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Thermal Fluctuations of extended DNA single molecules RAJALAKSHMI NAMBIAR, BEN SONDAY, JENS-CHRISTIAN MEINERS — Studying the thermal fluctuations of DNA molecules reveals not only a wealth of interesting statistical mechanics, but is also of importance for understanding genomic function in vivo. The thermal fluctuations are extremely sensitive to mechanical constraints, such as mechanical tension in the DNA. The force scale for this sensitivity is of the order of 100 fN, which is small for a cellular environment. We study the dynamics of single DNA molecules under tension both under equilibrium and non-equilibrium conditions using a modified scanning-line laser trap. In the equilibrium measurements, we measure the thermal fluctuations of the DNA molecule around its equilibrium extension. The time constants of the fluctuations yield the friction coefficient and thus information about the intramolecular hydrodynamic coupling as a function of the extension of the molecule. The results are compared to Brownian dynamics simulations and theory. In the non-equilibrium studies, the molecule is extended and then allowed to relax against an external force. The average relaxation trajectory is compared to a quasi-static prediction from the wormlike chain model, and the fluctuations of the individual trajectories around their mean are discussed in the framework of non-equilibrium statistical mechanics.

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