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Hydrodynamics and coherence properties of polaritons in 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 1D and 2D lattices, allowing to implement complex hamiltonians and to study the hydrodynamics and coherence properties of polaritons in a novel and controlled environment. I will first show how we could generate polaritons in a 1D quasi-periodic Fibonacci potential and reveal features characteristic for a fractal energy spectrum, opening the way to the investigation of the anomalous propagation (neither ballistic nor diffusive) predicted in such structures. Then I will present a 2D honeycomb lattice for polaritons, which allows direct imaging of Dirac cones, paving the way for studies of the hydrodynamics of massless Dirac polaritons. Finally 1D lattices sustaining a non-dispersive band or "flat band" will be presented: here reduced spatial coherence is evidenced as a consequence of phase frustration.