Quantum fluid dimers of hyperbolic exciton-polariton condensates

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Abstract: Exciton-polariton Bound States in the Continuum (BiCs) enable low-threshold condensation and marked directional behavior. This results in a tunable coupling mechanism, combining ballistic and evanescent features, allowing the engineering of hybridly coupled polariton chains.

Exciton-polariton Bound States in the Continuum (BiCs) are symmetry-protected from radiating in the far field. Their large quality factor, when in the strong coupling regime, enables to achieve low-threshold exciton-polariton condensation.

The saddle shaped single-particle dispersion of the BiC imparts the condensate with marked directionality. Along the BiC axis, it leads to a self-localization mechanism, offering opportunities to generate evanescently-coupled polariton chains [1]. Along the perpendicular axis, it leads to a polariton flow with a well-defined momentum, which is responsible for a time-delayed synchronization mechanism, often referred to as ballistic coupling.

Consequently, on this platform, it is possible by simply adjusting the relative angle between the axis connecting the pump spots and the grating axis, to tune the BiC condensate coupling from negative-mass-evanescent to positive-mass-ballistic [2]. In this context, we investigate and characterize this interplay, exploring the potential to engineer hybrid ballistic-evanescent polariton condensate chains.

These findings highlight the potential of 1D photonic crystal waveguides to engineer reconfigurable hybrid ballistic-evanescent polariton condensate chains and to study condensed matter phenomena at the interface between delay-coupled nonlinear oscillators and tight-binding physics [3].

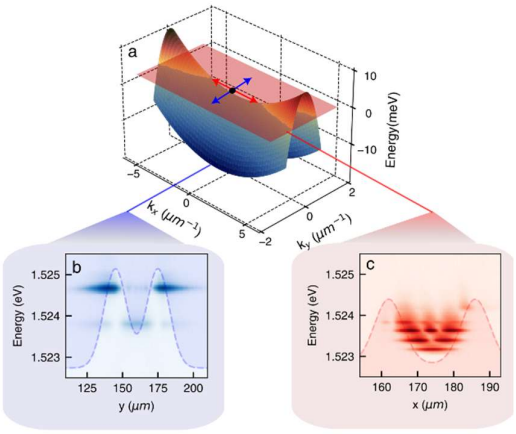

Fig. 1 a Hyperbolic dispersion hosting the BiC condensate, **b** and **c** condensate dimer spectra in the case of evanescent and ballistic case respectively.

References

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