Fate of nonlinear topological edge states delocalization in mechanical lattices

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We use a mechanical lattice analog of the Su-Shrieffer-Heeger tight-binding lattice model with Klein-Gordon type nonlinearity. We investigate the long-time dynamics of stable and unstable nonlinear topological edge states by computing the entropy and the participation number of the mode's and site's energy distributions respectively as well as the maximum Lyapunov exponent of the system's tangent dynamics. By analyzing the dynamical behaviors of these observables, we show that the delocalization of unstable topological edge states results in the thermalization of the entire lattice. Stable nonlinear topological edge states also reach the same fate, but pass a critical strength of perturbation. Interestingly, in all cases, the lattice's thermalized state is characterized by a renormalized squared dispersion relation symmetric about the mid band squared frequency. This phenomenon is a reminiscence of the chiral symmetry of the dynamical matrix of the linearized model.