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Euler buckling and nonlinear kinking of double-stranded DNA ALEXANDER FIELDS, KEVIN AXELROD, ADAM COHEN, Harvard University — Bare double-stranded DNA is a stiff biopolymer with a persistence length of roughly 53 nm under physiological conditions. Cells and viruses employ extensive protein machinery to overcome this stiffness and bend, twist, and loop DNA to accomplish tasks such as packaging, recombination, gene regulation, and repair. The mechanical properties of DNA are of fundamental importance to the mechanism and thermodynamics of these processes, but physiologically relevant curvature has been difficult to access experimentally. We designed and synthesized a DNA hairpin construct in which base-pairing interactions generated a compressive force on a short segment of duplex DNA, inducing Euler buckling followed by bending to thermally inaccessible radii of curvature. The efficiency of Förster resonance energy transfer (FRET) between two fluorophores covalently linked to the hairpin indicated the degree of buckling. Bulk and single-molecule measurements yielded distinctly different force-compression curves for intact DNA and for strands with single nicks, base pair mismatches, and damage sites. These results suggest that changes in local mechanical properties may play a significant role in the recognition of these features by DNA-binding proteins.

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