Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

Vendredi 15 juin 2018
10 h 00

Salle R. Planel- C2N site Marcoussis

Madame Marijana Milicevic

« ***Manipulation of Dirac Cones and Edge states in Polariton Honeycomb Lattices*** »

Composition du jury proposé

Rapporteur M. Dimitrii Krizhanovskii, University of Sheffield, Royaume-Uni
Rapporteur M. Mark Oliver Goerbig, LPS, Université Paris-Sud
Examinatrice Mme. Hannah Price, University of Birmingham, Royaume-Uni
Examinateur M. Jean Dalibard, Collège de France
Examinateur M. Mathieu Bellec, LPMC, Université de Nice-Sophia Antipolis
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Abstract

The engineering of Dirac matter using photonic materials opens unhindered opportunities to explore unconventional transport and novel topological phases. Thanks to the direct optical access to the spatial and momentum wavefunctions and spectrum exciton polaritons in semiconductor microcavities appear as an extraordinary platform to emulate 1D and 2D Hamiltonians, including Dirac Hamiltonians.

By etching a GaAs-based microcavity, a honeycomb lattice for polaritons has been fabricated. The lowest two bands of this structure emulate for photons the π and π^* bands of graphene. Remarkably, the system also permits exploring orbital degrees of freedom, inaccessible in actual graphene.

In the first part of this thesis a polariton emulator is used to address the physics of edge states in a honeycomb lattice. New edge states, with flat and dispersive bands, have been discovered and visualised in orbital graphene.

In the second part of the thesis we demonstrate experimentally a method to tailor the Dirac dispersion for photons. By implementing uni-axial strain in the honeycomb lattice, Dirac photons that combine zero, finite and infinite effective masses are created.

The experimental and theoretical results here presented open new perspectives for the engineering of interfaces between photonic lattices with different types of Dirac dispersions. Furthermore, the excitonic component of polaritons assures sensitivity to external magnetic fields, providing the possibility to break the time reversal symmetry of the system and to study photonic topological edge states in exotic Dirac cones. Finally, nonlinear Dirac physics can be probed in this system owing to polariton-polariton interactions.

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