Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Discontinuities at the DNA supercoiling transition BRYAN DANIELS, SCOTT FORTH, MAXIM SHEININ, MICHELLE WANG, JAMES SETHNA, LASSP, Cornell University — While slowly turning the ends of a single molecule of DNA at constant applied force, a discontinuity was recently observed at the supercoiling transition, when a small plectoneme is suddenly formed. This can be understood as an abrupt transition into a phase in which stretched and plectonemic DNA coexist. We argue that there should be discontinuities in both the extension and the torque at the transition, and provide experimental evidence for both. To predict the sizes of these discontinuities and how they change with the overall length of DNA, we organize a theory for the coexisting plectonemic state in terms of four length-independent parameters. We also test plectoneme theories, including our own elastic rod simulation, finding discrepancies with experiment that can be understood in terms of the four coexisting state parameters.

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Date submitted: 20 Nov 2008 Electronic form version 1.4