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Buckling morphologies of crystalline shells with frozen defects
EE HOU YONG, Harvard University, PROF L. MAHADEVAN (HARVARD UNI.) COLLABORATION — The crumpling of spherical crystalline lattices where the topological defects are frozen is studied. The geometry of the crumpled membrane is found to depend on the set of topological defects and more exotic defect sets can result in crumpled shapes resembling that of the Platonic and Archimedean solids. The phase diagram of the crumpled spheres can be categorized by two dimensionless numbers h/R (aspect ratio) and R/a (lattice ratio), where h is the thickness of the shell, R is the radius of the initial sphere and a is the average bond length of the triangulation. The shapes of the crumpled membrane can be understood using rotationally invariant quantities formed from spherical harmonics coefficients and a Landau free energy can be written, involving quadratic and cubic rotational invariants. Shells with different topological defects have qualitatively different hysteresis behaviors and the transitions appear to be first order in general.

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