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Competing Morphological Responses to Chirality-Induced Frustration in Twisted Filament Bundles DOUGLAS HALL, GREGORY GRASON, University of Massachusetts Amherst — In various biological fibers, including collagen and fibrin, cohesive filaments assemble together in a twisting, helical geometry. It is generally understood that the helical geometry of these fibers is driven by chirality at the molecular scale. The inter-filament twist favored by chiral interactions is incompatible with regular columnar ordering of one-dimensional filaments, frustrating their lateral assembly in bundles. In response to this frustration, chiral filament bundles adopt a spectrum of competing, inhomogeneous morphologies. To understand the principles of morphology selection, we use both discrete-filament simulations and continuum elasticity theory to model the equilibrium structures cross section, with particular focus where inter-filament stresses are relaxed at the expense of introducing excess surface in anisotropic, tape-like helical bundles. We show further that the perimeter anisotropy competes with the adoption of topological defects (excess 5-fold disclination) in the bulk. We show that competition between isotropic/anisotropic and defective vs. hexagonally-ordered states is controlled by filament number, the chiral twist of bundles, and the ratio cohesive strength to stiffness of inter-filament bonds.

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