AKB 10 Biopolymers

Zeit: Freitag 09:45–11:30 Raum: TU H2013

Hauptvortrag

AKB 10.1 Fr 09:45 TU H2013

Interfacial Forces move DNA in Thermal Gradients — •Dieter Braun — Noether Group on Dissipative Biosystems, Applied Physics, LMU München, Amalienstr. 54, D-80799 München

Temperature gradients can induce large effects at microscopic dimensions. We discuss the first measurement of thermophoresis of DNA [1] and show how this effect can be used to accumulate and separate Microparticles or DNA [1-3]. Within microfluidic environments, the field gradients can be applied freely by IR optics. Finite element methods allow the in-depth simulation of thermophoresis, thermal conduction and fluid flow to compare with experiments even in complicated settings. We discuss measurement approaches and applications of thermophoresis, show how thermophoresis can complement our new approach of convective PCR [4] and speculate whether the effect might have played a role in molecular evolution [5].

[1] Trapping of DNA by Thermophoretic Depletion and Convection, Physical Review Letters 89: 188103 (2002)

[2] Thermophoresis of DNA determined by Microfluidic Fluorescence, European Physical Journal E, in press

[3] 2D Colloidal Crystals formed by Thermophoresis and Convection, in preparation

[4] Exponential DNA Replication by Laminar Convection, Physical Review Letters 91: 158103 (2003)

[5] Thermal force approach to molecular evolution, Physical Biology 1: P1-P8 (2004)

Hauptvortrag

AKB 10.2 Fr 10:15 TU H2013

Driven Stiff Polymers — •Roland Netz — Physik Department, TU Muenchen, 85748 Garching

We consider stiff polymers in various non-equilibrium situations. Polymers that are anchored to surfaces, so-called brushes, are subject to shear flow and as a result deform and screen the hydrodynamic flow to various degrees, as relevant for glycocalix layers at endothelial cells in the blood stream. Conversely, stiff polymers at surfaces that are beating back and forth can be used to pump liquids over surfaces, which is a concept realized by ciliae but also attractive for synthetic designs. Elasticity is important here because for rigid rods the pumping efficiency is zero.

AKB 10.3 Fr 10:45 TU H2013

Discontinuous unbinding transitions of filament bundles — •J. Kierfeld, T. Kühne, and R. Lipowsky — MPI für Kolloid- und Grenzflächenforschung, 14424 Potsdam

The unbinding transition of bundles of semiflexible filaments, e.g., cytoskeletal F-actin filaments, is studied theoretically. We consider bundles formed due to attractive filament interactions mediated by crosslinking sticker molecules. Using a combination of analytical arguments and Monte-Carlo simulations, it is shown that the formation of bundles of parallel filaments requires a threshold concentration of linkers which becomes independent of the filament number for large bundles. Unbinding of bundles happens in a single, discontinuous transition. We discuss the behaviour of the bundle thickness at and below the transition. In the bound phase, large bundles tend to segregate into sub-bundles due to slow kinetics. Our results are in agreement with experiments on F-actin in the presence of the crosslinking α-actinin protein.

AKB 10.4 Fr 11:00 TU H2013

Towards a theory of the equilibrium phase behaviour of stiff polymer solutions — •Sven van Teeffelen, Erwin Frey, and Klaus Kroy — Hahn-Meitner-Institut Berlin

We study the equilibrium collective properties – packing structure and phase behaviour – of solutions of entangled stiff polymers that are isotropically dissolved in an aqueous salty solution in the presence of small flexible polymers mediating an additional depletion attraction. In order to make contact with well established liquid-state theories we calculate a microscopic effective pair potential between the filaments. We find that the bare interactions (hard core, depletion, electrostatic, van der Waals) are drastically renormalized by thermal fluctuations. In order to account for non-trivial cooperative effects at finite filament densities we make use of a scaling argument extending the tube model of semiflexible polymers. In particular, we find the spinodal in agreement with recent experiments on in vitro solutions of F-actin and Polyethylenglycol.

AKB 10.5 Fr 11:15 TU H2013

Relaxation of highly stretched DNA — •Oskar Hallatschek[1], Erwin Frey[1,2], and Klaus Kroy[1] — [1]Abteilung Theorie, Hahn-Meitner Institut, Glienicker Str. 100, 14109 Berlin, Germany — [2]Fachbereich Physik, Freie Universität,14195 Berlin, Germany

We have investigated theoretically the effect of local properties such as bending stiffness and inextensibility on the large scale dynamics of semiflexible polymers. In this talk we will focus on the contraction dynamics of highly stretched DNA after a sudden tension release. The polymer passes through various dynamical regimes during the relaxation from a completely stretched to a coiled conformation. Before entering the universal Rouse relaxation described by the "stem–flower" model, the relaxation dynamics exhibits features unique to a worm–like chain. In particular, we predict a novel relaxation mode which is fast compared to the diffusive contraction predicted by the stem–flower model. On a logarithmic time scale this regime actually supersedes the latter, and consequently our predictions should be accessible to experiments if pushed to larger force and higher time resolution.