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NANO HIGHLIGHT
Entropic Forces in Single-Biomolecule Mechanics

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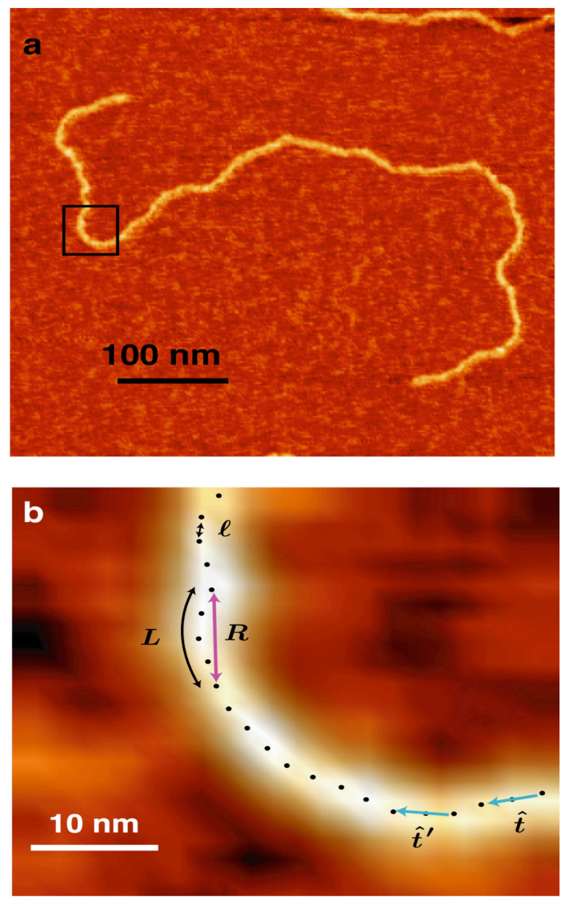
SPARE THE ROD: The DNA in our cells must not only store genetic information: It must constantly engage in mechanical rearrangements in the course being read, duplicated, and so on. Recent advances in the imaging and manipulation of single molecules seemed to show that a very simple mathematical model of DNA mechanics -- the *"Elastic rod"* model -- could describe its behavior very well. But the elastic rod picture seemed to rule out the very tightly-bent shapes that we know DNA frequently assumes in cells.



We imaged DNA using atomic force microscopy (top right), obtaining unprecedented resolution (closeup below). We found that on the nanometer scale, relevant in cellular processes, DNA is much more flexible than had been predicted by the elastic rod model. [Images from PA Wiggins, T van der Heijden, F Moreno--Herrero, A Spakowitz, R Phillips, J Widom, C Dekker and PC Nelson, Nature Nanotechnology, 2006.]

Our discovery of this unexpected, and biologically important, behavior of DNA relied on a tight interplay of theory and experiment, and illustrates the unity of scientific concepts. Ideas borrowed from renormalization-group theory (initially developed for the study of phase transitions) were crucial for initially formulating our hypothesis, and for the method we proposed to our experimental colleagues to test the hypothesis.

References

[1] For further information about this project email <nelson@physics.upenn.edu>
[2] PA Wiggins, T van der Heijden, F Moreno--Herrero, A Spakowitz, R Phillips, J Widom, C Dekker and PC Nelson, Nature Nanotechnology, 2006.