# ***INTERNSHIP PROPOSAL***

Laboratory name: Laboratoire de Physique de la Matière Condensée, Ecole Polytechnique
CNRS identification code: UMR7643
Internship director'surname: Jean-Damien Pillet/Landry Bretheau/Joël Griesmar
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Web page: https://pmc.polytechnique.fr/spip.php?article1274
Internship location: Ecole Polytechnique, Palaiseau

Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: PEPR Quantique

**Quantum Control of Superconductor-Nanotube Hybrid Circuits**

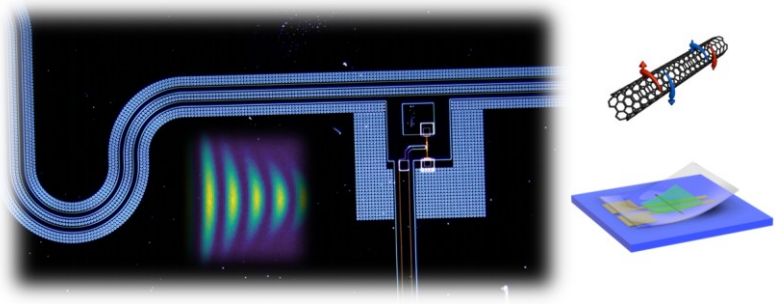
The quantum circuits in today's processors primarily rely on Josephson tunnel junctions, consisting of two superconductors separated by a thin tunnel barrier. The supercurrent flowing through this barrier via tunneling gives the system nonlinear properties, allowing the isolation of two quantum states of a bosonic oscillator, which are used to encode quantum information.

In the QCMX group, we are developing alternative qubits based on another class of Josephson junctions. In our approach, the tunnel barrier is replaced by a quantum conductor made of a single molecule: a carbon nanotube. Due to its extremely small size, this conductor can trap individual electron, adding a fermionic degree of freedom to the natural bosonic degree of freedom of the qubit.

Our team has already demonstrated coherent control of the bosonic degree of freedom through Rabi and Raymsey oscillations, and independently observed the fermionic degree of freedom in the form of Andreev bound states. The goal of this internship is to further explore the interaction between these two degrees of freedom within our hybrid architecture.

This system offers unique perspectives, including the possibility of controlling a single fermion within a quantum device. In addition to providing a novel resource for quantum information encoding, this approach allows us to study electronic behavior in low-dimensional systems.

We are seeking an intern to contribute to this project, offering a unique opportunity to deepen your knowledge in quantum physics, nanotechnology, and superconductivity. The internship may be followed by a three-year PhD.



Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: NO