Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Critical transition to bistability arising from hidden degrees of freedom in origami structures ITAI COHEN, JESSE SILVERBERG, Physics, Cornell Univ., JUN-HEE NA, Polymer Science and Engineering, UMass Amherst, ARTHUR EVANS, Physics, UMass Amherst, BIN LIU, Physics, Cornell Univ., THOMAS HULL, Maths, Western New England University, CHRISTIAN SANTANGELO, Physics, UMass Amherst, ROBERT LANG, Lang Origami, RYAN HAYWARD, Polymer Science and Engineering, UMass Amherst — Origami, the traditional art of paper folding, is now being used to design responsive, dynamic, and customizable mechanical metamaterials. The remarkable abilities of these origami-inspired devices emerge from a predefined crease pattern, which couples kinematic folding constraints to the geometric placement of creases. In spite of this progress, a generalized physical understanding of origami remains elusive due to the challenge in determining whether local kinematic constraints are globally compatible, and an incomplete understanding of how bending and crease plasticity found in real materials contribute to the overall mechanical response. Here, we show experimentally and theoretically that the traditional *square twist*, whose crease pattern has zero degrees of freedom (DOF) and therefore should not be foldable, is nevertheless able to be folded by accessing higher energy scale deformations associated with bending. Due to the separation of bending and crease energy scales, these hidden DOF lead to a geometrically-driven critical bifurcation between mono- and bistability. The scale-free geometric underpinnings of this physical phenomenon suggest a generalized design principle that can be useful for fabricating micro- and nanoscale mechanical switches.

Bin Liu
Physics Department, Cornell University

Date submitted: 14 Nov 2014 Electronic form version 1.4