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Energetic contributions of DNA plectoneme tips and tails KEIR NEUMAN, ANDREW DITMORE, National Institutes of Health — Global DNA topology is sensed locally by enzymes that act on plectonemes in supercoiled DNA. Here we report that the formation and diffusion of plectonemes are determined by the energetic contributions of their tips and tails. First, to systematically vary the formation energy of plectoneme end-loops, we introduced base-pair defect regions of variable size (1-16 bp) at a specific site in a DNA substrate. Direct manipulation measurements with magnetic tweezers revealed that even a single mismatch is sufficient to nucleate formation of a plectoneme. Presentation of the defect at an extruded plectoneme tip potentially serves as a damage-sensing mechanism and may facilitate the search process of repair enzymes. Second, our measurements unexpectedly revealed that after DNA buckles into an initial plectoneme loop, further plectoneme extrusion occurs through a cascade of additional buckling steps. These discrete steps do not match any obvious scale of the system but are consistent with discontinuous feed-in of curving plectoneme tails. In light of these results, theoretical models of plectonemes should include their overall structure, including the often neglected tips and tails.

Keir Neuman
National Institutes of Helath

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