Parcours M2 « Systèmes Complexes, Optique, Lasers » : Stage de Recherche 2020-2021

Laboratoire : PhLAM

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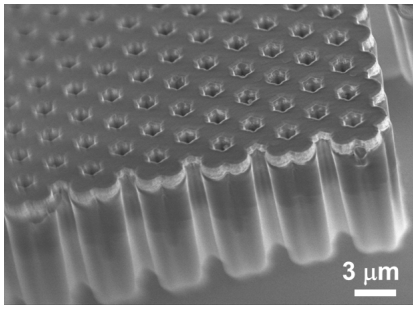
Collaborateur : -

Thématique : Optique non-linéaire, photonique, physique quantique

Quantum simulation with photonic lattices

A quantum simulator is a controllable physical system that simulates the physics of a complicated, hard to control material. A prominent example are materials based on the honeycomb lattice. This lattice is a hexagonal structure present in solid-state materials such as graphene –a carbon structure that is revolutionizing electron transport devices. However, many fascinating properties predicted for graphene are hard to study experimentally. This problem can be overcome by using a honeycomb lattice of coupled photonic resonators micropillars, in which the transport of photons is very similar to that of electrons in graphene, with the great advantage of having access to their dynamics in standard optical experiments.



Honeycomb lattice of microcavity polaritons, a photonic simulator of graphene.

In this project, we will study the propagation of photons in photonic lattices based on semiconductor microcavities. In these lattices photons are trapped in a micrometric resonator and can hop from site to site. By designing the geometry of the lattice, the physical properties of the system can be manipulated. Within this project, we will study novel transport and localisation properties of light based on the topology of the lattices. Nonlinear dynamics of photons in topological lattices will be one of the main subjects of the project.

This experimental project is part of the European ERC grant EmergenTopo recently awarded to Alberto Amo, and it will be developed in collaboration with the Center for Nanosciences and Nanotechnologies in Palaiseau (where the lattices are fabricated) and with theory groups from France, Japan and Italy.

This master thesis can be extended into a PhD thesis.

More information: http://honeypol.eu/.

-*Direct observation of photonic Landau levels and helical edge states in strained honeycomb lattices*, O. Jamadi et al., Light. Sci. Appl. 9, 144 (2020)

- *Lasing in topological edge states of a one-dimensional lattice*, P. St-Jean et al., Nat. Photon. 11, 651 (2017).

Mots - clés : nonlinear optics, quantum simulation, topology, laser