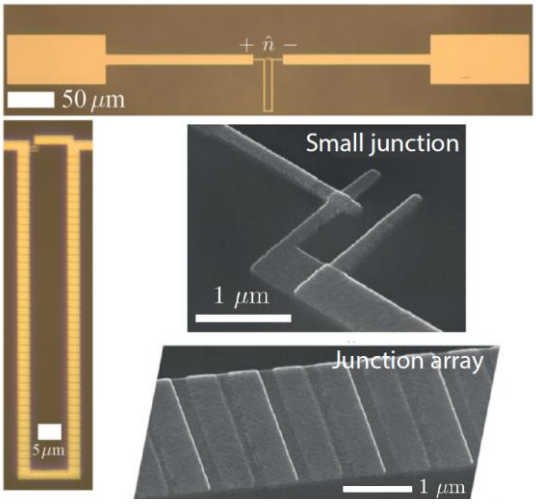
NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2022-2023

Toward practical quantum computation with high-impedance superconducting circuits

General Scope:
Superconducting quantum circuits have emerged as one of leading platforms to build a quantum computer. While most efforts of the community focus on creating larger scale devices, the performances of each individual quantum bits remains a major limitation to achieve practical applications. Recently, a new class of circuits demonstrated unprecedented coherence times exceeding a millisecond [1] opening a new promising route for high performance Quantum computation. In these circuits the logical states are encoded in the electrical degree of freedom of a loop formed by small Josephson junction shunted by an inductance (Junction array) providing both protection against decoherence as well as exceptional spectral isolation of the computational states allowing new implementation of quantum logic [2].



Superconducting circuit made of Aluminum. A loop formed by a small Josephson junction (JJ) shunted by an array of 100+ JJ defines a highly coherent quantum bit.

[1] *"Millisecond coherence in a superconducting qubit"*, A. Somoroff, Q. Ficheux et al, arXiv:2103.08578 (2021). Link

[2] *"Fast logic with slow qubits: microwave-activated controlled-Z gate on low-frequency fluxoniums"*, Q. Ficheux, et al, Phys. Rev. X 11, 021026 (2021). Link

Research topic and facilities available:
Our team has a strong experience in design, fabrication, and characterization of superconducting circuits. The student will help setting a new experiment operating at millikelvin temperatures in a dilution refrigerator as well as design, fabricate and characterize single and two-qubit devices with the aim of demonstrating record coherence times and universal quantum logical operations.

Possible collaboration and networking: The European Union (EU) is financially supporting the project in the context of the Quantum Flagship aiming at building a Quantum Computer for Europe (OpenSuperQ+ project). With more than 30 partner universities, research institute, and companies throughout the EU, the student will take part of one of the most ambitious European research project to date.

Possible extension as a PhD: This internship can be pursued with a funded PhD.

Required skills: Master 2 in physics or Engineering degree. Desire to pursue a career in academic or industrial research. We are seeking highly motivated students who want to bring a significant contribution to the field of quantum computation with superconducting electronic circuits. The student will acquire experience with condensed matter experiments, microwave engineering, cleanroom work, cryogenic equipment, and software development.

Starting date: Academic year 2022-2023

Contact: FICHEUX Quentin / BUISSON Olivier / ROCH Nicolas
Institut Néel - CNRS Phone : +33 4 56 38 71 77
e-mail : quentin.ficheux@neel.cnrs.fr / olivier.buisson@neel.cnrs.fr / nicolas.roch@neel.cnrs.fr

More information: http://neel.cnrs.fr