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Equilibrium Size Distribution of Twisted Biopolymer Bundles

GREGORY GRASON, University of Massachusetts, Amherst, ROBIJN BRUINSMA, University of California at Los Angeles — Using a continuum elastic model of hexagonal filament packing, we demonstrate that molecular-scale chirality strongly affects the equilibrium properties of aggregates, or bundles, of biopolymers, such as DNA and F-actin. We show that biopolymers tend to form bundles with long-range, chiral stress patterns, twisting or braiding helically around the central bundle axis. Due to the build-up of elastic stress on the outer surface, the cohesive energy of chiral filament bundles has a non-monotonic dependence on filament number. As a consequence, we demonstrate for two cases—bundles with 1) columnar-hexagonal order and 2) columnar-solid order—that a stable phase of dispersed bundles is thermodynamically stable below the point of bulk condensation and below a critical surface energy for the bundle exterior. This work suggests that the large characteristic radius biopolymer bundles observed in *in vitro* studies of is not a product of some mysterious long-range force or kinetic limitations of bundle growth, but rather in-plane elastic stresses which result from the local preference for the chiral packing of filaments.

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