

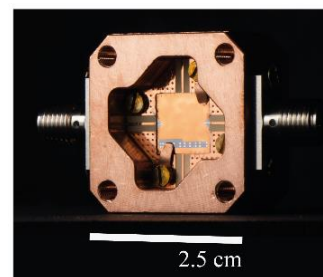
Master Thesis project 2022

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

Project supervisor: Dr. Martina Esposito, CNR SPIN Naples

University supervisor: Prof. Francesco Tafuri, University of Naples Federico II

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>.