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Confined wormlike chains in external fields

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The confinement of biomolecules is ubiquitous in nature, such as the spatial constraints of viral encapsulation, histone binding, and chromosomal packing. Advances in microfluidics and nanopore fabrication have permitted powerful new tools in single molecule manipulation and gene sequencing through molecular confinement as well. In order to fully understand and exploit these systems, the ability to predict the structure of spatially confined molecules is essential. In this talk, I describe a mean field approach to determine the properties of stiff polymers confined to cylinders and slits, which is relevant for a variety of biological and experimental conditions. I show that this approach is able to not only reproduce known scaling laws for confined wormlike chains, but also provides an improvement over existing weakly bending rod approximations in determining the detailed chain properties (such as correlation functions). Using this approach, we also show that it is possible to study the effect of an externally applied tension or static electric field in a natural and analytically tractable way. These external perturbations can alter the scaling laws and introduce important new length scales into the system, relevant for histone unbinding and single-molecule analysis of DNA.