Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

Lundi 20 juin
14h00
Institut d'Optique
Auditorium

«Non-linear physics associated to chiral symmetry in driven dissipative polariton lattices»

Nicolas PERNET

Link: https://zoom.us/j/94169025971?pwd=VDJkUkxZZXBMUXl2aCtYN054blErQT09

Meeting ID: 941 6902 5971 /Passcode: NXy6S

Jury members :

Mme Jacqueline BLOCH Université Paris-Saclay GS Physique, Directrice de thèse
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Abstract :

Microcavity polaritons originate from the strong coupling between cavity photons and electronic excitations of a semiconductor microcavity. These quasi-particles inherit properties from both constituents: the electronic component is responsible for giant Kerr non-linearities while the photonic part makes the system inherently dissipative and allows confining polaritons in micro-structures obtained *via* etching of the cavity. This thesis presents the study of the non-linear properties of micro-cavity arrays with chiral symmetry.

The first part of the work is dedicated to one-dimensional topological lattices emulating the Su-Schrieffer-Heeger model. In the non-linear regime, driving the system coherently using a laser leads to the formation of gap solitons at the edges and in the bulk of the structure. We evidenced that such solitons present symmetry properties making them robust against certain types of defects. In addition, we unveiled that a careful engineering of the drive allows observing novel non-linear solutions which are specific to open systems. We analyzed the systems excitations spectrum in presence of such stationnary state and demonstrate the possibility to realize a topological phase transition induce by the interactions.

In the second part, we explored the properties of the interaction between two gap solitons and showed that the interaction sign is strongly linked to the underlying structure of the lattice. This work showed the presence of a spontaneous symmetry breaking. The study of the systems non-linear response in the vicinity of such phase allows us to discover a novel effect of bistability allowing to induce chirality in the system depending on the drive protocol. We called this effect "helical bistability". The helical bistability is a very general effect that can be observed in a simple set of two coupled Kerr resonators and is linked to the physics of a particle with spin one half. These results are supported both by numerical simulations and experiments. This thesis illustrates how symmetries and non-linearities enriches the physics of photonic systems in a driven-dissipative context.

If you plan to attend the defense in person, please fill in the following document:
https://docs.google.com/spreadsheets/d/1p3-8EWfpD3NS8eQNAhk4CfH4_3KzzVQ0819CWU8K6Ko/edit?usp=sharing