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The fluctuating-rod limit of semiflexible biopolymers ASHOK PRASAD, YUKOH HORI, JANÉ KONDEV, Brandeis University Physics Department — We study the mechanical properties of semiflexible polymers, such as DNA and actin, in the "fluctuating rod" limit. This limit is attained when the contour length of the polymer is comparable to its persistence length, or when thermal fluctuations have been smoothed out by a large applied force. In this limit, we compute the exact average end-to-end distance and shape of the polymer for boundary conditions that correspond to different single molecule stretching experiments. We consider both the case of a force applied at one end of the polymer, when the tension is uniform along the chain, and the case of an applied field, when the tension increases linearly. For the latter case, we derive the force-extension relation valid for a wide range of electric field strengths, which may be used to extract the effective charge density of actin in solution. We also show that the experimental condition of axis-clamping by a laser tweezer gives rise to a measurable effect on its force-extension properties. This calculation underscores the importance of taking the entropic effects of the boundary conditions into account in single molecule experiments. This work is supported by NSF DMR-0403997. JK is a Cottrell Scholar of Research Corporation.

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