

CONTRACTS DOCTORAUX 2024

Titre du projet de thèse : Lattice quantum electrodynamics in an open cavity

Directeurs de thèse : Alberto Amo

Résumé du projet de thèse (en 20 lignes maximum) :

The coupling of one or several quantum emitters to the collective 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.

The main goal of this PhD thesis is to develop one of the first experimental systems for lattice quantum electrodynamics using solid-state quantum emitters in the near infrared. We plan to fabricate an open cavity system with embedded nanocrystals, each with a single organic molecule acting as a 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 will be etched using focus ion beam technology to engineer lattices of hemispheric concavities, 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. We plan to study the appearance of long range interactions between quantum emitters mediated by the lattice photonic modes. These results will set the basis to realize quantum simulation experiments.

This PhD thesis is at the crossroads of quantum science, solid-state physics and quantum optics experimental techniques.

