Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Buckling in a topological metamaterial ANNE MEEUSSEN, JAYSON PAULOSE, VINCENZO VITELLI, Univ of Leiden — Controlling the nonlinear response of mechanical metamaterials paves the way toward designing materials with adaptive and tunable mechanical properties. Buckling, a change in load-bearing state from axial compression to off-axis deformation, is a ubiquitous nonlinear instability that is often exploited to change the local or global mechanical response in metamaterials composed of slender elements. We create localized buckling regions in cellular metamaterials by engineering states of self-stress, regions where the response is dominated by stretching or compression of the constituent beams rather than bending at the stiff hinges connecting them. Unique to our approach is the use of topological states of self-stress, which originate in a topological invariant that characterizes the vibrational spectrum of the repeating unit cell. Unlike typical states of self-stress which result from additional geometric constraints induced by excess beams in a region, these topological states do not change the number of beams at each hinge. We demonstrate the phenomenon through numerical calculations of the linear response of the proposed metamaterial, and through experiments probing the nonlinear regime including localized buckling at specific regions.

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Date submitted: 14 Nov 2014 Electronic form version 1.4