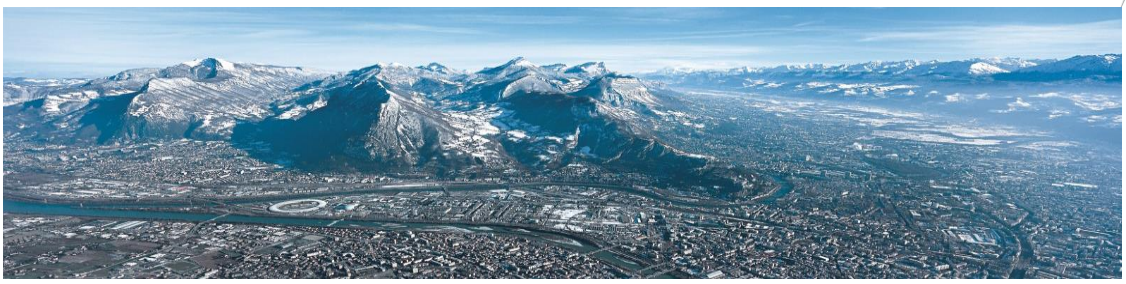
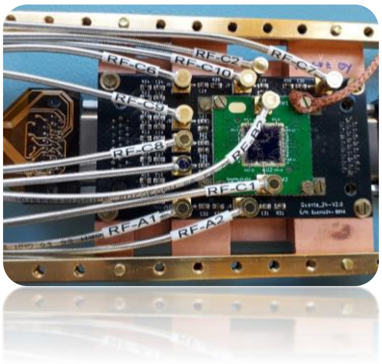


## Master /PhD thesis Project

# Ultra-strong coupling of a hole spin to a microwave photon

*Bonded and mounted sample before cryogenic cooling.*

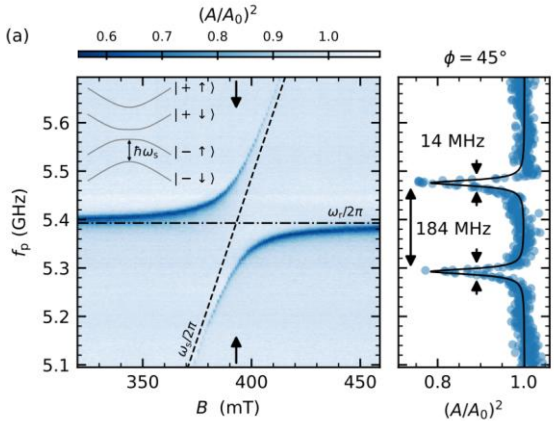


Quantum computing is currently pushing further the frontier of information technology. Among other fields, solid-state hole-spin qubits are a promising research area. Recently, we reached the strong-coupling regime between the spin of a single hole trapped inside the channel of a silicon transistor and a single microwave photon enclosed in a superconducting resonator [1]. This milestone paves the way to Circuit Quantum Electrodynamics (cQED) type experiments where we leverage such large spin-photon couplings to perform advance quantum information experiments.

The aim of this project is to further increase the coupling strength between the hole spin and the microwave photon to reach the ultra-strong coupling regime, a regime of light-matter interaction largely unexplored. First, we will probe this unique quantum system via microwave spectroscopy measurements [2]. In parallel, we will explore how time-domain experiments can unlock the peculiar physics of an ultra-strongly coupled spin to a microwave photon [3, 4].

Our research team is part of the French national “Plan Quantique” and is a founder member of the “Grenoble Quantum Silicon” group. We also strongly collaborate with the L-SIM group for theoretical support.

During the master project, you will collaborate on a daily basis with a lively team of three permanent researchers and three PhDs and take part in an exciting adventure to bring spin qubits to a new level. You will participate to the development of new samples that includes design, theory and nano-fabrication performed in our cleanroom facility. You will also learn to cool down samples to reach cryogenic temperatures and you will perform measurements using state-of-the-art DC and RF techniques. This master project may continue as a PhD thesis.




*Avoided crossing between a hole spin and a microwave photon showing the strong coupling between them.*


[1] Nat. Nano 18, 741, **2023**
[2] Phys. Rev. A 75, 032329, **2007**
[3] Nat. Rev Phys. 1, 19, **219**
[4] Rev. Mod. Phys. 91, 025005, **2019**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