Twist-Stretch coupling in a single DNA molecule.

A counter intuitive behavior.

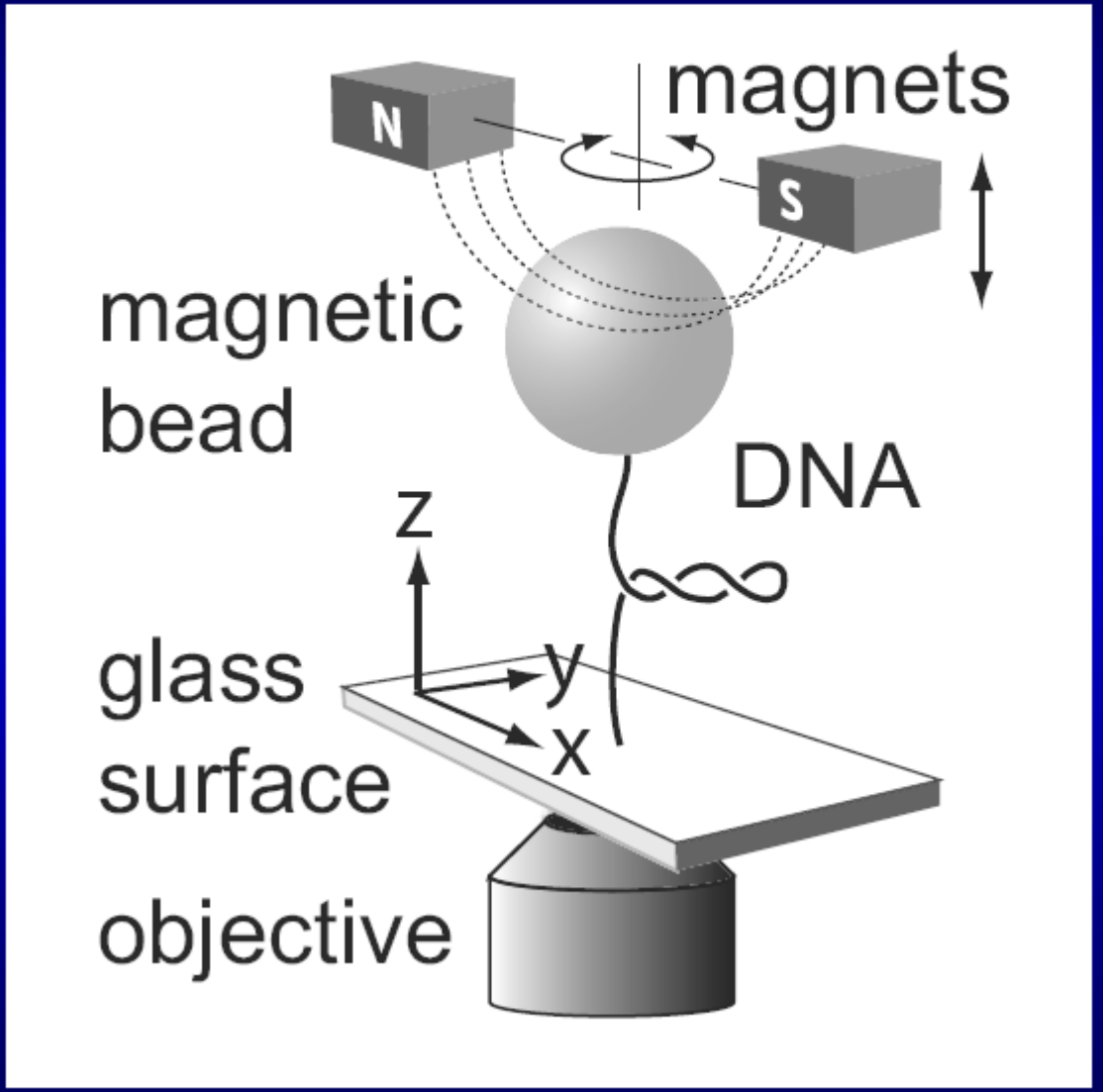
T. Lionnet, S. Joubaud, D. Bensimon, R. Lavery and V. Croquette. Wringing DNA, Phys Rev Lett. 2006 May 5;96(17):178102

New Scientist magazine, 25 Feb. 2006, v. 2540 p. 20 http://www.newscientist.com/channel/health/mg18925405.400.html

Twisting a DNA molecule (F = constant)

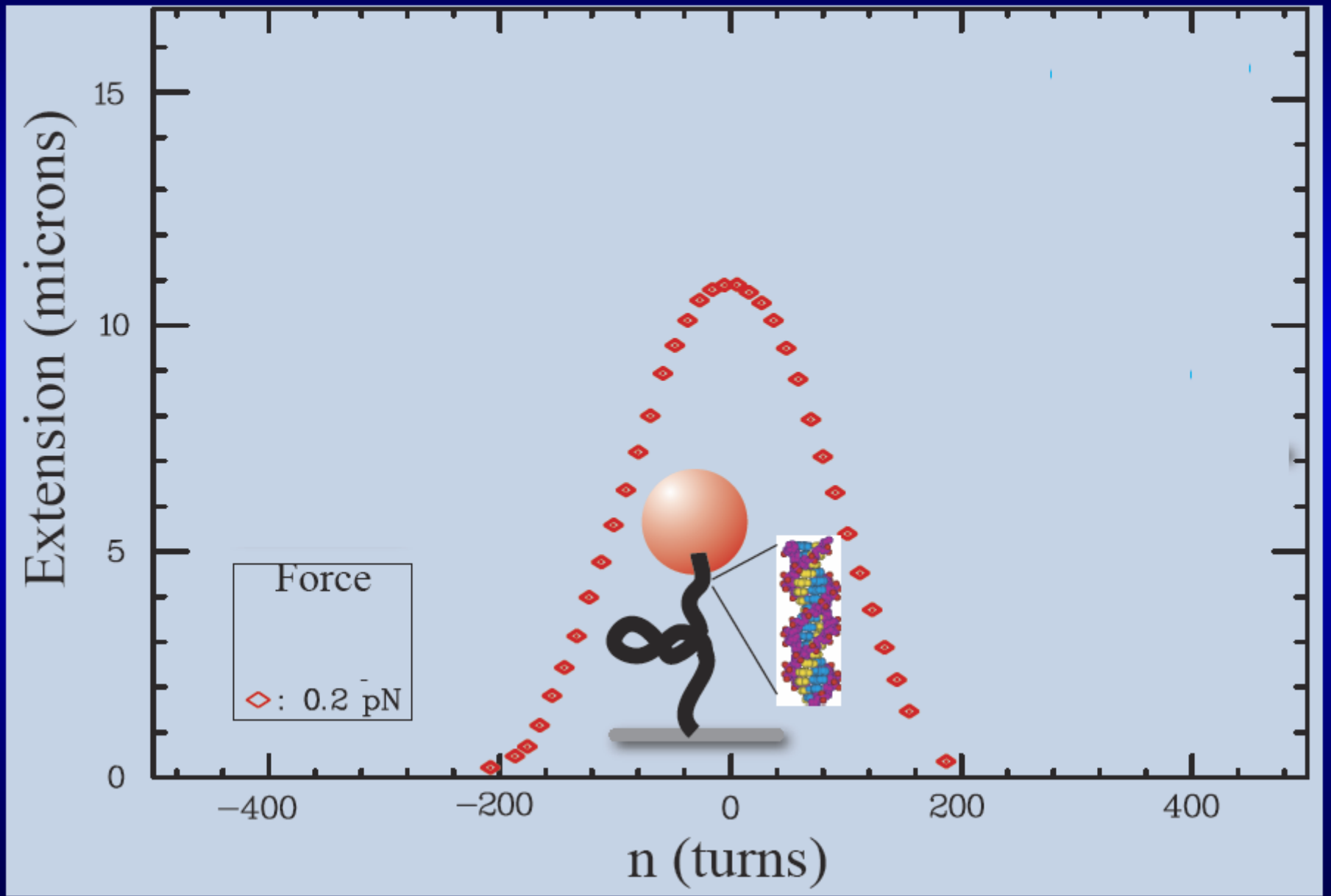
A simple model

Molecular modeling approach



Twisting a single DNA molecule: experiment.

F = 0.2 pN F = 1 pN F = 8 pN



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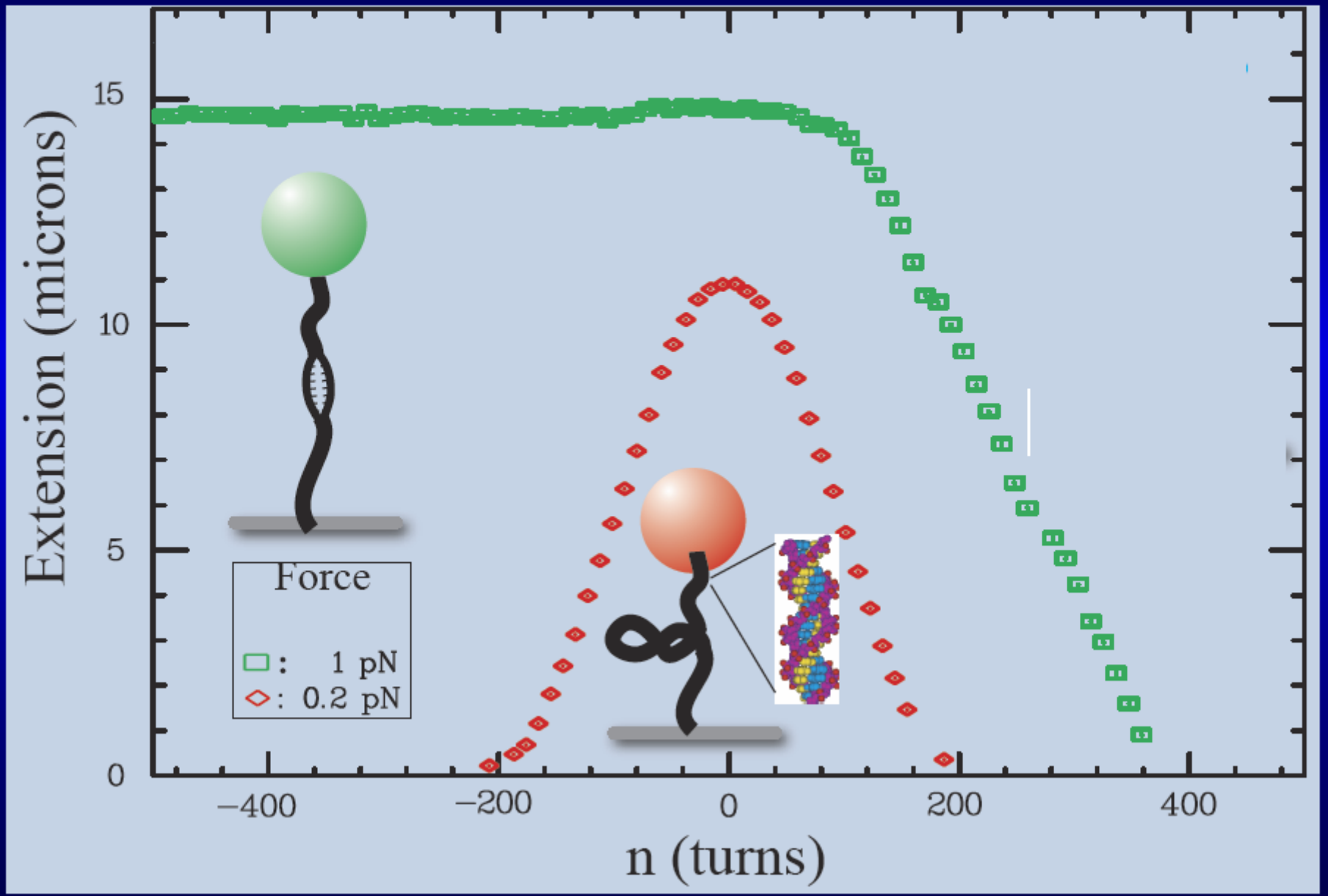

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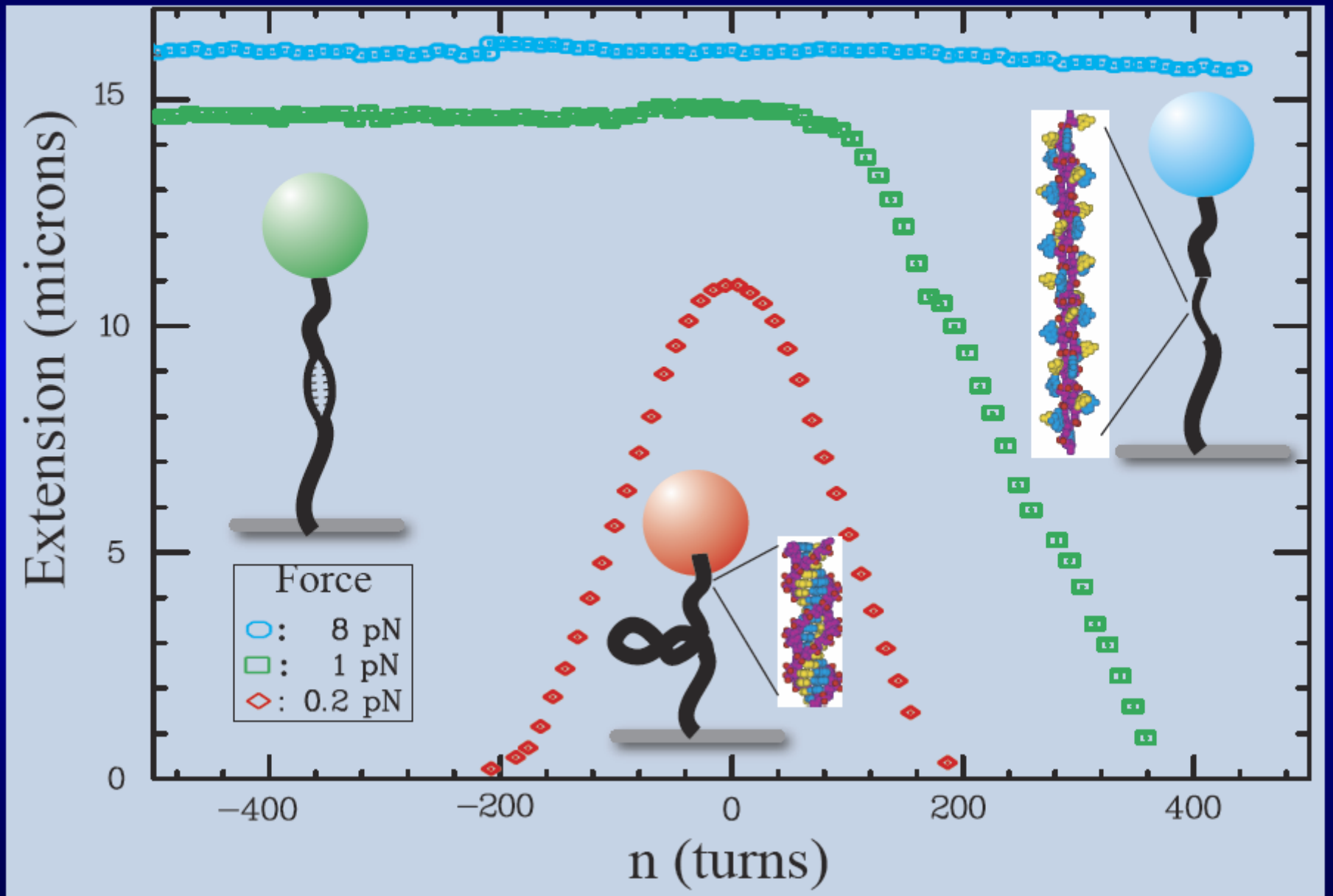
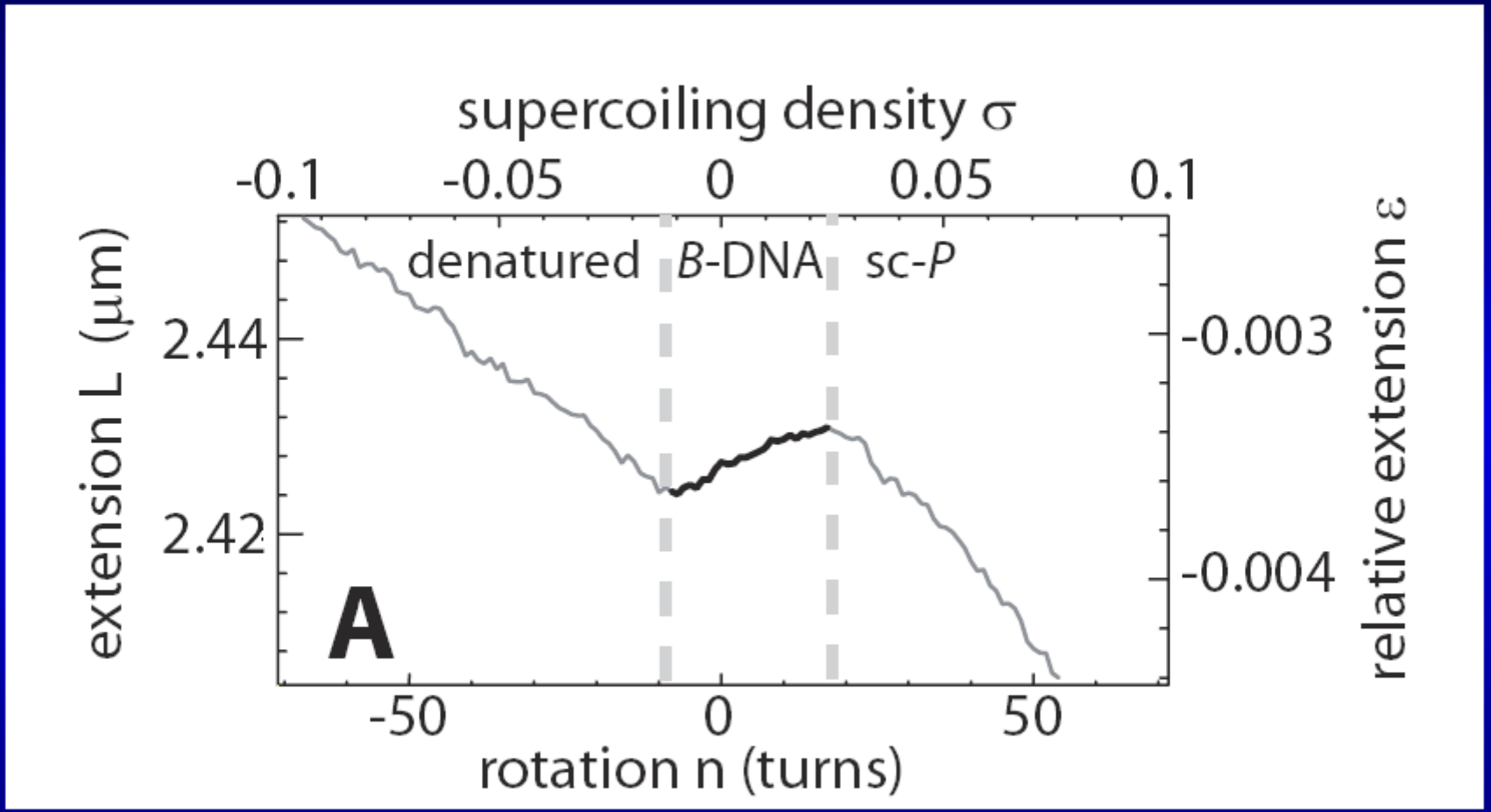


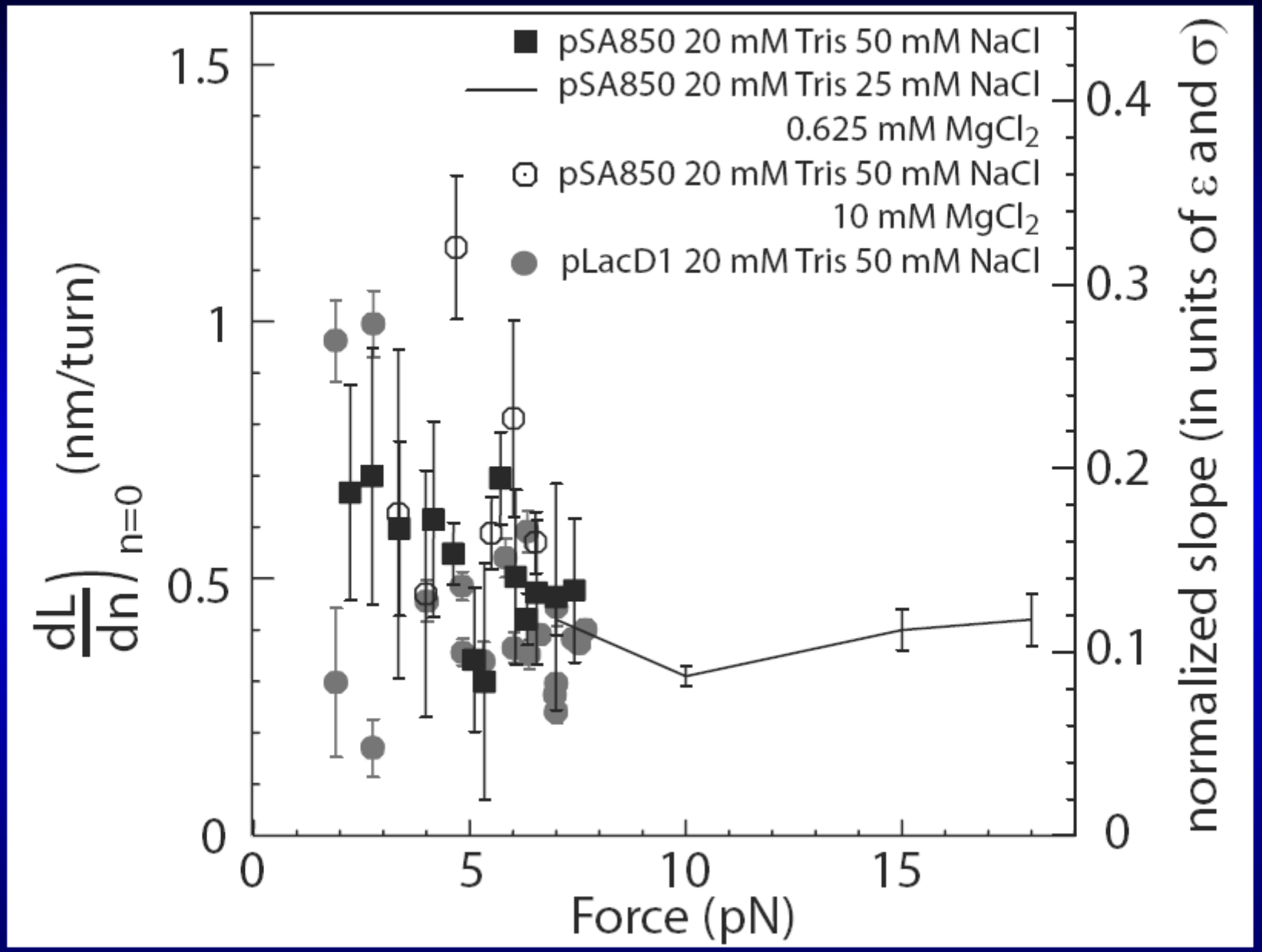
Details of the high force curve.

F = 7 pN



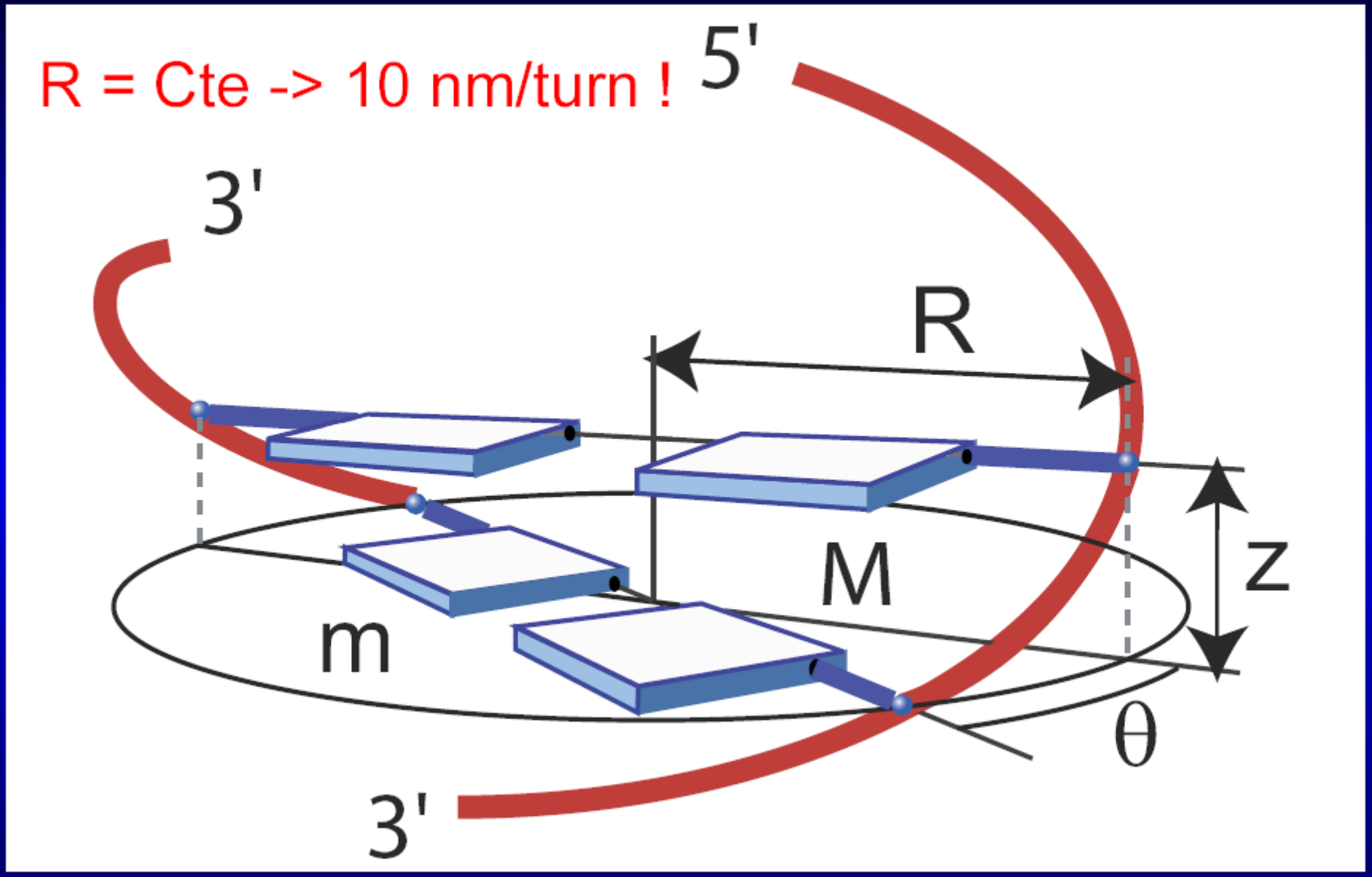
DNA lengthens as we add turns !

The twist-stretch coupling is insensitive to F, Mg++, sequence.



Mean 0.42 nm/turn

A simpel geometrical model.



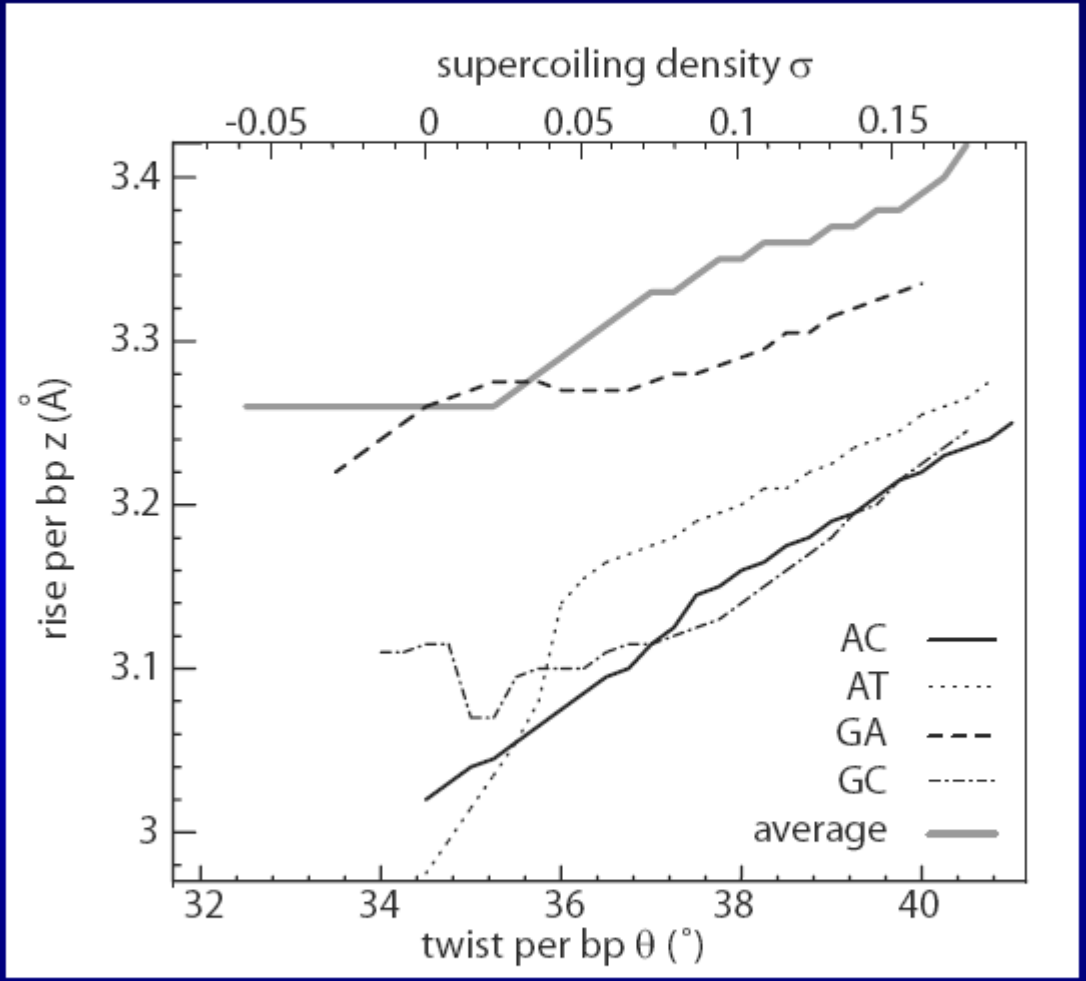
Molecular modeling approach.

Energy minimization with imposed twist.

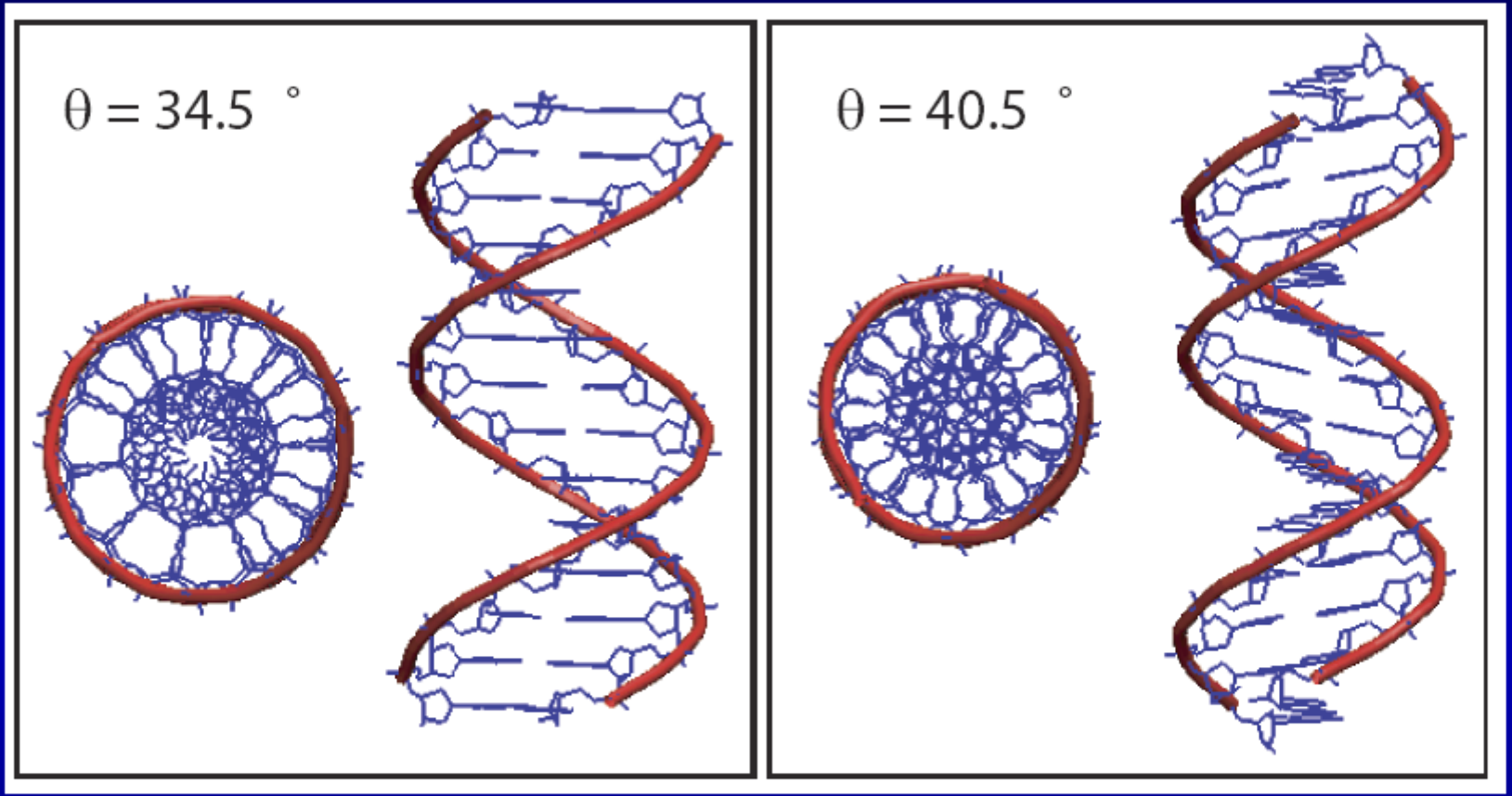
Twist-stretch depends slightly on F

F = 0 pN typically 0.9 nm/turn

F = 6 pN typically 0.68 nm/turn



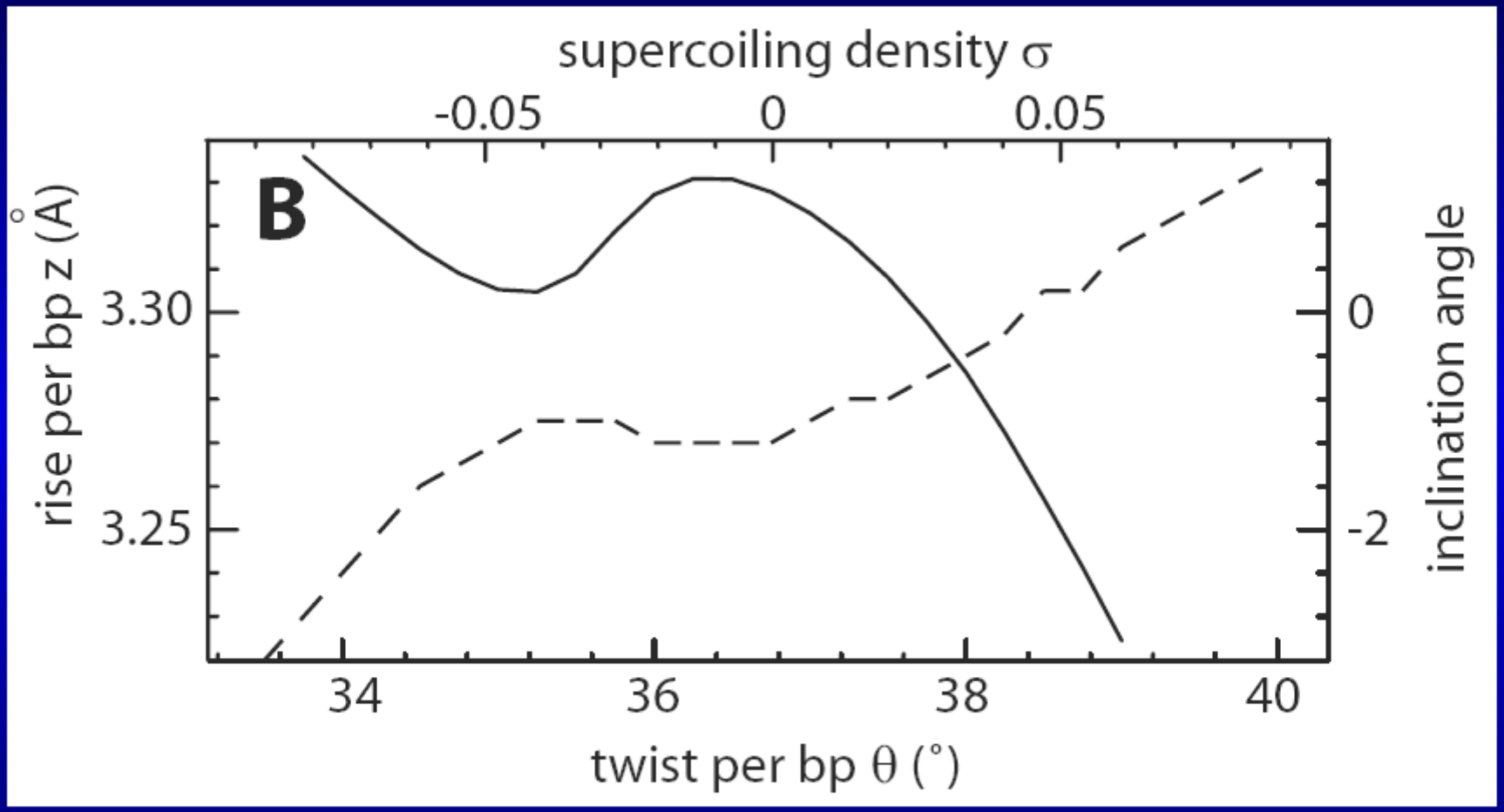
The radius of DNA changes with twist.



DNA radius decreases with twist

The radius of DNA changes is related to bases inclination.

Imposing a constant inclination drastically alters twist-stretch coupling



Increasing twist leads to DNA changes comparable to those observed in the transition from DNA-B to DNA-A