Electrostatic fluctuation effects in polymer translocation through nanopores

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Electrostatic correlations between charged macromolecules and ions are omnipresent in various nanoscale systems. From the charge and polymer selectivity of biological and artificial membrane nanopores to the functioning of energy storage and nanofluidic devices, charge fluctuations are at the heart of many biological and industrial processes. In the first part of the talk, I will present a beyond-mean-field variational scheme for the calculation of ion densities confined to nanopores. Then, I will couple this formalism with Stokes equation and derive a correlation-corrected charge and polymer transport theory. I will apply this theory to polymer translocation problem. First, I will show that in the presence of trivalent and quadrivalent cations in the solution, charge correlation effects may stop or even reverse the direction of the translocating polymer [1]. Next, I will consider hydrodynamically driven polymer translocation through nanopores.
It will be shown that due to electrostatic fluctuation effects, DNA translocation events are accompanied with the inversion of the sign of the ionic current through the nanopore [2,3]. I will conclude by presenting a brief summary of open questions in the theoretical modeling of translocation polyelectrolytes.

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