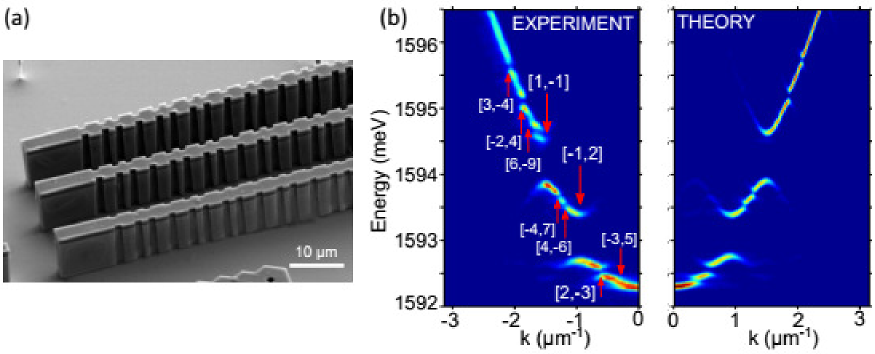
Topological properties of polariton Fibonacci quasicrystals

F. Baboux[1], E. Levy[2], D. Tanese[1], E. Gurevich[2], T. Jacqmin[1], A. Lemaître[1], E. Galopin[1], I. Sagnes[1], A. Amo[1], E. Akkermans[1] J. Bloch[1,3]

1 Centre de Nanosciences et de Nanotechnologies, CNRS, Univ. Paris-Sud, Université Paris-Saclay, C2N – Marcoussis, 91460 Marcoussis, France
2 Technion Israel Institute of Technology, Haifa 32000, Israel
3 Physics Department, École Polytechnique, F-91128 Palaiseau Cedex, France

One-dimensional quasiperiodic potentials present intriguing spectral and topological properties. For instance, a potential shaped in the form of a Fibonacci sequence is expected to result in a fractal energy spectrum. In this work we report the experimental realisation of a photonic Fibonacci potential in a 1D microcavity. The eigenstates of this system are exciton-polaritons, whose energy and real- and momentum-space wavefunctions can be directly accessed through the photons leaking out of the structure. Thanks to these properties, photoluminescence experiments reveal the fractal energy spectrum of the Fibonacci potential, characterised by self-similar gaps and minibands [1].



(a) Scanning Electron Microscope image of three different microcavity wires with a Fibonacci sequence modulation of the optical potential. (b) Fractal energy spectrum of the structure observed in photoluminesence.

Additionally, we observe topological edge stages in these structures. The edge states appear in the minigaps of the fractal energy spectrum, and traverse periodically the gaps when varying a structural degree of freedom of the Fibonacci sequence. The period and direction of the traverses provide a direct determination of the gap Chern numbers, which can be connected to the gap labelling theorem [2,3]. These results suggest interesting perspectives for further exploring topological effects in synthetic dimensions using polaritons.

1. D. Tanese, E. Gurevich, F. Baboux, T. Jacqmin, A. Lemaître, E. Galopin, I. Sagnes, A. Amo, J. Bloch, and E. Akkermans, *Fractal Energy Spectrum of a Polariton Gas in a Fibonacci Quasiperiodic Potential*, Phys. Rev. Lett. **112**, 146404 (2014).
2. J. Bellissard, A. Bovier, and J.-M. Ghez, Reviews in Mathematical Physics **4**, 1 (1992).
3. E. Levy, A. Barak, A.Fisher and E. Akkermans, “Topological properties of Fibonacci quasicrystals: A scattering analysis of Chern numbers”, arXiv:1509.04028.