INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: **Laboratoire Charles Coulomb (L2C)**
CNRS identification code: **UMR5221**
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Internship location: **L2C, Place Eugene Bataillon 34095 Montpellier cedex 05**

Thesis possibility after internship: **YES**
Funding: **SECURED** If YES, which type of funding: **ERC**

Spin control of single fluorescent defects in silicon

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**.

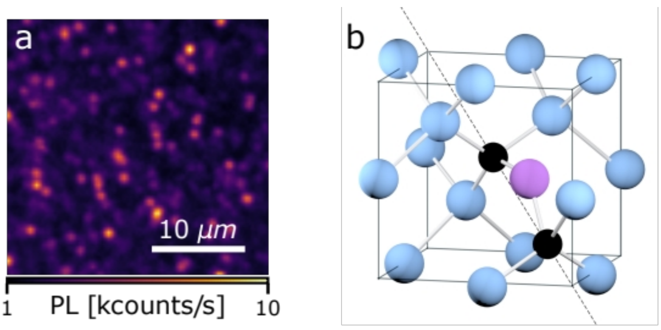

***Fig. 1**: **a**- Photoluminescence raster scan at 10K of a carbon-implanted silicon sample. The bright spots are individual crystal point defects emitting single photons. **b**- Atomic structure of the G center in silicon, made of 2 substitutional carbon atoms (black) and 1 interstitial silicon atom (purple).*

This internship, which can be followed by a PhD, aims at tackling the **spin properties** of these new optically active defects in silicon and in particular of a common carbon-complex called the G center. The G defect is a promising quantum system in silicon as it features an optical telecom emission and a metastable triplet spin whose magnetic resonance can be optically detected. The first goal of this internship is to demonstrate the coherent control of a single electron spin by performing Rabi oscillations on an individual G center. The next step is to address and control nuclear spins, either intrinsic to the G center, such as 13C or 29Si, or nearby the defect in the silicon lattice, in order to use them as memory qubits. The final objective is to assess the potential of these fluorescent defects as solid-state spin qubits.

Some recent publications of the host group linked to the project:
- W. Redjem et al, Nature Electronics 3, 738 (2020)
- A. Durand et al., Applied Physics Letters 121, 084993 (2022)
- A. Durand et al., Physical Review B 110, L020102 (2024)

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