POLARITONS IN PERIODIC AND QUASI-PERIODIC LATTICES

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At the frontier between non-linear optics and the physics of Bose Einstein condensation, microcavity polaritons opened a new research field, both for fundamental studies of bosonic quantum fluids in a driven-dissipative system, and for the development of new devices for all optical information processing.

In this talk, I will review how semiconductor microcavities can be engineered into periodic and quasi-periodic lattices, allowing to implement complex hamiltonians in non-equilibrium conditions.

I will first present a geometrically frustrated lattice of micropillar optical cavities, featuring a flat energy band. Taking advantage of the non-equilibrium nature of polaritons, bosonic condensation can be triggered in such flat band. This realization offers a novel approach to studying coherent phases of light and matter under the controlled interplay of frustration, interactions, and dissipation.

I will then describe the implementation of a quasi-periodic lattice reproducing the Fibonacci sequence. Features characteristic of their fractal energy spectrum are observed such as the opening of gaps obeying the gap labeling theorem and log-periodic oscillations of the integrated density of states. Additionally, we investigated the topological properties of the Fibonacci quasi-crystal by emulating edge stages. The edge states appear in the gaps of the fractal energy spectrum, and traverse periodically the gaps when varying a structural degree of freedom of the Fibonacci sequence. These experiments provide a direct determination of the Chern numbers of the Fibonacci crystal.