NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2019-2020

Superconducting qubits

General Scope:
During the last decade, it has been demonstrated that superconducting Josephson quantum circuits constitute ideal blocks to build quantum bits and to realize quantum mechanical experiments. These circuits appear as artificial atoms whose properties are fixed by electronics compounds (capacitance, inductance, tunnel barrier) [1].
We demonstrated a new quantum measurement on superconducting qubits (see quantum trajectories in Fig.1) [2]. We propose to study the so-called "Quantum-Non Demolition" property of this measurement and to implement it on a multi-qubit plateform for quantum information processing.

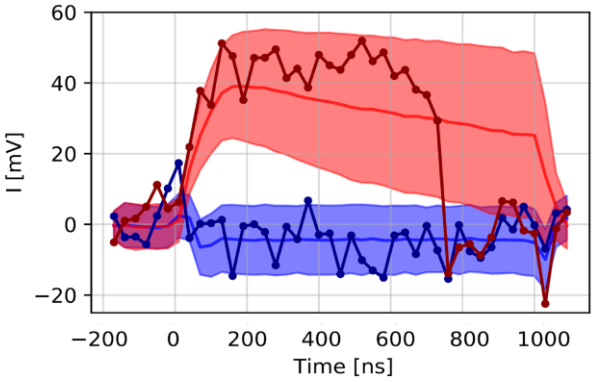

Figure: Quantum trajectories (successive single shot measurement) when the qubit is prepared in its ground state |g> (blue points) and excited state |e> (red points) at t=0ns. A quantum jump is observed at about 750ns.

[1] *"V-shaped superconducting artificial atom based on two inductively coupled transmons,"* E. Dumur et al., Phys. Rev. B **92**, 020515(R) (2015).
[2] *"Fast high fidelity quantum non-demolition qubit readout via a non-perturbative cross-Kerr coupling",* R. Dassonneville, et al, arxiv1905.0027 (2019).

Research topic and facilities available:
Our team has a strong experience in nanofabrication, microwave electronics, cryogenic equipment and superconducting qubit experiments. The student will fabricate the artificial atom through nanofabrication using lithography processes in NanoFab and PTA facilities. She/He will then carry out microwave measurements in the quantum limit of the device at very low temperature. All the microwave equipment as well as the dilution fridge are already installed. The student will participate to the understanding and improvement of the quantum non-demolition measurements

Possible collaboration and networking: Our "Quantum Electronics Circuits Alps" team is part of several national networks. This project on superconducting qubits been financially supported by the National French Funding Agency (ANR) and the student will collaborate with Quantronics team in CEA-Saclay.

This internship can be pursued toward a PhD

Required skills: Master 2 or Engineering degree. We are seeking highly motivated students on quantum mechanics who want to develop experiments on quantum bits.

Starting date:

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