Master QLMN (Quantum, Light, Materials and Nano Sciences)

Proposition de stage / Internship proposal

Date de la proposition :

Responsable du stage / *internship supervisor*:

Nom / *name*: Lauret Prénom/ *first name* : Jean-Sébastien

Tél : Courriel / *mail*: lauret@ens-paris-saclay.fr

Nom du Laboratoire / *laboratory name*:

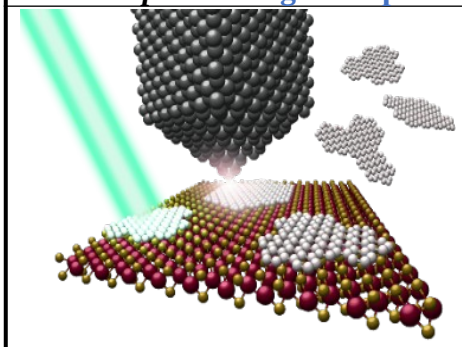
Etablissement / *institution*: LuMIn Code d'identification :FRE2036

Site Internet / *web site*: www.noos.universite-paris-saclay.fr

Adresse / *address:* bâtiment 520 campus d'Orsay

Lieu du stage / *internship place*: bâtiment 520

***Internship title*: Single Graphene Quantum dots in Layered Heterostructures**



Over the last few years, the development of new single quantum emitters has been a fast-growing field of research. Such emitters should share essential qualities: tunability, brightness, photostability, possibility of electrical injection, etc.

In this context, graphene quantum dots (GQDs) have many assets. The perfect control on their size, symmetry, and edge shape, provided by top-down synthesis, offers a wide range of tunable properties. The understanding and mastering of these properties open the way toward Swiss-knife emitters with well-defined functionalities. The first step toward this goal is addressing the photophysics of GQDs at the single-molecule level, as we recently reported for the first time [1, 2]. We showed that GQDs are photostable and make very bright quantum emitters with excellent single-photon purity at room temperature.

A second step is their integration into physical platforms, allowing simple handling of GQDs and extension of their capabilities. A natural choice for this integration is 2D materials and their combination in van der Waals heterostructures. First due to the genuine match of GQDs to these 2D hexagonal materials, then for the exciting properties of these latest. For example, transition metal dichalcogenides such as MoS_2 have been subject to extensive studies revealing fascinating excitonic physics and pseudo-spin properties. Coupling GQDs on top of these 2D materials will provide hybridization of the exceptional physical properties of both systems, such as huge spin-orbit coupling and valley asymmetry, and a rich excitonic physics and novel photonic effects due to the interlayer coupling. Ultimately, the development of heterostructures architecture will provide versatile single quantum systems with finely tunable properties. Single GQD will then unleash their full potential by reaching, for instance, lifetime limited optical emission, enhanced photostability, and acquire new properties such as spin properties through the interaction with valley sensitive-materials.

The present project aims is first to demonstrates GDQs-hBN and GDQs-MoS_2 heterostuctures, and to studies their mutual interactions by optical spectroscopy and quantum optics experiments at the single object level.

Requirement: A strong background in Quantum Mechanics, Light-Matter interaction, Optics, condensed matter and/or atomic Physics. Additional skills: good knowledge in python coding for data treatments.

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[1] S. Zhao et la, Nature Com 9, 3470 (2018) ; [2] T. Liu et al, submitted

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

Si oui, financement de thèse envisagé ou acquis / *financial support for the PhD* **? EDOM, CDSN, ANR**

Financement acquis / *Secured funding*	x	Nature du financement */Type of funding*	*½ ANR*
Financement demandé / *Requested funding*	*x*	Nature du financement */Type of funding*	*½ QUANTERA*