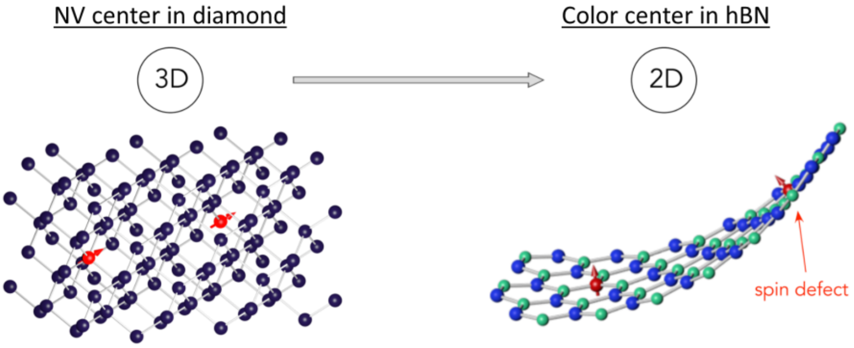
Responsable du stage / *internship supervisor*:
Nom / *name*: ROBERT
Prénom/ *first name* : Cedric
Tél : 0567048869
Fax :
Courriel / *mail*: cerobert@insa-toulouse.fr
Nom du Laboratoire / *laboratory name*: LPCNO Laboratory of Physics and Chemistry of Nano-Objects
Code d'identification : UMR 5215
Organisme : CNRS-INSA Toulouse

Site Internet / *web site*: https://lpcno.insa-toulouse.fr/en/
Adresse / *address:* 135 avenue de Rangueil 31077 Toulouse cedex 4
Lieu du stage / *internship place*: LPCNO Toulouse

Titre du stage / *internship title*: Study of color centers in 2D materials for quantum sensing

Résumé / *summary*
Quantum sensing technologies powered by solid-state spin defects have already shown a huge potential for covering the growing need for high-precision sensor (magnetic field, electric field, strain, temperature…), both for basic science and for industrial applications[1]. However, state-of-the-art quantum sensing methods based on spin defect color centers hosted in three-dimensional (3D) materials such as nitrogen-vacancy (NV) centers in diamond are facing several obstacles including (i) a limited spatial resolution resulting from the dim proximity that can be achieved between the quantum sensor and the target sample, and (ii) the impossibility to engineer ultrathin, flexible quantum sensors that could be easily transferred onto the samples to be probed (microelectronic devices, biological samples…). The targeted breakthrough of this project will be to overcome these limitations through the design of a new flexible **quantum sensor based on an atomically-thin two-dimensional (2D) material**. To this end, we will study the magneto-optical properties of recently discovered spin defects in 2D hexagonal boron nitride (hBN) also known as white graphene[2].
The internship work aims at building a state-of-the-art optical setup to measure quantum properties of color centers in hBN. This will include the development of a Hanbury Brown and Twiss measurement setup to assess the single photon nature of the emitters and the measurement of their spin relaxation and coherence times.
This project makes a bridge between two vibrant fields of research in condensed matter: (i) point defects for **quantum technologies** and (ii) **2D materials** beyond graphene. It is expected to have strong and broad impacts for applied science (printed electronics, spintronics, optoelectronics …) and from the point of view of fundamental physics.
This experimental work will benefit from the state-of-the art facilities and the world-recognized expertise of LPCNO Toulouse for the fabrication of atomically thin materials and their study by advanced optical spectroscopy tools. In particular, the candidate will have the opportunity to work with tunable wavelength lasers, liquid Helium magneto-cryostats and single photon detectors.



Requirements : We are looking for highly motivated candidates with a broad interest from fundamental to applied physics and quantum optics. A taste for experimental work in optics is clearly required. Programming and interfacing skills with Python will be appreciated.

References :
[1] Nat. Phot. **12**, 507 (2018), Rev. Mod. Phys. **89**, 035002 (2017)
[2] Nat. Phys. **17** 1074 (2021), Phys. Rev. Appl. **18**, L061002 (2022)

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Yes**