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Hindered DNA coordinated motion in nanochannels YENG-LONG CHEN, YU-HUI LIN, DMYTRO LUZHBIN, Institute of Physics, Academia Sinica — We investigate the relaxation dynamics of long DNA molecules confined in micro- and nano-channels with Brownian dynamics simulations. Prior experiment by Reisner et al. found that the stretch fluctuation correlation time (t_{relax}) of DNA molecules in nanochannels increases as the channel height (H) decreases for H greater than the DNA Kuhn length (σ_k), and t_{relax} decreases as H decreases for $H < \sigma_k$. Our simulations capture this behavior, and quantitatively agree with the experimental results within the error bars. The scaling-law dependence of t_{relax} on H in different regimes is verified. Rouse mode analysis of the chain relaxation mechanism further shows that segmental relaxation on length scale longer than σ_k are hindered and the dynamics of segments shorter than H dominate the chain relaxation processes. We also find that the inclusion of intra-chain hydrodynamic interactions affect segmental relaxation. The implications for DNA translocation through nanopores and nanochannels are discussed.

Yeng-Long Chen
Institute of Physics, Academia Sinica

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