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Colloquium ISL

22 Avril 2022
A 11h

Polaritons in semiconductor lattices: emulating condensed matter physics

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Photonic resonators, coupled within a lattice, have appeared in the recent years as a powerful synthetic platform to imprint on light some of the fascinating physical properties that can emerge in condensed matter, or even to go beyond what exists in nature. For instance, light can become superfluid, present spin orbit coupling, spin Hall effect or propagate along topologically protected edge states. New physical properties may emerge when drive and dissipation come into play. Such realizations are not only interesting from a fundamental point of view, but also inspire innovative photonic devices.

After a general introduction to polariton physics and polariton lattices [1], I will present some recent experiments we have performed at C2N. Using lattices of semiconductor microcavities, we explore single and many body physics of photons in 1D or 2D lattices and the emergence of novel physics related to the openness of the system [2]. Topological physics can be investigated when non-linearities come into play[3]. Interestingly, our photonic platform also enables exploring universal scaling related to the Kardar–Parisi–Zhang universality class[4].

References :

[1] Ciuti and I. Carusotto, *Quantum fluids of light*, Rev. Mod. Phys. **85**, 299 (2013)

[2] A. Amo and J. Bloch, *Exciton-polaritons in lattices: A non-linear photonic simulator*, Comptes Rendus de l'Académie des Sciences **8**, 805 (2016) (Elsevier)

[3] N. Pernet et al., *Topological gap solitons in a 1D non-Hermitian lattice*, arXiv:2101.01038 (to appear 2022)

[4] Q. Fontaine et al., *Observation of KPZ universal scaling in a one-dimensional polariton condensate*, arXiv:2112.09550 (2021)