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ΔΙΑΛΕΞΗ

"Tension induced binding of semiflexible biopolymers"

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Αίθουσα σεμιναρίων στο ισόγειο του ΕΙΕ

Abstract

Many cellular processes, such as cell motion, adhesion or mitosis require the reorganisation of the cytoskeleton. This remodeling is achieved with transient or reversible cross-linkers, which bind and unbind stochastically. Besides thermal unbinding, which in vitro can be controlled by temperature, mechanical forces are known to affect cross-link unbinding. In this talk I am going to present a theoretical investigation of the effect of the polymer tension on the collective behaviour of the reversible cross-links. We use a model of two parallel-aligned, weakly-bending wormlike chains with a regularly spaced sequence of binding sites subjected to a tensile force. Reversible cross-links attach and detach at the binding sites with an affinity controlled by a chemical potential. In a mean-field approach, we calculate the free energy of the system and we show the emergence of a free energy barrier which controls the reversible (un)binding. The tension affects the conformational entropy of the chains which competes with the binding energy of the cross-links. This competition gives rise to a sudden increase in the fraction of bound sites as the polymer tension increases. In the strong stretching limit, we show that this transition is related to the cross-over between weak and strong localisation of a directed polymer interacting with an effective square potential well in the transverse direction. The observed scaling of stretching force with cross-link strength and chemical potential can be explained with a simple model of a directed polymer in an effective confining potential. We have shown that the tensile stiffness of the pair of polymers increases with the number of cross-links. Our new finding of a force-induced first-order transition in the number of cross-links implies a sudden force-induced stiffening of the polymers. Apart from its relevance to cytoskeletal bundles, our model also bears some resemblance to the denaturation of DNA which is known to be affected by external stretching forces.