Abstract Submitted
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Defect-induced shape transitions in filament bundles[1] ISAAC BRUSS, GREGORY GRASON, University of Massachusetts - Amherst — From extracellular proteins to artificially fabricated materials, cohesive filament bundles are found across many systems. Employing continuum elasticity theory and numerical simulations, we study the interdependence between the organization of cohesive filaments arranged into a bundle, and their global structure, focusing on the effects of topological defects on equilibrium bundle shape. We analyze the structural stability of parallel filament bundles possessing 5- and 7-fold disclinations in their cross section, whose presence gives rise to inhomogeneous patterns of compressive and tensile stress. We argue that a generic coupling between filament tilt and inter-filament strains leads to a class of defect-induced shape instabilities, which are the filamentary analogue of defect-induced buckling transitions of 2D membranes, and can be understand as a consequence of the generic Helfrich-Hurault instability of layered materials under tension. We show that bundles containing 5-fold disclinations prefer twisted motifs, and 7-fold disclinations give rise to radial undulations. Furthermore, the pitch and wavelength of these deformations are conditional on the relative cost of filament bending and cohesive interactions.

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Isaac Bruss
University of Massachusetts - Amherst

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