Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Unpredictable Motion and Post-chaotic Self-Organization of Flexible Structures. NICHOLAS NECHITAILO, Naval Surface Warfare Center, Dahlgren, Virginia — Two physical phenomena, "reverse buckling" and "post-chaotic self-organization", were discovered by the author of this paper. The phenomena were analyzed using Newton's mechanics, Euler bifurcation and buckling theory, and Poincare's theory of chaotic motion when "prediction becomes impossible." However, our experimental and theoretical findings revealed a more complex nonlinear physics with some predictability of final states. Geometric and material nonlinearities in flexible plates, beams and shells lead to transient chaos and unexpected final shapes. In one experiment, an axisymmetric transverse pressure pulse was applied to a circular metal membrane. It buckled, lost axial symmetry and formed a folded six-corner star. In another test, an impulsively stretched rod buckled and obtained a final shape similar to that of a rod under static axial compression. "Reputable" finite element and finite difference codes could not reliably predict deformation of an aluminum beam under a transverse pressure pulse. The anomalous responses were observed in a narrow region of the load amplitude and duration. These were described by simple analytical equations. Similar phenomena were seen in nonlinear equations of motion representing various non-mechanical systems.

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Date submitted: 09 Nov 2015 Electronic form version 1.4