Master Thesis project 2022

Experimental characterization of a Josephson Traveling Wave Parametric Amplifier (TWPA)

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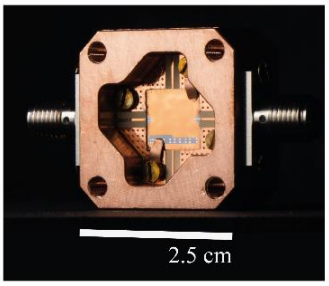

General description of the project: One of the present leading technologies for the realization of a quantum computer is based on *superconducting quantum circuits*. It exploits superconducting circuits based on Josephson junctions that can be adopted as quantum bits (qubits), the basic units of quantum information [1]. Travelling wave parametric amplifiers (TWPAs) are key pillars in the framework of superconducting quantum circuits since they allow broadband and near quantum-limited amplification for multiplexed readout of superconducting qubits [2].

This Master thesis project aims at a complete cryogenic characterization of a novel Josephson TWPA: Reversed Kerr TWPA [3] . The student will experimentally characterize the device in terms of gain, bandwidth, added noise, dynamic range and ideally also in terms of the ability to perform single-shot readout of a superconducting qubit. The successful candidate will have the opportunity to work at the first installation and operation of a Reversed Kerr TWPA in the cryogenic setup of the QT Lab in the Physics Department of the Federico II in collaboration with Seeqc Italy.

The Reversed Kerr TWPA device under investigation, has been already fabricated at the CNRS Neel Institute in Grenoble, France, using CNRS NanoFab facility.

In addition to gaining experimental skills in cryogenics, microwave electronics and quantum device characterization, the student will also investigate in deep the physics of TWPAs and in general Josephson-junction-based metamaterials for their theoretical modelling.

Experimental facilities: Cryostat and microwave electronics of the QT Lab - Seeqc joint Lab in Naples.

Possible collaborations and networking: Collaboration with Dr. Nicolas Roch's group at Neel Institute in Grenoble, France, and Seeqc Italy.

Contact: If interested/curious about this project please write to martina.esposito@spin.cnr.it or visit https://sites.google.com/view/martinaesposito.

[1] P. Krantz, M. Kjaergaard, F. Yan, T. P. Orlando, S. Gustavsson, and W. D. Oliver, "A quantum engineer's guide to superconducting qubits," Appl. Phys. Rev., 6, 2, 2019.

[2] M. Esposito, A. Ranadive, L. Planat, and N. Roch, "Perspective on traveling wave microwave parametric amplifiers," Appl. Phys. Lett., 119, 12, 2021.

[3] A. Ranadive, M. Esposito et al., "A reversed Kerr traveling wave parametric amplifier," https://arxiv.org/abs/2101.05815.