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The Statistics of DNA Confined in a Charged Fluidic Nanoslit
YONGQIANG REN, DEREK STEIN, Brown University — Advances in nanofabrication and single-molecule fluorescence microscopy have enabled detailed studies of the configuration "states" of highly confined DNA polymers. In nanoslits of decreasing height, h, we observed an abrupt transition in the behavior of the coil size from an h-dependent, "de Gennes" regime, to an h-independent, "Odijk" regime. The cross-over occurred at increasing h with decreasing ionic strength. In the Odijk regime, DNA conformations are well described by a 2-D self-avoiding walk model, and correlations in the excluded volume interactions between the segments play an important role. In the de Gennes regime, we probed the electrostatic interactions between the negatively charged DNA molecules and the negatively charged nanoslit walls. From the scaling of the coil size with h, we inferred electrostatic depletion regions that reduced the effective h. The depletion regions significantly exceeded the Debye length, on which a non-trivial dependence was observed. Our investigations reveal a rich state diagram for nanoconfined DNA, and suggest the possibility of controlling single DNA molecules using purely electrostatic forces.

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