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Nonlinearly induced edge-to-bulk scattering in the photonic Su-Schrieffer–Heeger model

Dissipative Kerr solitons (DKS) in optical microresonators revolutionized the field of integrated photonics and opened a route toward their applications and investigation of fundamental properties [1]. Lattices of microresonators can provide complex dispersion landscapes and, consequently, better control of DKS properties (e.g., spectrum width, shape). Even a case of two coupled resonators demonstrates rich nonlinear dynamics that can be effectively used to manipulate solitons [2,3]. Here we further investigate four-wave mixing processes and properties of DKS in the photonic Su-Schrieffer–Heeger (SSH) model. Using the set of linearly coupled Lugiato-Lefever equations (LLEs) [4], we show the generation of frequency combs at the edge state of the SSH model and predict nonlinear mixing between the edge and the bulk modes that is forbidden in the linear limit. We prove our findings using chains of 8 and 10 SiN microresonators from Ligentec. We bring the system in the chaotic state and measure the mode occupation for individual comb lines in different resonators via Kerr comb reconstruction technique [2]. We observe the presence of the bulk modes in the second resonator, whereas they are absent in the edge. Moreover, we observe hopping-like breathing between two edge states in the chaotic state. Our results shed light on the nonlinear processes in lattices of coupled resonators and show that four-wave mixing processes break the conventional topological protection in the high-power regime.

References

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