Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Periodic Buckling Patterns On Constrained Elastic Shells. JOEL MARTHELOT, ANNA LEE, PIERRE-THOMAS BRUN, FRANCISCO LOPEZ JIMENEZ, PEDRO M. REIS, MIT — Thin spherical shells range from nanometer-sized viruses to space vehicles. A pressure differential between the inner and outer part of the shell can result in the buckling and catastrophic failure of the structure. We revisit this classic buckling problem, depressurizing thin elastic shells, which are arrested from within by a concentric spherical mandrel. As a result, buckling is constrained to occur within the gap between the two. Above a critical pressure, dimples appear sequentially on the surface of the shell to form a robust periodic pattern. We perform precision desktop experiments to construct the bifurcation diagram of the process, and explore a range of geometric and material properties. A scaling analysis enables us to rationalize the dependence of the size of the dimples on both the radius of the shell and the radial gap between the shell and the inner rigid mandrel. Moreover, we characterize the process of nucleation and progression of the dimpled pattern front. Particular emphasis is given to the patterns obtained in the strongly nonlinear post-buckling regime where a network of sharp ridges forms.

Joel Marthelot
MIT

Date submitted: 08 Dec 2015 Electronic form version 1.4