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DNA entropic elasticity for short molecules JINYU LI, University of Colorado, PHILIP C. NELSON, University of Pennsylvania, M. D. BETTERTON, University of Colorado — Single-molecule experiments in which force is applied to DNA or RNA molecules have enabled important discoveries of nucleic acid properties and nucleic acid-enzyme interactions. These experiments rely on a model of the polymer force-extension behavior to calibrate the experiments; typically the experiments use the worm-like chain (WLC) theory for double-stranded DNA and RNA. This theory agrees well with experiments for long molecules. Recent single-molecule experiments have used shorter molecules, with contour lengths in the range of 1-10 persistence lengths. Most WLC theory calculations to date have assumed infinite molecule lengths, and do not agree well with experiments on shorter chains. Key physical effects that become important when shorter molecules are used include (i) boundary conditions which constrain the allowed fluctuations at the ends of the molecule and (ii) rotational fluctuations of the bead to which the polymer is attached, which change the apparent extension of the molecule. We describe the finite worm-like chain (FWLC) theory, which takes into account these effects. We show the FWLC predictions diverge from the classic WLC solution for molecules with contour lengths a few times the persistence length. Thus the FWLC will allow more accurate experimental calibration for relatively short molecules, facilitating future discoveries in single-molecule force microscopy.

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