Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Propagation modes of entropically trapped and extended DNA molecules MORTEN MIKKELSEN, Technical University of Denmark, WALTER REISNER, Brown University, HENRIK FLYVBJERG, ANDERS KRISTENSEN, Technical University of Denmark — Nanoconfinement is a powerful tool for controlling polymer conformation and dynamics in lab-on-a-chip type devices for the analysis of DNA and other biomolecules. We present a new device concept that combines confinement-based extension of DNA with the entropic trapping principle, leading to qualitatively new physics and applications. The device consists of a 50 nm slit channel with an array of transverse 100 × 100 nm grooves, where the transport of DNA molecules perpendicular to the groove axis is investigated under pressure driven buffer flow. At low flow velocities the DNA remains trapped and extended in the nanogrooves while buffer circulates through the slit, enabling physical mapping of the DNA while performing real time buffer exchanges. For flow velocities above a molecular weight dependent escape threshold, we show that the molecule transport through the slit channel randomly alternates between two modes of propagation: A stepwise groove to groove hopping, called the 'sidewinder', and a continuous tumbling across the grooves, where the molecules feel the topology as an effective friction, called the 'tumbleweed'. The observed length dependence on the molecule velocity may lead to a novel separation methodology.

Anders Kristensen
Technical University of Denmark

Date submitted: 21 Nov 2008 Electronic form version 1.4