Master 2 ICFP & Quantum engineering

Proposition de stage / Internship proposal

Date de la proposition : 28 septembre 2023

Responsable du stage / *internship supervisor*:
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Nom du Laboratoire / *laboratory name*: Laboratoire Charles Coulomb (L2C)
Etablissement / *institution* : CNRS et Université de Montpellier   Code d'identification : UMR5221
Site Internet / *web site*: https://solidstatequantumtech-l2c.fr/
Adresse / *address:* 1 place Eugène Bataillon, 34095 Montpellier
Lieu du stage / *internship place*: L2C - Montpellier

Titre du stage / *internship title*: **Fluorescent artificial atoms in silicon for quantum technologies**

Building on the great success of microelectronics and integrated photonics industries, silicon is undoubtedly one of the most promising platforms for deploying large-scale quantum technologies. To date, silicon-based quantum chips mostly rely on long-lived electrical qubits, which are either weakly coupled to light or emitting in the mid-infrared range unsuitable for optical fiber propagation. In order to isolate artificial atoms that feature an optical interface enabling the long-distance exchange of quantum information while benefiting from well-advanced silicon integrated photonics, one strategy is to investigate **fluorescent point defects in silicon** emitting in the near-infrared telecom bands. In this context, the host group has recently shown that silicon hosts many point defects that can be optically isolated at single scale (see Fig. 1) and offer a **single photon emission at telecom wavelengths**.

This internship, which can be followed by a PhD, aims at tackling the **optical properties of these new fluorescent artificial atoms in silicon**, in order to assess their potential as sources of indistinguishable single photons at telecom wavelengths. Unlike real atoms trapped in vacuum, these defects are trapped in a crystal lattice disturbing their luminescence and leading to different emission wavelengths between defects and optical line broadening through spectral diffusion. The beginning of the internship will be devoted to building a new confocal microscope setup optimized for single defect spectroscopy at cryogenic temperature. The second task will be to analyze the orbital fine structure of individual defects through resonant excitation using a tunable laser. Finally, the trainee will explore the broadening of the emission lines of single defects, with the aim of quantifying the phenomenon of spectral diffusion and assessing the feasibility of a future single-photon coalescence experiment.

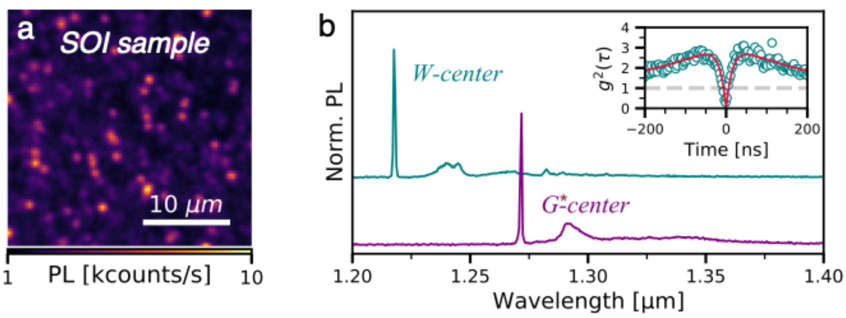

Figure 1: **a**-*Photoluminescence (PL) raster scan recorded at 10K from a commercial silicon sample under green laser illumination.* **b**- *PL spectra recorded at 10K on a single G*-center and on a single W-center. The autocorrelation function $g^{(2)}$ displayed in the inset demonstrates the single-photon emission.*

Publications of the host group linked to the project:

- W. Redjem *et al,* Nature Electronics **3**, 738 (2020)
- A. Durand *et al.,* Phys. Rev. Lett. 126, 083602 (2021)
- Y. Baron *et al.,* ACS Photonics 9, 2337 (2022)

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes**
Si oui, financement de thèse envisagé ou acquis / *financial support for the PhD* **? acquis**

Financement acquis / *Secured funding*	X	Nature du financement /*Type of funding*	**projet ERC Starting SILEQS**
Financement demandé / *Requested funding*		Nature du financement /*Type of funding*	