Non-local programmable floppy sequences in kagome chains

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Abstract

The kinematics of Kagome kagome lattices consist of unit cells comprising two triangles connected at a single vertex. The kinematics of the kagome family deformation are characterized profoundly dictatedby their twist angle. As we sweep the twist angle, we elicit a global soft mode that reconfigures the lattice from a fully deployed state, corresponding to the regular kagome lattice, to a fully folded state, where all the triangles de facto collapse and align to form a one-dimensional prismatic structure, whose kinematics are reminiscent of those of a torsional chain. We call this structure a kagome chain. Our study focuses on systematically exploresing the twist angle spectrum to investigate reveal potential exotic emergent phenomena behaviors directly emerging enabled by thisfrom its dimensional collapse mechanism. Of particular interest are the two extreme configurations of the spectrum (regular kagome and kagome chain), whose mechanics are mutually linked by duality mapping. Both these configurations shows promise forhave the capability of hosting bulk zero modes. Invoking the duality relations between the chain and its deployed lattice counterpart, we study how the floppy modes manifest in the chain. We document the emergence of nonlocal floppy twist sequences that are sensitive to the direction of loading and can therefore be programmed according to a variety of patterns. We validate our analysis via experiments conducted a physical kagome chain prototype.

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