MAR15-2014-020136

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Topological mechanics: from metamaterials to active matter

VINCENZO VITELLI, Leiden University

Mechanical metamaterials are artificial structures with unusual properties, such as negative Poisson ratio, bistability or tunable acoustic response, which originate in the geometry of their unit cell. At the heart of such unusual behavior is often a mechanism: a motion that does not significantly stretch or compress the links between constituent elements. When activated by motors or external fields, these soft motions become the building blocks of robots and smart materials. In this talk, we discuss topological mechanisms that possess two key properties: (i) their existence cannot be traced to a local imbalance between degrees of freedom and constraints (ii) they are robust against a wide range of structural deformations or changes in material parameters. The continuum elasticity of these mechanical structures is captured by non-linear field theories with a topological boundary term similar to topological insulators and quantum Hall systems. We present several applications of these concepts to the design and experimental realization of 2D and 3D topological structures based on linkages, origami, buckling meta-materials and lastly active media that break time-reversal symmetry.