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Elasticity of Short DNA Molecules: Quantitative Agreement Between Theory and Experiment YEONEE SEOL, JINYU LI, University of Colorado, PHILIP NELSON, University of Pennsylvania, THOMAS PERKINS, University of Colorado and JILA, M. D. BETTERTON, University of Colorado —
Single-molecule experiments have yielded new insight into the mechanical behavior of individual DNA molecules and protein-DNA interactions. Single-molecule force experiments require a model to deduce the polymer's intrinsic contour length (L) from measurements of force and extension. To date, the worm-like chain model (WLC) provides the best description of DNA elasticity. This theory requires parameters, the contour length L and the persistence length p. Using both theory and experiment, we studied the elasticity of dsDNA as function of L using the classic WLC solution, for L between 632 nm and 7.03 microns. When the elasticity data were analyzed using the classic WLC, the fit value of p depended L. Therefore we developed the finite worm-like chain solution (FWLC) by including the finite length of the chain and bead rotation. After incorporating these two corrections, our FWLC solution was used to predict elasticity curves and to analyze experimental data. The FWLC provides a single theoretical framework in which to analyze single molecule experiments over a broad range of experimentally accessible DNA lengths, including both short and very long molecules.

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