Master in Photonics – "PHOTONICS BCN"
Master ERASMUS Mundus "EuroPhotonics"

MASTER THESIS PROPOSAL

Full time from April 2026 (it can start part time from February 2026)
Presentation date to be chosen: end of July or beginning of September 2026

Note: The main Master Thesis supervisor has to be a professor of the Master in Photonics program. One co-supervisor (internal or external) can be defined. Main Supervisor is responsible for the subject of the proposal and has to give continuous support to the student (research development, Report writing and presentation preparation). For external proposals a co-supervisor from the Master program and a collaboration agreement with UPC are needed.
You can find all information about the Master Thesis process in our webpage.

Laboratory: Quantum Computing Technology group
Institution: IFAE
City, Country: Cerdanyola del Vallès, Spain

Title of the master thesis: Superconducting qubits as dark matter detectors

Name and affiliation of the master thesis supervisor: Pol Forn-Díaz, IFAE
Name and affiliation of the co-supervisor (if any): **Ariadna Gómez del Pulgar Martínez, IFAE**
(for external proposals a co-supervisor chose among the Master Program professors and a collaboration agreement with UPC is needed)
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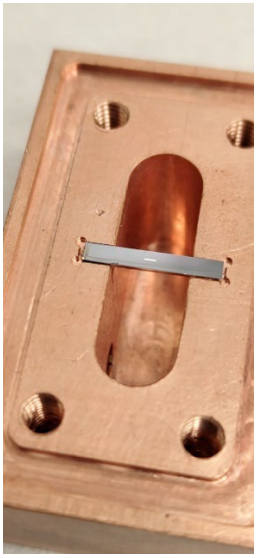
Keywords: Quantum Sensing, Dark Matter, superconducting qubits

1. **Summary of the subject (maximum 1 page):**

Superconducting qubits are the leading candidate platform on which to build quantum processors owing to a continuous development of many fronts of the technology. The current advanced state of superconducting qubits permits envisioning them towards applications beyond quantum computing. An important direction of application is quantum sensing, given the high sensitivity of qubit devices to environmental fluctuations. In particular, superconducting qubits are the best existing single microwave photon detectors. This permits using qubits to detect signals in the form of individual microwave photons appearing from interactions through fundamental physics effects, such as dark matter axions.

2. **Objectives (maximum 1 page):**

In this master thesis project, a first generation of dark matter axion detectors based on superconducting qubits will be built. The challenge in achieving a highly efficient detector is the combination of cavity QED physics with qubits to detect photons and the resilience of qubits under strong magnetic fields, which are necessary to achieve the axion-to-photon conversion. The project will focus on the characterization of the design, fabrication and characterization of a first qubit using nitridized aluminum, a novel superconducting material with resilience to high magnetic fields. The project will be directly supervised by a PhD student from the IFAE QCT group.



Additional information (if needed):
* Required skills: quantum physics
* Miscellaneous: monthly stipend available to cover travel and personal costs, funded by the Catalonia Quantum Academy.
Research group: https://qct.ifae.es/