

# First proposal of Master 2 Internship

M2 - ANNÉE UNIVERSITAIRE 2017/2018

Régis Mélin, Institut Néel, Grenoble, France

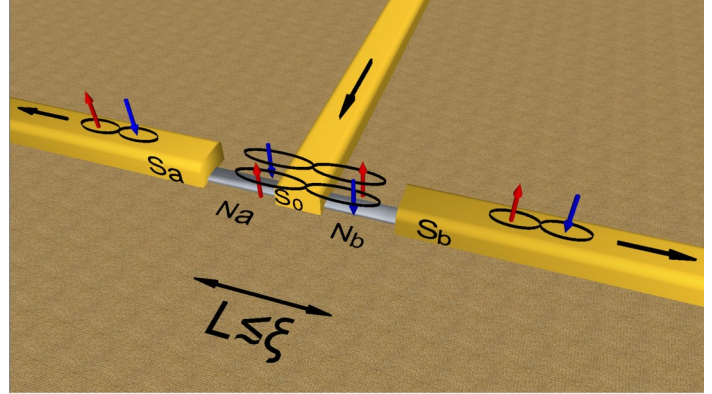
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**1 – Title of internship:** Effect of Coulomb interactions on four-fermion correlations in an equilibrium three-terminal Josephson junction

**2 – Name and title of advisor :** Régis Mélin (Senior Research scientist, CNRS).

**3 – Laboratory :** Institut Néel, Grenoble, France



Many experimental and theoretical works in the field of quantum nanoelectronics aim at manipulating **simple systems** with small numbers of degrees of freedom. Several implementations have been realized, on the basis of Josephson junctions.

It was proposed that correlations among four fermions could be obtained in those three-terminal Josephson junctions [1]. Four-fermion correlations are obtained from Wick theorem, and those were confirmed experimentally [2,3].

The goal of the internship is to demonstrate that, under specific experimental conditions, Coulomb interactions can be the driving force for producing spatially separated four-fermion correlations at equilibrium, in absence of bias voltage. The goal is to calculate the nonlocal inverse inductance and to characterize entanglement. The challenge is to demonstrate *long-range* entanglement between two remote quantum dots in a three-terminal Josephson junction.

The method will be based on equilibrium Green's functions.

The internship is within on-going theoretical collaboration with Benoît Douçot (LPTHE, Jussieu, Paris, France) and with the experimental group of Moty Heiblum (Weizmann Institute, Israël).

[1] A. Freyn et al., Phys. Rev. Lett. 106, 257005 (2011).

[2] A.H. Pfeiffer, Phys. Rev. B 90, 075401 (2014).

[3] Y. Cohen et al., arXiv:1606.08436 (2016).