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Origins of topological bulk modes in isostatic lattices D. ZEB ROCKLIN, University of Michigan, Department of Physics, BRYAN CHEN, Instituut-Lorentz, Leiden University, MARTIN FALK, Massachusetts Institute of Technology, TOM LUBENSKY, University of Pennsylvania, Department of Physics and Astronomy, VINCENZO VITELLI, Instituut-Lorentz, Leiden University — Mechanical lattices under periodic boundary conditions with coordination $z = 2d$, where d is the spatial dimensionality, and with a gapped phonon spectrum at all wavenumbers not equal to zero are isostatic. When cut, these lattices with N sites in two dimensions necessarily have of order $N^{1/2}$ zero modes on their boundaries. Recently, Kane and Lubensky showed that these systems can be described by a super-symmetric Hamiltonian analogous to that of the Su-Schrieffer model for polyacetylene and they identified a topological invariant, the *topological polarization*, that determines on which edges zero modes lie in finite systems. We show that a family of two-dimensional four-site-per-unit-cell isostatic lattices possess topologically protected *bulk* zero modes. These "Weyl modes" are novel, tunable low-energy mechanisms of the mechanical lattice. They are the analogs of the zero-energy electronic modes of topological semimetals. We discuss how adjusting the lattice parameters induces Weyl modes and alters their wavevectors (generally incommensurate with the lattice) and how they can transport zero modes from one edge to an opposite one as surface wavenumber varies. An accompanying talk discusses the novel dynamical properties of the system.

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