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Localization and delocalization transitions in the continuous deformation of a polaritonic quasicrystal

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In condensed matter systems, quasicrystals (QC) are an intermediate between completely periodic perfect crystals and completely random or disordered media. They are structures that lack translational symmetry, but still exhibit long-range order. As a result, QC can exhibit very different localization properties. Famous examples include the Fibonacci QC, where all states are critically localized with fractal nature, and the Aubry-André model, known to host a localization transition.
Here, we investigate the localization properties in a family of QC obtained by continuously deforming one of these two model into the other. We establish a theoretical localization phase diagram in the continuous deformation, where the localization properties are so far unexplored. There, we identify a novel and unexpected delocalization-localization transition. We implement the model for microcavity polaritons, by etching one-dimensional quasiperiodic structures out of planar semiconductor microcavities. Photoluminescence experiments provide direct access to the localization properties of the eigenstates in each structure, enabling to reconstruct the experimental localization phase diagram. In particular, we evidence the presence of the exotic delocalization-localization phase transition.
This works opens the way to the study of nonlinear quantum fluids dynamics in quasiperiodic potentials, where novel many-body localization and delocalization effects are expected.

Choix de session parallèle

2.3 Fluides quantiques et lumière

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