Topological properties of a non-Hermitian quasi-1D chain with a flat band

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The spectral properties of a non-Hermitian quasi-1D lattice in two of the possible dimerization configurations are investigated. Specifically, it focuses on a non-Hermitian diamond chain that presents a zero-energy flat band. The flat band originates from wave interference and results in eigenstates with a finite contribution only on two sites of the unit cell. To achieve the non-Hermitian characteristics, the system under study presents non-reciprocal hopping terms in the chain. This leads to the accumulation of eigenstates on the boundary of the system, known as the non-Hermitian skin effect. Despite this accumulation of eigenstates, for one of the two considered configurations, it is possible to characterize the presence of non-trivial edge states at zero energy by a real-space topological invariant known as the biorthogonal polarization. This work shows that this invariant, evaluated using the destructive interference method, characterizes the non-trivial phase of the non-Hermitian diamond chain. For the second non-Hermitian configuration, there is a finite quantum metric associated with the flat band. Additionally, the system presents the skin effect despite the system having a purely real or imaginary spectrum. The two non-Hermitian diamond chains can be mapped into two models of the Su-Schrieffer-Heeger chains, either non-Hermitian, and Hermitian, both in the presence of a flat band. This mapping allows to draw valuable insights into the behavior and properties of these systems. [1]

References

[1] C. Martínez-Strasser, M. A. J. Herrera, A. García-Etxarri, G. Palumbo, F. K. Kunst, D. Bercioux, Topological Properties of a Non-Hermitian Quasi-1D Chain with a Flat Band. Adv Quantum Technol. 2023, 2300225

Figures

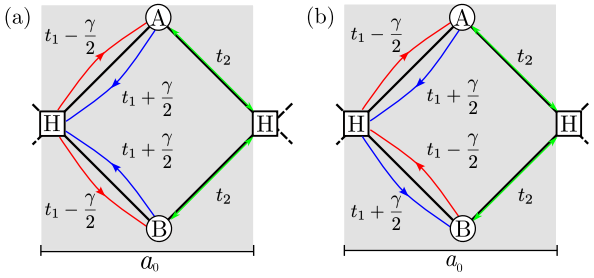

Figure 1: Sketch of the non-Hermitian diamond lattice in the A and B configurations, panel (a) and (b), respectively.

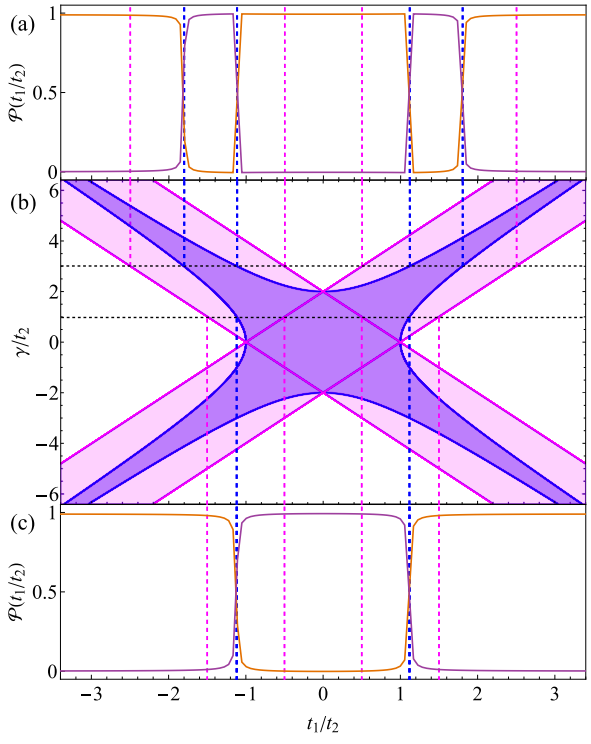

Figure 2: Phase diagram of the DCA model along with the biorthogonal polarization of two cuts in this phase diagram.