Topological photonics with excitonic polaritons

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Topology is a branch of mathematics, which appeared to be powerful to get deep physical understanding of some physical phenomena such as the quantum Hall effect. Interestingly this framework also enabled identifying crucial physical ingredients to implement similar phenomena in synthetic platform: on can understand the key role of spin orbit coupling and time reversal symmetry breaking to obtain non zero Berry curvature and Chern numbers.

In the present talk, I will explain why exciton-polariton lattices obtained by coupling excitons to cavity photons in semiconductor heterostructures provide a platform of choice for implementing topological physics [1]. Due to their mixed light matter character, exciton polaritons can indeed undergo spin-orbit coupling (polarization effect on the photon part), while simultaneously experiencing time-reversal symmetry breaking (Zeeman splitting of the exciton part under a magnetic field) [2-5]. Lattices can be imprinted on the photon part using nanotechnology (ex. honeycomb or staggered honeycomb lattices) to engineer non-zero Berry curvature. In addition, this photonic platform offers the opportunity to explore novel topological effects in presence of gain and loss, of non-linearity and in a driven dissipative context. Finally topological physics can be studied in highly non-linear regimes, thanks to the giant polariton Kerr linearity [6].

After an introduction to the polariton platform, I will review recent progress in the field of topological polaritonics. In particular, I will describe interferometry experiments, which enables realizing a full tomography of the eigenstates, and provides direct access to the Berry curvature in k space. I will also explain how interactions can trigger the emergence of non-trivial topology in a lattice.

References

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