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CHALLENGES IN SINGLE-MOLECULE DNA SEQUENCING

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The main challenges of the so called physical approaches to DNA sequencing, based on the reading of electrical signals associated to the DNA bases while a single DNA polymer is translocated through the synthetic nanopore [1], are twofold: (1) electric signal-to-noise ratio that distinguishes between the DNA bases and (2) full control and localization of a DNA in the nanoelectrode gap or nanopore. We study both issues for various types of the nanopore technologies (carbon nanotubes, silicon nanopores and linear quadrupole , aqueous nanotraps), by multiscale theoretical approaches, ranging from quantum mechanical , quantum-classical and classical molecular dynamics, to continuum fluid dynamics. Our results are validated by experiments at Arizona State University[2,3] (Stuart Lindsay) and Yale University [4,5] (Mark Reed). This talk will discuss problems and possible solutions for DNA translocation and tunneling recognition with electrode functionalization in presence of thermal fluctuations, viscosity, electrophoretic, dielectrophotretic and electroosmotic forces.

[1] Branton D et al, NATURE BIOTECHNOLOGY **26**, 1146-1153 (2008).

[2] Liu HT et al, , SCIENCE, **327**(5961), 68 (2010).

[3] P. Pang et al, , ACS NANO **5** (9), 7277–7283 (2011).

[4] W. Guan et al, , PNAS **108** (23), 9326-9330 (2011).

[5] Park, J. H. et al, SMALL 8, 907 (2012).