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Intrinsically polarized elastic metamaterial OSAMA BILAL, Department of physics, ETH Zurich/ Division of Engineering and Applied Science, California Institute of Technology, Pasadena, CA, ROMAN SUESSTRUNK, SEBASTIAN HUBER, Department of physics, ETH Zurich, CHIARA DARAIO, Division of Engineering and Applied Science, California Institute of Technology, Pasadena, CA —
Mechanical metamaterials, with periodically repeating basic building blocks in space, expand the envelope of possible properties of matter. Metamaterials harness their effective properties through structure rather than chemical composition. Successful implementations of such materials enabled the realization of ultrastiff-utralight materials, negative Poisson ratio materials, and fluid-like solids. In this work, we theoretically analyze and experimentally implement a new design principle for mechanical metamaterials. By combining states of self-stress, topological invariants and additive manufacturing techniques, we realize a new class of three-dimensional mechanical metamaterials with polar elasticity. The fabricated specimens show, at two of its opposing faces along the same axis, an asymmetric elastic response (i.e., soft on one face and harder on the other). We design our lattice to retain angular dependency to a perpendicular load, providing a direct experimental observation of nodal Weyl lines.

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