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Strain dependent twist-stretch elasticity in elastic filaments MONEESH UPMANYU, Colorado School of Mines — Structural chirality (i.e. handedness) often results in large mechanical couplings which modify the conformation and expression of natural and synthetic filamentous aggregates. Twist-stretch elasticity of double stranded DNA is vital during chromatin organization, transcription regulation and protein binding. Engineering such couplings in structurally robust and multifunctional nanowires and nanotubes offers an elegant route for fabrication of nanoscale motors, oscillators and switches. In instances where the device operation relies upon mechanical coupling, twist-stretch elasticity, eliminating the need for an externally actuated rotational degree of freedom. Recent results on single-walled carbon nanotubes and DNA reveal a reversal in the sign of the twist-stretch coupling at large strains. Here, we present a simple non-linear theory that captures the behavior macroscopically. Model simulations reveal that the higher order coefficients are sensitive functions of the microscopic deformation energetics. Such dynamic couplings already exist in nature, a general design principle that remains to be exploited for mechanically coupled self-actuation in nanoscale devices and biomimetic strategies.

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