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Abstract for an Invited Paper
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Nanofluidic DNA analysis - applications and physics[1]

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DNA stretching in nanofluidic channels that are round 100 nm in diameter and 100's of microns long is an emerging technique for the genetic analysis of long nucleic acid molecules. We will explain why nanofluidic stretching differs from other single-molecule techniques, in particular how the ability to measure individuality is greatly enhanced by the fundamentally different averaging properties. We will present an overview of the basic physics that enables this exciting new technique, and discuss proof-of-principle experiments that have demonstrated how genetic information can be gathered by the technique. In order to unlock the full potential of multi-step analyses, we have begun to develop a toolbox for connecting nanochannels into networks, and control the motion of single molecules by creating a spatially and temporally modulated energy landscape. As part of this "nanoplumbing" approach, we have demonstrated nanofluidic switches that can be activated by application of an external a.c. electric field requiring only two external electrodes. Finally, I will discuss recent results which show that stretched DNA can undergo a phase transition-like collapse under application of an a.c. field, and discuss possible mechanisms. We have observed giant electrostriction of 75% and more, comparable with high-performance artificial muscles.

[1]Part of the work was performed in the laboratory of R.H. Austin at Princeton University.