Physics Seminar

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Nanomechanics of self-assembled protein filaments

Over the past twenty years, several experimental tools have been developed to measure the mechanical properties of single biopolymers such as DNA. Atomic force microscopy (AFM) or optical tweezers provide direct measurements of the force versus extension curve. So far all the single biopolymer pulling experiments can be described using either the worm like chain (WLC) model or various two-states polymer models.
During this seminar, I will present mechanical studies of a more complex class of biopolymers, i.e. self-assembled protein filaments. This group encompasses proteins such as myosin, collagen, fibrinogen and intermediate filament (IF) proteins. All these proteins have in common the ability to self-assemble into rope-like or rod-like structures 10 to 100 nm in diameter. Another common characteristic is the shape of the building-blocks which are 50 to 500 nm long coiled coils with diameters around 2-3 nm. The mechanical properties of these systems are much more complex than single biopolymers and necessitate different experimental approaches. For example they can exhibit, high extensibility (above 100% extension), strain stiffening effects, and anisotropic elastic properties.

If time permits I will also present some simple ways to assemble these proteins into macroscopic gels and micro-fibres that may compete with state-of-the-art polymer materials such as Kevlar.