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Extension and Diffusion of DNA in Nanochannels DOUGLAS TREE, University of Minnesota, YANWEI WANG, Soochow University, KEVIN DORFMAN, University of Minnesota — Nanochannels are an ideal platform for studying the basic physics of confined polymers, using DNA as the model polymer. While the scaling laws for strong (Odijk) and weak (de Gennes) confinement were established decades ago, recent experiments have illuminated the complex physics arising between these limiting cases. We will first present Monte Carlo simulation data on the extension of DNA in nanochannels. Our results provide clear evidence for the existence of two transition regimes between the Odijk and de Gennes regimes, thereby resolving the apparent contradiction between these scaling theories and the corresponding experiments by Austin and coworkers. We will then present results for the diffusivity of DNA in nanochannels and explain their connection to the different regimes of extension. By using Monte Carlo sampling of the Kirkwood diffusivity and a numerical solution for the confined Green's function, we have calculated the diffusivity for DNA contour lengths ranging over three orders of magnitude and nanochannel sizes over two orders of magnitude. By using a DNA model that accurately reproduces the free solution radius of gyration and diffusivity over a range of molecular weights, we can directly connect the simulation data and experiments.

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