Master 2 Nano Physics/Quantum Physics/ Condensed matter Physics:
INTERNSHIP PROPOSAL

Laboratory name: ***Laboratoire de Physique des Solides***
CNRS identification code: UMR8502
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Internship location: Laboratoire de Physique des Solides
Université Paris Sud- 1 rue Nicolas Appert - Groupe NS2 - Bat 510
91405 Orsay Cedex

Thesis possibility after internship:	YES
Funding: YES/NO	If YES, which type of funding:

Resolving microwave photon numbers with high impedance resonators

Subject: The detection of single microwave photons has been a long standing goal in microwave quantum optics for the past decade. The challenge is greater than in the optical regime, since a single microwave photon carries 5 orders of magnitude less energy than an optical photon. Different complex scenarios have already been implemented all using low impedance microwave cavities and superconducting qubits.

In this internship we propose to use a novel type of detection mechanism. It relies on the newly developed high kinetic inductance coplanar waveguide resonator that enhances the ac-voltage created by a single photon. Coupling the resonator to a metallic island will result *via* highly efficient photon-assisted processes in the appearance of an extra-charge on the island measurable with a single electron transistor in near proximity. The high impedance resonator will consist in high kinetic inductance superconducting nanowires that have been developed in the group either in tungsten [1] or granular aluminum.

The student will fabricate the sample using state-of-the-art electron beam and optical lithography and metal evaporation, use finite element simulations to model the coupled system, and measure at very low temperature (10mK) the fabricated sample in a dilution refrigerator.

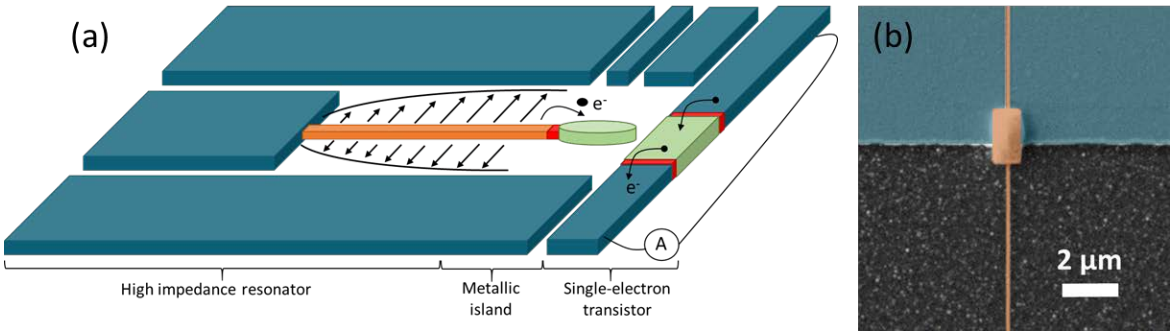

Figure: (a) Detection scheme proposed to detect single microwave photons using a high impedance resonator. (d) Scanning electron microscope picture of a tungsten nanowire exhibiting a very high kinetic inductance necessary to increase the detection efficiency.

[1] *High kinetic inductance microwave resonators made by He-Beam assisted deposition of tungsten Nanowires.* J. Basset, D. Watfa, G. Aiello, M. Fechant, A. Morvan, J. Esteve, J. Gabelli, M. Aprili, R. Weil, A. Kasumov, H. Bouchiat and R. Deblock. Applied Physics Letters 114, 102601 (2019).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Macroscopic Physics and complexity:	NO
Quantum Physics:	YES	Theoretical Physics:	NO