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Experimental Test of the Wormlike Chain Model for Confined DNA DAMINI GUPTA, JULIAN SHEATS, ABHIRAM MURALIDHAR, JEREMY J. MILLER, DEREK E. HUANG, KEVIN D. DORFMAN, Chemical Engineering and Materials Science, University of Minnesota, Minneapolis MN, USA, WALTER REISNER, Physics Department, McGill University, Montreal QC, Canada — We present experimental validation of a wormlike osculating-sphere model for double-stranded DNA. Single molecule fluorescence imaging of λ-DNA (48,500 base pairs) in rectangular nanochannel confinement was performed to measure the ensemble of molecule extensions in a low ionic strength buffer. The mean and variance of the extension furnish the parameters of the effective Hookean spring description of the chain extension. The geometric means of the channel widths range from 100 nm to 316 nm, thereby probing the transition between Odijk and de Gennes regimes in nanochannel sizes ranging from approximately 1.5 to 5 times the DNA persistence length. We found a steep drop in the variance of the extension as the channel size decreased in these channels. Our experimental results are in strong quantitative agreement with Pruned-Enriched Rosenbluth Method simulations using the wormlike osculating-sphere model in rectangular channels, where the only fitting parameter is the stained DNA contour length.

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