TOPOLOGICAL EDGE-MODE LASING IN NON-HERMITIAN POLARITON SYSTEMS

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The control of topological properties in optical systems is a contemporary attracting objective from both experimental and theoretical perspective. Recently, topological insulators were suggested to be realizable in the strong matter-light coupling regime [1] and lately experimentally probed in exciton-polaritons lattices of coupled microcavities [2]. Here, the edge mode populated by a polariton condensate presents novel topological effects which differ from those demonstrated so far. Motivated by this recent achievements, in this work we investigate the properties of topological edge states and topological phase transition in a four-site unit-cell one-dimensional chain (Fig.1, left). Here the topological band-gap is generated by the gain and loss mechanisms rather than the different hopping ratio between the individual cells [3].
We theoretically analyse the system in general terms, allowing to address relevant physical structures well beyond polaritonic setups and investigating the transition from Hermitian to non-Hermitian topological insulators. Our results clearly indicate the presence of different topological phases with diverse number of topological edge modes which are characterised by a well defined topological invariant. We then numerically study the physically stable solutions of the system in the presence of nonlinear terms by solving the temporal evolution of the tight-binding model considered. Our results predict an establishment of single edge-mode lasing in microcavity arrays (Fig.1, right). Investigation of the proposed system is within the current experimental reachability.

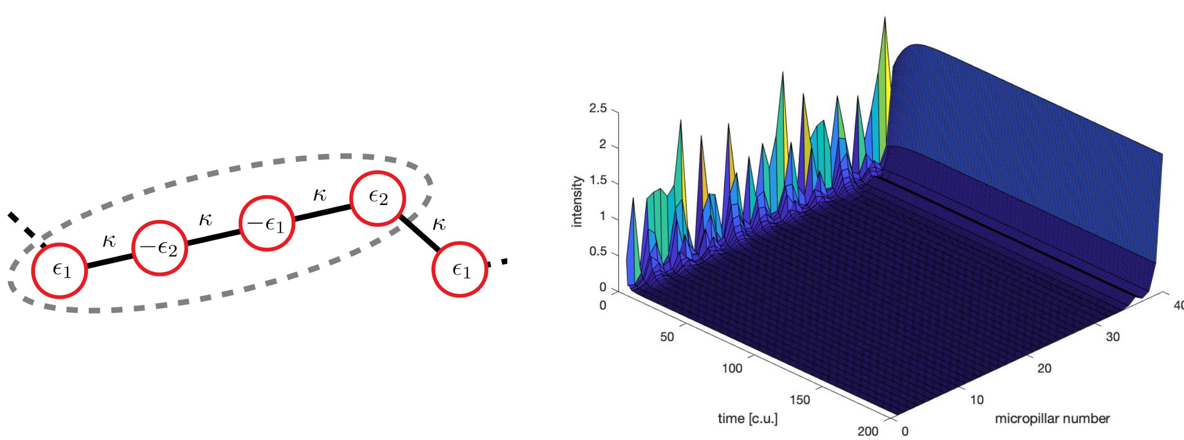

Fig. 1. Left: Schematic of the system considered, with single-cavity coupling κ and on-site potential $\epsilon_n = g_n e^{i\theta}$ where $n = 1, 2$ and $\theta = (0, 2\pi)$. Right: Temporal evolution of the field intensity in a N=10 unit-cells structure of microcavities showing stable single edge-mode lasing.

References

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