

INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique des Lasers, Atomes et Molécules (PhLAM)
CNRS identification code: 8523
Internship director's surname: Alberto AMO
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Web page: <https://photonlattices.eu/>
Internship location: Laboratoire PhLAM, Cité Scientifique in Villeneuve d'Ascq (next to Lille)

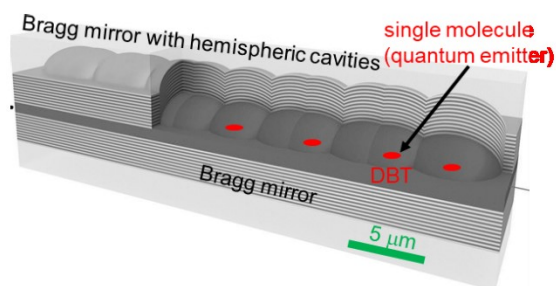
Thesis possibility after internship: YES

Funding: YES If YES, which type of funding: EU QuantERA project

Experimental many-body physics with quantum emitters in a photonic lattice

The coupling of one or several quantum emitters to the optical modes of a photonic lattice opens up new opportunities to engineer exotic sources of quantum light and to develop novel types of quantum simulators with long range interactions. It would allow studying strongly correlated phases of light in a lattice.

The main goal of this internship is to develop one of the first experimental systems for lattice quantum electrodynamics using molecular quantum emitters. We are currently fabricating an open cavity system with embedded nanocrystals, each with a single quantum emitter. The open cavity is made of two mirrors brought in close proximity (about 1 micron apart) with the use of dedicated piezo actuators. One of the mirrors has been etched using focus ion beam technology to engineer lattices of hemispheric cavities, which define a photonic lattice. The coupling of the quantum emitters to the photonic lattice modes is expected to result in the emergence of non-classical states of light with spread entanglement [1].



The internship will consist in the alignment and characterization of the open cavity with quantum emitters and the study of the temporal dynamics and quantum properties of the light emitted by the emitters in the lattice. We will use a fully developed experimental set-up with a streak camera and photon counters.

This internship is part of the [QuantERA european project MOLAR](#) and will be continued into a financed PhD thesis. The internship is also paid.

Group website: <https://photonlattices.eu/>

[1] A. González-Tudela and J. I. Cirac, [Phys. Rev. Lett. 119, 143602 \(2017\)](#).

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

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|---------------------------|-----|-------------------------------------|----|
| Condensed Matter Physics: | YES | Soft Matter and Biological Physics: | NO |
| Quantum Physics: | YES | Theoretical Physics: | NO |