Title:
Conformations of Semiflexible Polymers

Speaker:
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Abstract:

Cytoskeletal filaments like F-Actin, microtubuli and intermediate filaments play an essential role in a multitude of cell functions in all eukaryotes. In solution, these filaments undergo thermal shape fluctuations but, due to their rigidity, maintain an average direction and are therefore referred to as semiflexible. In recent years, the wormlike chain (WLC) model has emerged as the standard model for the description of those semiflexible biopolymers. Within this framework, numerous correlation functions and probability distribution functions have been calculated, and the effect of boundary conditions and spatial confinement has been explored. Recently, also the shape of semiflexible polymer rings [1], relevant for the conformations of circular DNA, has been studied. Investigating the asphericity and the nature of asphericity a broad variety of shapes have been found and characterized theoretically.

Whereas a number of experimental studies have demonstrated the applicability of the WLC model to DNA and F-Actin, evidence has accumulated suggesting that it may constitute an oversimplification in the case of microtubules due to their highly anisotropic molecular architecture [2]. Microtubules consist of strings of tubulin heterodimers, so-called protofilaments that are arranged in parallel forming a hollow tube. This architecture shares some similarities with bundles of wormlike chains [3]. To account for both of these architectures, we have recently introduced a novel class of models [4], termed wormlike bundles (WLB). They show a state-dependent bending stiffness that derives from an interesting interplay between the high stiffness of the individual filaments and their soft relative sliding motion. We demonstrate that this state-dependence gives rise to fundamentally new behavior that cannot be reproduced trivially using existing relations for WLCs.

In this talk we review these recent advances, and illustrate biological applications as well as some of the intriguing physical features of thermally undulating biopolymers.

[1] K. Alim and E. Frey, [q-bio.BM/0708.0111]
[2] F. Pampaloni et al, PNAS **103,** 10248 (2006); K. M. Taute et al, [q-bio.BM/0708.1928]
[3] M. Claessens et al, Nature Materials **5**, 748-753 (2006)
[4] C. Heussinger, M. Bathe, and E. Frey, Phys. Rev. Lett. **99**, 048101 (2007)