

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Topological States of Light

Supervisor : Solnyshkov Dmitry
Laboratory : Institut Pascal (PHOTON)
University : University Clermont Auvergne
Email and Phone : dmitry.solnyshkov@uca.fr 0473405258
Possible co-supervisor : Guillaume Malpuech
Laboratory : Institut Pascal (PHOTON)
University : University Clermont Auvergne

Summary :

The thesis research will take place within the EU project TOPOLIGHT, in close collaboration with the experimental groups from Poland (University of Warsaw), UK (University of Southampton), and Switzerland (IBM Research). The activity will be centered on the engineering of non-linear topological states of light.

The project relies heavily on the possibility to create and control artificial gauge fields in photonic systems thanks to the recently discovered emergent optical activity in strongly birefringent cavities¹. The other key ingredient is the strong coupling of light and matter, giving rise to strongly interacting polariton quasiparticles appearing in microcavities². The two main objectives of research will be the realization of synthetic Landau levels in a photonic system³ and the implementation and study of the Harper-Hofstadter⁴ Hamiltonian in a lattice.

In particular, the PhD student will be involved in the modelling of hybrid liquid crystal microcavities operating in the strong coupling regime, in the analysis of skyrmionic polarization patterns of light, in the design and analysis of the experimental studies of textured microcavities, in the studies of the spin dynamics of polariton condensates in real and reciprocal space, in the extraction of the quantum geometry of the cavities and in the studies of topologically non-trivial polariton lattices and associated chiral states⁵.

References:

- ¹ K. Rechcinska et al, Science 366, 727 (2019).
- ² A. Kavokin et al, Microcavities (OUP Oxford, UK, 2011).
- ³ N. Schine et al, Nature 534, 971 (2016).
- ⁴ D. R. Hofstadter, Phys. Rev. B 14, 2239 (1976).
- ⁵ D. D. Solnyshkov et al, arXiv:2011.03012 (2020).