronics group

Code d'identification : Organisme : CEA, CNRS, Université Paris-Saclay

Site Internet / *web site*: http://iramis.cea.fr/drecam/spec/Pres/Quantro/static/

Adresse / *address:* SPEC (Service de Physique de l'Etat Condensé), CEA Saclay, 91191 Gif-sur-Yvette

Lieu du stage / *internship place*: idem

Titre du stage / *internship title*:

Quantum jumps and quasiparticle trapping in superconducting one-atom contacts

Can one measure in real time the changes in the occupation of a single quasiparticle state within a superconductor, and understand this dynamics? We have shown recently that although bulk superconductors consist in an assembly of delocalized and overlapping pairs of electrons, the Cooper pairs, localized states arise at atomic-size contacts [1]. The occupation of these fermionic states with 0, 1, or 2 quasiparticles was detected using circuit quantum electrodynamics techniques [2], with a measurement almost at the quantum non-demolition (QND) limit. One observes quantum jumps between states with 0 and 2 quasiparticles, which correspond to the two possible states of a localized Cooper pair. In addition, frequent changes in the parity (transitions between 0 and 1, or 1 and 2) are found in the experiment, due to the trapping or the un-trapping of single quasiparticles. We propose to design an experiment in which this dynamics is slowed down, with an improved detection scheme reaching the QND limit, to characterize the individual processes from a continuous measurement of the occupation.

The subject requires the student to develop a good understanding of quantum physics, and to learn and master different techniques: nanofabrication, low temperatures, low-noise and microwave measurements. He/she will be integrated in an active research group on quantum electronics.

[1] L. Bretheau et al., "Exciting Andreev pairs in a superconducting atomic contact" Nature 499, 312 (2013). arXiv:1305.4091

[2] C. Janvier et al., "Coherent manipulation of Andreev states in superconducting atomic contacts" Science 349, 1199 (2015), arXiv:1509.03961

Quantronics group website

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : yes**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: CFR (CEA) or EDPIF**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**