BP 16: Poster Session I

Time: Tuesday 17:00–19:30 Location: Poster D

BP 16.1 Tue 17:00 Poster D

Preparation of dense arrays of end-tethered DNA on solid substrates — •Hui Li, Juha Koota, Ina Seuffert, Alexander André, Georg Maret, and Thomas Gisler — Fachbereich Physik, Universität Konstanz, 78457 Konstanz, Germany

We discuss various routes to produce dense end-tethered arrays of long-chain DNA molecules to solid substrates, using DNA carrying end groups such as biotin or thiol which specifically bind to surface-anchored streptavidin or gold.

Conventional end-tethering by adsorption of coiled DNA results in low tethering densities and mushroom-like conformations [1] due to the entropic repulsion of the coils. Using DC electric fields applied via conducting substrates such as gold or streptavidin-coated indium-tin oxide, DNA can be driven to the surface by electrophoresis. However, the high viscosity of the high DNA concentration near the surface dramatically slows down the tethering, resulting in only moderate enhancements of the tethering density.

As an alternative approach we exploit the liquid crystalline order in DNA solutions induced by osmotic stress [2] or by convective deposition onto a pinned contact line occurring in a "coffee ring" [3]. We investigate the effects of end-functionalization and end-tethering on liquid crystalline textures, and resulting tethering densities.

[1] R. Lehner, et al. Phys. Rev. Lett. 96 (2006), 107801.

[2] R. Podgornik, et al. Proc. Natl. Acad. Sci. USA 93 (1996), 4261-4266.

[3] I.I. Smalyukh, et al. Phys. Rev. Lett. 96 (2006), 177801.

BP 16.2 Tue 17:00 Poster D

Biological surfaces and their response to environmental stress — •Agnieszka Krol-Otwinowska, Karl Hieble, and Margret Giesen — Institute of Bio- and Nanosystems IBN-4, Research Centre Jülich GmbH, Germany

Biological surfaces form the interface between a living organism and the atmosphere. In addition, they mediate the response of a living organism to environmental stress by means of structural changes and chemical reactions. On the molecular scale, structural changes and chemical reactions generally involve changes in the local polarization of the electron charge density in the biological surfaces, which opens a pathway to study the response of biological surfaces to environmental stress from a surface scientist's perspective: Change in the local polarization of the electron charge density is the origin of the mechanical surface stress which is defined as the total work to enlarge the area of a solid surface by a certain amount. For the first time, we introduce measurements of the surface stress of biological surfaces under natural conditions and demonstrate that changes in the surface stress are sensitive indicators for the interaction of biological surfaces with their environment. As an example we present measurements of the surface stress of plant leaf wax layers and its dependence on climatic relevant parameters (gases, air humidity, UV-light).

BP 16.3 Tue 17:00 Poster D

Fast and Light-Efficient Wavefront Sensing — •Marcel Andreas Lauterbach, Markus Rueckel, and Winfried Denk — Max Planck Institute for Medical Research, Department of Biomedical Optics, Jahnstr. 29, 69120 Heidelberg, Germany

Adaptive Optics can improve the image quality of confocal/multi-photon microscopic images by correcting wavefront distortions of the excitation beam. The wavefront distortions can originate from the sample itself and must be measured for correction. The wavefront sensing should be light-efficient to allow fast correction and to avoid photodamage in the biological sample during the measurement process.

We developed an interferometer-based virtual modal wavefront sensor (VMWS) that can be configured to measure, for example, Zernike coefficients directly. This sensor is particularly light efficient. Including up to Zernike mode 21, aberrations can be determined with a precision of about 0.17 rad ($\lambda/37$) using low resolution (65 * 65 pixels) images and only about 400 photons total.

The VMWS uses Phase Shifting Interferometry (PSI), for which we developed a new scheme ("Nonlinear PSI" (NPSI)), which makes faster measurements possible. It allows an almost arbitrary reference phase shift during the interferogram recording. We especially investigated the case of a sinusoidal phase shift. We show results of wavefront measurements and the comparison with theoretical considerations and envision the applicability of the VMWS and NPSI to confocal/multi-photon microscopy. VMWS and NPSI are not limited to microscopy but should be applicable whenever a reference wavefront is available.

BP 16.4 Tue 17:00 Poster D

Energy Transfer between Photosynthetic Pigment-Protein Complexes in Model Membrane Systems — •Tobias Pflock[1], Manuela Dezi[2], Giovanni Venturoli[2], Jürgen Köhler[1], and Silke Oellerich[1] — [1]Experimentalphysik IV, Universität Bayreuth, D-95447 Bayreuth — [2]Dept. of Biology, University of Bologna, Italy

The photosynthetic unit (PSU) of purple bacteria represents a well known model system in photosynthesis research. It mainly consists of protein complexes, namely LH2 and LH1-RC, which contain photoactive pigment molecules harvesting solar light. The ring-shaped complexes are embedded in lipid membranes to form functional units that very efficiently transfer the excitation energy to the reaction center (RC). Therefore, the supramolecular organisation of the PSU within the biological membrane plays a significant role, and it is of particular interest to understand how the involved lipids contribute to the spatial arrangement of the membrane proteins.

In order to address this question systematically, we chose to reconstitute proteins into large unilamellar vesicles (LUV). This allows us to control the membrane lipid composition as well as the lipid-protein ratio. Selective excitation of the pigments embedded in LH2 rings by a pulsed laser makes it possible to determine the transfer efficiency to LH1-RC units directly via fluorescence lifetime measurements. Using a streak camera system we studied the fluorescence decay of reconstituted pigment-protein complexes to characterize excitation energy transfer from LH2 to LH1-RC complexes.

BP 16.5 Tue 17:00 Poster D

Lipid-mediated protein interactions in lipid bilayers — •Beate West and Friederike Schmid — Fakultät für Physik, Universität Bielefeld, Universitätsstr. 25, 33615 Bielefeld

Lipid-mediated interactions play a central role for the interactions between proteins in a lipid bilayer. The lipid bilayer as well as the proteins are simulated using a coarse-grained model.

We study how proteins influence the structure of the lipid bilayer at different temperatures, and, on the other hand, how the lipids influence the interactions of the proteins. To this end, we calculate the effective pair potential between the proteins with the method of umbrella-sampling.

BP 16.6 Tue 17:00 Poster D

Fluctuation-dissipation relation for colloidal particles in shear flow — •Thomas Speck and Udo Seifert — II. Institut für Theoretische Physik, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart

In equilibrium, the well-known fluctuation-dissipation theorem (FDT) connects the response of an observable with its auto-correlation function. For driven systems, breaking of detailed balance leads to dissipation and to the breakdown of the FDT. We have shown recently how to quantify this violation in terms of velocity correlations and how to restore then the original form of the FDT [1]. We investigate the violation function in the case of two interacting colloidal particles driven by shear flow and illustrate our results with numerical calculations.

[1] T. Speck and U. Seifert, Europhys. Lett. **74**, 391 (2006).

BP 16.7 Tue 17:00 Poster D

Cell shape-dependent forces at focal adhesions — •Sebastian Schmidt[1], Ilka Bischofs[2], and Ulrich Schwarz[1] — [1]University of Heidelberg, Im Neuenheimer Feld 293, D-69120 Heidelberg, Germany — [2]University of California at Berkeley, Department of Bioengineering, 717 Potter Street, Berkeley CA 94720, USA

Adhesion-dependent cells probe the mechanical properties of their environment by internally generated forces transmitted to the extracellular environment at sites of focal adhesions, with dramatic consequences for different physiological processes, including cell division and lineage specification. We introduce a mechanical model which allows to relate cellular forces applied to focal adhesions with their shape. Our model predicts that forces at focal adhesions are mainly determined by the

line tension present in the cell contour. Both surface tension in the cell envelope and extracellular stiffness have an indirect effect by changing the geometrical arrangement through which the line tension acts. We also discuss the effect of tension-mediated reinforcement of the cell contour.

BP 16.8 Tue 17:00 Poster D

Energy transfer processes in a bisporphyrinic switch — •Jedrzej Szmytkowski[1,3], Robert Hauschild[1], Manfred Scholdt[1], Teodor Silviu Balaban[2,3], and Heinz Kalt[1,3] — [1]Univesität Karlsruhe (TH), Karlsruhe, Germany — [2]Forschungszentrum Karlsruhe, Institute for Nanotechnology, Karlsruhe, Germany — [3]Center for Functional Nanostructures (CFN), Karlsruhe, Germany

Energy transfer processes are the first step in light-harvesting and have been optimized in photosynthetic organisms. Artificial mimics are essential in understanding and controlling the efficiency with which after photon capture an energetic trap can be accessed. We have studied various bis-porphyrinic constructs, covalently attached to spacers such as a rigid steroidal skeleton or a terpyridine capable of undergoing a conformational switch from an extended "W" conformation into a more compact "U" form. The switching can be performed by addition of coordinating metals or of ditopic ligands. Singlet-singlet energy transfer was put into evidence by time-resolved fluorescence and the data have been analyzed using decay associated spectra (DAS). While in the steroidal systems a Förster-type energy transfer occurs, the rate and efficiency of the energy transfer can be influenced by the added ligand in the terpyridinc constructs.

BP 16.9 Tue 17:00 Poster D

Accuracy check of detection algorithms for fluorescent colloidal spheres by simulation — •Markus Gyger — Institute for Soft Matter Physics, University of Leipzig, Linnéstr. 5, 04103 Leipzig, Germany

In the discussion about like-charge attraction of colloidal spheres confined between parallel glass-plates there have been indications that the observed attraction is an artifact due to diffraction effects in optical video microscopy. We present a simulation technique which checks the accuracy of the detection algorithms for confined fluorescent colloidal particles and allows for determination of the difference between real and detected particle position in dependance on the interparticle separation. To that aim, images of interacting particles, whose positions were detected by different particle detection algorithms, were computer generated, simulating the image-taking process of digital video microscopy. Re-detecting the particle positions from the simulated images and comparing them with the originally detected positions provides some insight into the detection accuracy and systematic errors of the detection algorithms.

BP 16.10 Tue 17:00 Poster D

Brownian dynamics simulations of protein cluster assembly — •Jakob Schluttig and Ulrich Schwarz — University of Heidelberg, Im Neuenheimer Feld 293, D-69120 Heidelberg

Most proteins in the cell are active in complexes with two to several hundreds of components. Because only very small assemblies can be studied in an all-atom framework, coarse-grained approaches are required to model the association and dissociation dynamics of larger protein assemblies. We model proteins as spherical particles covered with few binding sites. Their motion is simulated with Brownian dynamics and binding is allowed to occur if two binding sites approach each other to a prescribed encounter length. The diffusion of clusters is treated using bead models for the hydrodynamics in the viscous regime. Using computer simulations, we measure the mean first passage times for the formation of clusters of different sizes.

BP 16.11 Tue 17:00 Poster D

Evolutionary emergence of complexity in model food webs — •Christian Guill and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland

Explaining the amazing diversity of ecological communities remains one of the greatest challenges in theoretical ecology. We investigate various mechanisms that promote the emergence of large and complex food webs in an evolutionary model that also includes population dynamics. Networks are created by starting from one species and external resources, followed by an iterated process of adding new species that are obtained by modifying existing species. Species are ordered on a one-dimensional niche axis, and links between them that represent feeding relationships are assigned according to the rules of the niche model (R.J. Williams, N.D. Martinez, 2000, Nature 404, 180-183). The average body size (or mass) of the species is assumed to increase with their position on the niche axis. The tested hypotheses for the promotion of complexity are the influence of different functional responses, adaptive behaviour, and body size effects that relate the metabolic rate of a species to its position on the niche axis. Adaptive foraging behaviour is found to be the key mechanism for the emergence of complex networks, while body size effects only determine the degree of complexity.

BP 16.12 Tue 17:00 Poster D

Nanotomography of Human Bone Based on Scanning Probe Microscopy — •Stephanie Röper[1], Christian Dietz[1], Sabine Scherdel[1], Anke Bernstein[2], Nicolaus Rehse[1], and Robert Magerle[1] — [1]Chemische Physik, TU Chemnitz, D-09107 Chemnitz — [2]Experimentelle Orthopädie, Martin-Luther-Universität Halle-Wittenberg, D-06097 Halle/Saale

Natural materials such as bone and teeth are nanocomposites of proteins and minerals, which exhibit a complex hierarchical structure ranging from macroscopic to molecular length scales. Scanning probe microscopy (SPM) based Nanotomography is a novel approach to image these materials. We focus on human bone which is first embedded in a methacrylate resin and then and then sectioned with the use of a microtome. For SPM based Nanotomography the specimen is ablated layer-by-layer by wet chemical etching and imaged with tapping mode scanning force microscopy after each etching step. From the resulting series of images the three-dimensional structure is reconstructed. The etching and imaging is done in-situ in a liquid cell of an SPM connected to reservoirs of etchants and water for flushing after each etching step. The flow of the different liquids is controlled with computer controlled valves which allow for an automated etching and measuring protocol. We will present first results of volume images of human bone and discuss our concepts for adjusting the imaging parameters to maintain a good imaging quality.

BP 16.13 Tue 17:00 Poster D

Dynamics of micro-capsules in shear flow using spectral methods — •Steffen Kessler, Reimar Finken, and Udo Seifert — II. Institut für Theoretische Physik, Universität Stuttgart, Pfaffenwaldring 57/III, 70550 Stuttgart

Soft objects such as vesicles or micro-capsules in hydrodynamic Stokes flow present a challenging physical model system both from a theoretical and experimental point of view. We present a novel three dimensional numerical approach using spectral methods to simulate the dynamical behaviour of a micro-capsule in a linear shear flow. The shape of the membrane is expanded into a set of smooth basis functions. Using the balance between elastic and hydrodynamic forces and the no-slip boundary condition at the capsule membrane, we derive the equations of motion of the expansion coefficients. This set of coupled nonlinear equations is solved numerically. The mechanical properties of our capsule include resistance to shear, compression and bending. Different constitutive laws and arbitrary external flows can be employed in the code. A viscosity contrast between inner and outer fluid is permitted. We are able to observe relaxation into a stationary tank-treading state, which is also seen in experiments. Numerical results for the deformation and inclination angle agree well with theoretical predictions in the low shear rate limit. The spectral code is used to investigate capsule dynamics beyond the quasispherical approximation.

BP 16.14 Tue 17:00 Poster D

Interaction of Model Proteins in a Lipid Bilayer under Surface Tension — •Jörg Neder[1], Beate West[2], and Peter Nielaba[1] — [1]Department of Physics, University of Konstanz, 78457 Konstanz — [2]Department of Physics, University of Bielefeld, 33615 Bielefeld

Recently O. Lenz and F. Schmid [1] introduced a simple coarse-grained model to study lipid layers and their phase transitions. Using an extension of this model [2] we are investigating the influence of an applied surface tension to a bilayer membrane. One aim of our work is the comparison of lipid-mediated protein-protein interaction between the tensionless state of the bilayer and states with non-vanishing surface tension. Furthermore, we are interested in developing a method for calculating the chemical potential of incorporated model proteins.

[1] O. Lenz, F. Schmid, J. Mol. Liquids, **117**, 147 (2005)
[2] F. Schmid, et al., http://arxiv.org/pdf/physics/0608226

BP 16.15 Tue 17:00 Poster D

Nanoscale thermophoresis for bioanalysis on a chip — •Christoph Wienken and Dieter Braun — Emmy Noether Group at the Center of NanoScience (CeNS),, Ludwig Maximilian Universität München, Amalienstrasse 54, 80799 Munich, Germany

We explored a chip-based all electrical measurement scheme for thermophoresis on the nanoscale. Thermophoresis, also called Soret effect, is the movement of particles in a temperature gradient. It is sensitive to the particles' properties like charge and size.[1] Previously, measurements were carried out all optical. But for simpler and cheaper detection we now use a all electrical setup. By miniaturizing the setup to nanoscale we significantly increased the speed of the measurement.

In the experiment both heating and concentration measurements are realized electrically. We use a very narrow, miniaturized gold/gold capacitor covered with a nanoliter droplet. Applying a high frequency AC voltage to the capacitor creates a temperature gradient between the capacitor and its environment by ohmic heating of the solution. Due to this gradient particles move out of the capacitor and result in a changed conductivity of the analyte. The latter is detected in the current signal.

Our simulations show that the analysis results are obtained within milliseconds, much faster than existing methods. This is due to the highly localized resistive heating near the capacitor. The chip-based layout doesn*t require any precisely applied volumina but only a millimetre-sized droplet which covers the sensitive area.

[1] Stefan Duhr and Dieter Braun, PNAS 103, 19678-19682 (2006)

BP 16.16 Tue 17:00 Poster D

Sexual reproduction prevails in a world of structured resources in short supply — •Irene Ament[1], Barbara Drossel[1], and Stefan Scheu[2] — [1]Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland — [2]Institut für Zoologie, Technische Universität Darmstadt, Deutschland

The maintenance of sexuality against the two-fold cost of sex is one of the most stunning problems in evolutionary biology. We present a model that is based on the availability of resources, which is the strongest factor determining the growth of populations. Key features of the model are that there is a broad spectrum of resources, that sexual reproduction sets in when resources become scarce, that only a few genotypes can coexist locally, and that resources regrow slowly. We show that under a wide range of conditions the sexual species outcompete the asexual ones. The asexual species win when survival conditions are harsh and death rates are high or consumer genotypes are so manifold that all resources are exploited to the same extent. These results are robust against modifications of the model, including various types of spatial structure.

BP 16.17 Tue 17:00 Poster D

Transport of phospholipids in the canalicular membrane of the hepatocyte — •Thomas Schwager[1], Hermann-Georg Holzhütter[2], and Andreas Herrmann[3] — [1]Charite, Augustenburger Platz 1, 13353 Berlin — [2]Institut für Biochemie, Charite, 10117 Berlin — [3]Institut für Biologie, Humboldt-Universität, 10115 Berlin

The bile is secreted by the hepatocytes from the liver of humans and other vertebrates. It plays an important role in the import of fat and in the export of cholesterol and xenobiotics. The hepatocytes pair to form a tiny canaliculus which transports the secreted bile. We present a mathematical model which contains the main molecular processes involved in the bile formation at the canalicular membrane. The membranes are modelled as a pair of regular hexagonal lattices, one of each representing the inner and the outer leaflet. The mobile constituents of the membrane may move along the lattice as well as between the leaflets, the so-called flip-flop. The interaction properties of the different particle species are characterized by affinities which influence the mobility of the particles. Although the model is very simple, it can quantitatively represent the known state of the canalicular membrane. It is applied to study the effect of perturbations of this reference state. Two examples of such perturbations: depletion of cholesterol and partial knock-out of the MDR3 transporter will be studied.

BP 16.18 Tue 17:00 Poster D

Stretching of a DNA/HU-protein complex in SMD simulations — •Carsten Olbrich and Ulrich Kleinekathöfer — International University Bremen (Jacobs University Bremen as of spring 2007), Campus Ring 1, 28759 Bremen, Germany

HU is a member of a family of prokaryotic proteins that interact with the DNA in a non-specific way. Its major function is the binding, compaction and stabilization of DNA. We applied steered molecular dynamic (SMD) simulations to DNA which is bonded to a HU protein and present some results in comparison with experiments done with optical tweezers. These show discrete steps during disruption. The goal is to analyze in detail these steps with the help of MD simulations.

BP 16.19 Tue 17:00 Poster D

Solution Behavior of Semiconductor-Binding Peptides — •Stefan Schnabel[1], Simon Mitternacht[2], Michael Bachmann[1,2], Anders Irbäck[2], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, University of Leipzig — [2]Complex Systems Division, Lund University, Sweden

Recent experiments have identified peptides with adhesion affinity for GaAs and Si surfaces. Here we use all-atom Monte Carlo (MC) simulations with implicit solvent to investigate the behavior in aqueous solution for four such peptides, all with 12 residues. At room temperature, we observe that all the four peptides are largely unstructured, which is consistent with experimental data. At the same time, it turns out that one of the peptides is structurally different and more flexible, compared to the others. This finding points at structural differences as a possible explanation for varying adhesion properties of the four peptides. An experimental test of this hypothesis is proposed.

BP 16.20 Tue 17:00 Poster D

Particle image correlation spectroscopy (PICS) — •Stefan Semrau and Thomas Schmidt — Physics of life processes, Leiden institute of physics, Leiden university, The Netherlands

Single-particle tracking (SPT) and image correlation microscopy (ICM) have been proven to be powerful tools for the investigation of local inhomogeneities in biological systems. Driven by recent discussions on the refinement of the classical fluid-mosaic model of the plasma membrane both tools were applied to elucidate the contribution of lipid organization and protein interactions to the behavior of signaling molecules. To overcome the drawbacks of both SPT and ICM we have developed an analysis tool that combines both techniques and resolves correlations on the nanometer length and millisecond time scale (Semrau and Schmidt, Biophys. J., Vol. 92, 2007). This tool, adapted from methods of spatiotemporal image correlation spectroscopy, exploits the high positional accuracy of single-particle tracking. While conventional tracking methods break down if multiple particle trajectories intersect, our method works for arbitrarily large molecule densities and diffusion coefficients as long as individual molecules can be identified. It is computationally cheap and robust and requires no a priori knowledge about the dynamical coefficients. We demonstrate the validity of the method by Monte Carlo simulations and by application to single-molecule tracking data of membrane-anchored proteins in live cells. The results faithfully reproduce those obtained by conventional tracking: upon activation, a fraction of the small GTP-ase H-Ras is confined to domains of < 200 nm diameter.

BP 16.21 Tue 17:00 Poster D

Single molecule microscopy using focal plane illumination — •Jörg Ritter, Werner Wendler, and Ulrich Kubitscheck — Institute of Physical and Theoretical Chemistry, Bonn, Germany

Single molecule fluorescence microscopy performed in spatially extended samples severely suffers from a high fluorescence background. To overcome this problem we used a focal plane instead of the conventional epi-illumination. By means of a custom made cylindrical lens system (NA 0.33) we created a light sheet with a Rayleigh length of 37 μm, a FWHM width of 8.3 μm, and a FWHM thickness of 2 μm within the object plane of a detection objective lens. In this manner a simple optical sectioning microscope was created (Voie et al., 1993). The light sheet was produced inside a water chamber, where the sample was fixed within an agarose gel cylinder on a micrometer stage (Huisken et al., 2004). Fluorescence light was detected perpendicular to the illumination plane by a water-dipping microscope objective lens (60X, NA 1.0) and imaged onto an EMCCD. Only the plane of interest was illuminated and affected by photobleaching. Movement of the stage allowed the acquisition of 3D image stacks. Excitation in the focal plane only resulted in a striking reduction of fluorescence background. The axial resolution was determined by the light sheet thickness and the resolving power of the detection objective lens, and was determined as 1.35 μm FWHM at 680 nm (theoretical expectation, 1.17 μm). The penetration depth of the optical sectioning was limited by the working distance of the water-dipping microscope objective (2.5 mm).

BP 16.22 Tue 17:00 Poster D

Intranuclear dynamics of single mRNA molecules in living C. tentans salivary gland cell nuclei — •Roman Veith, Jan-Peter Siebrasse, and Ulrich Kubitscheck — Institute of Physical and Theoretical Chemistry, Bonn, Germany

The salivary glands of the dipteran Chironomus tentans provide an elegant model system for the analysis of specific messenger ribonucleoprotein particles, the Balbiani Ring (BR) mRNPs. BR mRNPs contain long RNA transcripts of roughly 35-40 kb in size, which possess a highly repetitive sequence. The diameter of the granular BR mRNPs is about 50 nm. Transcription and splicing of the BR mRNA and the formation of the BR particles was genetically and biochemically thoroughly investigated, and in several recent studies their intranuclear localisation in fixed glands was visualized by electron microscopy. However, up to now little was known about the intranuclear dynamics and mobility of the BR mRNPs. We analysed the intranuclear motions of BR particles in real-time by single particle tracking of fluorescence labelled BR mRNPs in living cell nuclei. Labelling was achieved in situ by nuclear microinjection of Cy5-conjugated oligonucleotides, which were complementary to the highly repetitive sequence on the BR mRNA. This approach generated fluorescent RNPs in vivo. Injection of control oligos and application of DRB proved that the labelling was specific. Using high speed single-molecule microscopy we analysed the intranuclear movements of the particles, and compared it to various model particles such as fluorescent microbeads, quantum dots and fluorescent dextrans.

BP 16.23 Tue 17:00 Poster D

Coarse-grained simulation studies of peptide-induced pore formation — •Gregoria Illya and Markus Deserno — Max Planck Institute for Polymer Research, Mainz, Germany

The interactions of cell membrane and antimicrobial peptides, which are amphiphilic molecules, can be very complicated. In the low concentration phase, antimicrobial peptides adsorb to the surface of the membrane, while in the high concentration phase, they insert across the membrane, resulting in the formation of pores. Despite being intensively studied experimentally, the mechanism of pore formation and its structure are remain disputed.

We investigate the interactions between lipid bilayers and amphiphilic peptides using a solvent free coarse-grained simulation technique. In our model, each lipid is represented by a 'hydrophilic' bead and three 'hydrophobic' beads. The amphiphilic peptide is modelled as a 'hydrophobic-hydrophilic' tube with 'hydrophilic' sites at the tube's ends.

It is observed that as the attractive interaction between peptides and lipids is successively increased, the preferred state of the peptide changes from desorbed to adsorbed to inserted. We show how several peptides which bind to the membrane surface cooperatively insert and subsequently induce the formation of pores.

BP 16.24 Tue 17:00 Poster D

Detecting lipid bilayer formation and expansion by a microfabricated cantilever array — Ioana Pera and •Jürgen Fritz — International University Bremen, D-28759, Bremen, Germany (Jacobs University Bremen, as of Spring 2007)

Biological applications of cantilever array sensors focus mainly on the detection of nucleic acids or proteins. We want to apply cantilever array sensors to the investigation of mechanical properties of lipid bilayers. Supported lipid bilayers formed on solid surfaces are model systems for cellular membranes and are often used as biosensor coatings. The investigation of mechanical properties of cellular membranes, e.g. their fluidity, rigidity, stretching and bending, can give novel insights into biological processes such as cell adhesion, exocytosis, or initiation of viral infection [1].

Here we report on lipid bilayer formation on the surface of microfabricated cantilevers and the related surface functionalizations [2]. Bilayer formation by vesicle fusion on top of cantilevers resulted in different bending strengths (between several 10 nm to several 100 nm) and bending directions (tensile or compressive) of the cantilevers. The bending depended mainly on the surface on which the bilayers were formed, i.e. if they were physisorbed on the silicon oxide or chemisorbed on the gold surface of cantilevers. First experiments on further modification of bilayers with the pore forming peptide melittin will be discussed.

[1] H.T. McMahon, J.L. Gallop, Nature 438 (2005) 590.

[2] J. Fritz, I. Pera, Langmuir 2006 (web release 09-Dec-2006).

BP 16.25 Tue 17:00 Poster D

Toxicologic impact of Carbon Nanotubes on Caco-2 cells — •Heike Kreher, Claus-Michael Lehr, and Marc Schneider — Universität des Saarlandes, Biopharmazie und Pharmazeutische Technologie, Campus Saarbrücken, Geb. A4 1 Postfach 151150, D-66041 Saarbrücken, Deutschland

Nanoparticles with most interesting properties for scientists and industry are Carbon Nanotubes (CNTs) which are stronger than steel at only 1/6th the weight and have higher current density than copper. For this reason CNTs are manufactured in a huge amount. In addition CNTs are produced in diesel engines of cars and in combusters. Thus it appears that humans are already exposed to CNTs in the air and it is important to know how these particles affect pulmonary cells and intestinal cells in terms of acute and long-term toxicity. After imaging of dispersed CNTs, we tested their influence in vitro on Caco-2 cells, which have morphological and biochemical similarity to the small intestinal columnar epithelium. We used standard assays to investigate the viability and the cytotoxicity respectively (LDH- and MTT-assays). Another important parameter, when considering the interaction of materials with epithelial layers is the barrier function itself. This was tested measuring the electrical resistance across the barrier (TEER values). To perform the tests, CNTs were suspended in medium in different concentrations and then the solutions were sonicated for 3 minutes. LDH test did not show any disturbance of the membrane integrity of the cells. Whereas MTT test showed a slight toxicity with increasing CNT concentration.

BP 16.26 Tue 17:00 Poster D

Biofilm adsorption on structured substrates — •Hubert Mantz[1], Christoph Gilow[1], Anthony Quinn[1], Karin Jacobs[1], Markus Bellion[2], and Ludger Santen[2] — [1]Saarland University, Experimental Physics, D-66041 Saarbrücken, Germany — [2]Saarland University, Theoretical Physics, D-66041 Saarbrücken, Germany

The aim of this experimental study is to shed light on the mechanism of biofilm adsorption. The behavior of biomolecules at surfaces plays a fundamental role in a number of areas (e.g. the interaction between implant materials and human tissue) as structure of a protein is often closely related to its function.

Among a number of other factors, the complex process of protein adsorption is determined by surface properties. As a model system, a combination of structured substrates was used to isolate the contribution of different parameters (chemical composition, roughness, surface charge ...).

The adsorption kinetics of some proteins (amylase, lysozyme, albumin), as measured by in situ-ellipsometry have been compared to other techniques such as surface plasmon resonance and surface probe microscopy measurements.

The results have also been compared to Monte Carlo simulations, assuming conformational changes of the proteins with increasing surface coverage. Our results will be useful for the design of special (non-) adhesive biointerfaces.

BP 16.27 Tue 17:00 Poster D

Brownian dynamics of rods in a crowded environment — •Tobias Munk, Felix Höfling, Erwin Frey, and Thomas Franosch — Arnold-Sommerfeld-Center und CeNS, Ludwig-Maximilians-Universität München, Theresienstraße 37, 80333 München

Molecular crowding in the cell provides a heterogeneous, randomly structured medium. The properties of this environment strongly influence the diffusion of proteins and stiff polymers.

We have developed a theoretical model that mimics the essentials of this motion: A single spherical or rod-like object moves through a fixed array of hard-core obstacles. By means of Brownian dynamics simulations, we investigate the dynamics of the overdamped motion over nine decades in time and compare to a purely ballistic motion. For rods, interesting phenomena occur due to anisotropic friction and the coupling of rotational and translational degrees of freedom. In particular, we analyze predictions of the tube model.

BP 16.28 Tue 17:00 Poster D

Bacteriophage HK97 studied by nanoindentation — •Wouter H. Roos[1], Irena L. Ivanovska[1], John E. Johnson[2], and Gijs J. L. Wuite[1] — [1]Fysica van complexe systemen, Vrije Universiteit, 1081 HV Amsterdam, Niederlande — [2]Molecular biology, Scripps Research institute, La Jolla, CA, U.S.A.

After procapsids of bacteriophage HK97 have self-assembled, they ma-

ture and subsequently package dsDNA. The maturation process is accompanied by an expansion of the capsid, together with a crosslinking of the capsid proteins. We perform nanoindentation experiments using atomic force microscopy to probe the elastic properties of the HK97 shells at different states of maturation. We also determine the breaking force, i.e. the minimum force which is needed to deform the shell irreversibly.

BP 16.29 Tue 17:00 Poster D

Force generation in a filopodia model system — •Simone Köhler[1], Mireille Claessens[1], Michael Schleicher[2], and Andreas Bausch[1] — [1]TUM Physik Department E22, James Franck Straße, D-85747 Garching — [2]LMU Institute for Cell Biology, Schillerstraße, D-80336 München

Formins are multi-domain proteins with a highly conserved formin-homology domain 2, that can nucleate actin filaments from monomers alone and may even trigger filament growth by a processive capping mechanism. A formin of the slime mould *Dictyostelium discoideum*, dDia2, has been shown to be important for the formation, elongation and maintenance of filopodia. Fascin, an actin-bundling protein is essential for filopodial protrusion, too. For further understanding the interaction of these two proteins *in vitro* experiments have to be done.

We study the role of fascin on assembly rates and force generation by dDia2-induced actin polymerisation using total internal reflection fluorescence microscopy (TIRFM) as well as an *in vitro* motility assay. In the motility assay the force generated by actin polymerisation can be used to propell formin coated beads in a medium containing only purified proteins while TIRFM allows to follow the polymerisation of single actin filaments from dDia2 immobilized on a surface.

BP 16.30 Tue 17:00 Poster D

Ex-situ measurements of adsorbed protein layers — •Christof Weitenberg, Hubert Mantz, and Karin Jacobs — Saarland University, Experimental Physics, D-66041 Saarbrücken, Germany

Measurements of biological tissue are usually done in situ, i.e. in solution. We investigated the possibility of an ex-situ determination of the thickness of lysozyme protein layers adsorbed to silicon oxide surfaces by means of ellipsometry. The expected shape of the adsorption kinetics and isotherms for different ionic strengths could be reproduced. Yet the time scale for adsorption appears to be much larger than for comparable in-situ measurements. We discuss the possible explanations for this behavior as well as assets and drawbacks of the applied ex-situ procedure.

BP 16.31 Tue 17:00 Poster D

Polymers in external fields — •Christian Sendner and Roland Netz — TU Muenchen, Physik Department, 85748 Garching

The dynamical response of polymers to external fields at finite temperature is investigated. We explicitly take hydrodynamic interactions in the limit of zero Reynolds number into account. The response of grafted DNA chains to alternating electric fields is examined, addressing important parameters like the bending rigidity. Terminally attached ligands change the dynamics of that system leading to possible biosensing applications [1]. In another project we analyze the influence of a solid–liquid interface on stiff polymers, driven parallel to the surface. This leads to a preferred orientation of the rod with respect to the wall, and gives rise to an effective repulsion away from the surface. We give scaling results for this long ranged repulsion in the high temperature limit. This purely hydrodynamic effect could lead to desorption transitions for short polymer chains which could be important for applications in the field of DNA chips.

[1] C. Sendner, Y.W. Kim, U. Rant, K. Arinaga, M. Tornow, and R. R. Netz, Phys. Stat. Sol. (a) 203 (14), 3476-3491 (2006)

BP 16.32 Tue 17:00 Poster D

Influence of spacer length and density on the vertical structures of supported membranes studied by neutron reflectivity — •Peter Seitz[1], Oliver Purrucker[2], Anton Förtig[3], Raimund Gleixner[4], Giovanna Fragneto[5], Rainer Jordan[3], and Motomu Tanaka[1,2] — [1]Physikalisch-Chemisches Institut, Universität Heidelberg, Germany — [2]Physik-Department E22, Technische Universität München, Germany — [3]Institut für Technische Chemie, Technische Universität München, Germany — [4]Max Planck Institute of Biochemistry, Martinsried, Germany — [5]Institut Laue-Langevin, Grenoble, France

We studied the structure of a new class of polymer-supported membranes, which are separated from the solid substrate via poly(2-methyl-2-oxazoline) spacers of defined length, functionalized with a surface coupling group and hydrophobic membrane anchors. The proximal leaflet was deposited via Langmuir-Blodgett transfer, followed by vesicle fusion to deposit the distal layer. Precise control of the polymer chain length and its lateral density enables the quantitative adjustment of the thickness and the viscosity of the polymer interlayer. Previously, we measured the membrane-substrate distance with fluorescence interference contrast microscopy (FLIC). To gain a deeper insight to the vertical structure of the membrane, we conducted specular neutron reflectivity experiments under a systematic variation of the spacer length and density, and calculated the static roughness and the volume fraction of water in the polymer interlayer.

BP 16.33 Tue 17:00 Poster D

Persistence length of semiflexible polymers and bending rigidity renormalization — •Petra Gutjahr, Reinhard Lipowsky, and Jan Kierfeld — Max Planck Institute of Colloids and Interfaces, Science Park Golm, 14424 Potsdam, Germany

The persistence length of semiflexible polymers and one-dimensional fluid membranes is obtained from the renormalization of their bending rigidity. The renormalized bending rigidity is calculated using an exact real-space functional renormalization group transformation based on a mapping to the one-dimensional Heisenberg model. The renormalized bending rigidity vanishes exponentially at large length scales and its asymptotic behaviour is used to define the persistence length. For semiflexible polymers, our results agree with definitions based on the asymptotic behaviour of tangent correlation functions. Our definition differs from the one commonly used for fluid membranes, which is based on a perturbative renormalization of the bending rigidity.

BP 16.34 Tue 17:00 Poster D

Exact mean and variance of neuronal subthreshold voltage fluctuations driven by shot noise — •Lars Wolff and Benjamin Lindner — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Neurons are subject to a vast number of synaptic inputs from as many as tens of thousands of other cells. These inputs consist of spikes changing the conductivity of the target cell, i.e. they enter the neural dynamics as multiplicative shot noise. Up to now, only for simplified models like current-based (additive-noise) point neurons or models with Gaussian white noise input, exact solutions are available. We will present a method to calculate the exact time-dependent mean and variance for the voltage of a point neuron with conductance-based Poissonian shot noise and a passive membrane. The exact solutions show novel features (for instance, maxima of the moments vs time) and are in excellent agreement with numerical simulations. The theoretical analysis of subthreshold membrane fluctuations may contribute to a better comprehension of neural noise in general. It may also help devising schemes for the extraction of synaptic parameters or network parameters from voltage recordings.

BP 16.35 Tue 17:00 Poster D

Cellular Potts Model based simulation of endothelial network formation — •Martin Peglow and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

The Cellular Potts Model is a cell centered based Monte Carlo approach to development biology, focusing on intercellular adhesion forces. In an early stage of embryogenesis the capillary network, the first organ in vertebrates, is built to supply other tissues with oxygen and nutrients. Cells beeing self organized, there has to be a cell communication system which can describe the underlying mechanisms of vaculogenesis and angiogenesis. We study a theoretical model that describes chemotactic diffusion of growth factors, which are produced by autocrine cells and decay within the extracellular matrix. For a better understanding of this process, which has already been shown in vitro, we studied the influence of different strengths of a contact inhibited mechanism on the structure and shape of the network in 2d and 3d. Contact inhibition here means that chemotactic filopodia were supressed at cell-cell interfaces.

BP 16.36 Tue 17:00 Poster D

Remodelling of an arteriovenous vascular network during tumor growth and simulation of drug flow: A theoretical model — •Michael Welter and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

Tumor acquire sufficient oxygen and nutrient supply by coopting host vessels and neovasculature created via angiogenesis, thereby transforming a highly ordered network into chaotic heterogenous tumor specific vasculature. Vessel regression inside the tumor leads to large regions of necrotic tissue interspersed with isolated surviving vessels. A theoretical model is presented that captures these features in agreement with data from human melanoma. Extending our earlier work [K. Bartha and H. Rieger, J. Theor. Biol. 241, 903 (2006)] emphasis is put on realistic modeling of the vascular system by incorporating a stochastically grown hierarchical arteriovenous network, Fahraeus-Lindqvist and phase separation effects and refined tissue oxygen level computation. The irregularity of tumor vasculature has drastic effects upon potential drug delivery, therefore we also present results of simulations of a tracer substance flowing through the remodeled network.

BP 16.37 Tue 17:00 Poster D

Beitrag abgesagt — •XXX XXX —

BP 16.38 Tue 17:00 Poster D

Shift-Twist-Symmetry and pattern formation in the visual cortex — •Wolfgang Keil[1], Michael Schnabel[1,2], and Fred Wolf[1] — [1]Max-Planck-Institut for Dynamics and Self-Organization, Göttingen, D-37073 — [2]Bernstein Center for Computational Neuroscience, Göttingen

Neurons in the primary visual cortex preferentially respond to visual stimuli of a particular orientation. Across the cortex, these orientation preferences are arranged in quasiperiodic 2-D patterns, known as orientation maps. Biologically plausible symmetry assumptions have been used successfully to derive a theoretical model which accounts for the emergence of such patterns [1].

Recent measurements have revealed anisotropic coupling statistics in the underlying neural tissue [2], which require the reduction of symmetry in the original model. We discuss consequences of the remaining symmetry (shift-twist-symmetry) in pattern-formation models of the visual cortex. Focussing on the influence of linear and quadratic shift-twist-symmetric coupling terms in the corresponding amplitude equations, the attractors of the dynamics and their stability ranges are calculated. Statistical properties of the spatial arrangement of the emergent structures are compared with recent measurements in tree-shrews. Including additional linear terms improves the agreement with the data. The data exhibits significant signatures of higher-order statistics which are still to be explained by theoretical models.

[1] F. Wolf. Phys. Rev. Lett., 95,208701 (2005)
[2] W.H. Bosking, J. Neurosci., 17, 2112 (1997)

BP 16.39 Tue 17:00 Poster D

Detection of Coupling Directions in Multivariate Dynamical Systems with Applications to Tremor-Correlated Spike Activity in Parkinson's Disease — •Bjoern Schelter[1], Kathrin Henschel[1], Florian Amtage[2], Jan Vesper[3], Bernhard Hellwig[2], Carl Hermann Luecking[2], and Jens Timmer[1] — [1]FDM, Center for Data Analysis and Modeling, University of Freiburg, Germany — [2]Dpt. of Neurology and Neurophysiology, Neurozentrum, University of Freiburg, Germany — [3]Dpt. of Stereotactic Neurosurgery, Neurozentrum, University of Freiburg, Germany

Tremor in Parkinson's disease is a neurological disorder that manifests itself in involuntary oscillations of the upper limbs at a frequency of approximately 5 Hz. The aim of this study was to investigate the relation between tremor and spike activity in the subthalamic nucleus (STN) of patients with Parkinson's disease.

Data were obtained during stereotactic surgery on patients with Parkinson tremor. Muscular and neuronal spike activity was recorded simultaneously. Multivariate analysis techniques were applied to infer the underlying interdependence structure with particular emphasize on distinguishing direct and indirect interdependencies as well as the direction of the information flow. The techniques were successfully applied and our results support the hypothesis that synchronous neuronal activity in the STN contributes to the pathogenesis of Parkinsonian tremor.

BP 16.40 Tue 17:00 Poster D

Protein Adsorption kinetics monitored via SPR — •Hendrik Hähl, Hubert Mantz, and Karin Jacobs — Saarland University, Experimental Physics, D-66041 Saarbrücken, Germany

The formation of protein layers on solid surfaces plays an important role in many biological processes. In our studies we focus on the adsorption of human saliva proteins. In the oral cavity, some of them can act as a medium for bacteria. The aim is to test the influence of the different contributions of the surface potential on the protein adsorption process.

Former investigations showed that the adsorption kinetics exhibits a different behaviour for different long-range van-der-Waals interactions (cf contribution of H. Mantz et al.). Now the influence of the short-range forces should also be tested.

By covering thin gold layers with self assembled monolayers of thiols with different headgroups, it is possible to tune the short-range forces acting on the adsorbing proteins. The growth of the protein layer is monitored via surface plasmon resonance. By the shift of the minimum in the reflectivity curves the thickness of the adsorbed layer can be measured. In combination with imaging ellipsometry this gives us major advantages in comparison with commercially available setups, e.g. the layer thicknesses can be compared directly.

BP 16.41 Tue 17:00 Poster D

Photobleaching in two-photon scanning fluorescence correlation spectroscopy — •Zdeněk Petrášek and Petra Schwille — Biotechnologisches Zentrum, Institut für Biophysik, TU Dresden

Two-photon Fluorescence Correlation Spectroscopy (FCS) takes advantage of the excitation being sufficiently localized, so that no confocal arrangement using a pinhole is necessary to create a well confined measurement volume. Although two-photon FCS has all the advantages well known from two-photon microscopy, signal-to-noise ratios lower than with one-photon excitation are usually achieved, a fact commonly attributed to optical saturation and photobleaching.

Scanning FCS (sFCS) combines the standard FCS with relative movement of the sample and the excitation beam. Although the information about diffusion kinetics is partially lost by scanning, sFCS can provide useful information on the role of photobleaching and saturation at high excitation intensities.

The measurements with circular-scanning sFCS indicate that photobleaching is the major factor responsible for the effects encountered at high excitation intensities, such as apparently shorter diffusion times and decrease of the autocorrelation amplitude $g(0)$. Furthermore, sFCS reduces these effects and extends the range of excitation intensities where $g(0)$ is not affected by photobleaching, thus allowing measurements at higher molecular brightness and S/N ratio.

Numerical calculations show that photobleaching alone can explain the observed decrease of $g(0)$ and lower than expected fluorescence, without the need to consider saturation effects.

BP 16.42 Tue 17:00 Poster D

Mimicking E-cadherin mediated cell adhesion with synthetic lipid membranes — •Susanne Fenz and Kheya Sengupta — Institute of Bio- and Nanosystems 4: Biomechanics, Research Center Jülich, D-52425 Jülich, Germany

Mobility of cell adhesion molecules on the cell surface plays an important role in the formation of cell-cell adhesion. In order to distinguish active transport from passive diffusion we set up a biomimetic system. A supported bilayer decorated with the extracellular domain of the homophilic cell adhesion molecule E-cadherin (E-cad) mimics the surface of one cell and a vesicle that also exhibits E-cad acts as the other cell. The adhesion process is observed with reflection interference contrast microscopy (RICM) which enables us to reconstruct shape and fluctuations of the membrane. From these data membrane tension and adhesion energies can be calculated. We found that E-cad induced strong binding of the vesicle indicated by an increase of the adhesion energy and strong reduction of the fluctuations of the vesicles' membrane as compared to a negative control. Simultaneously we measured the change in the diffusion constant in the plane of the bilayer following adhesion of vesicles as a function of the adhesion strength.

BP 16.43 Tue 17:00 Poster D

Growth dependent alterations of the energy metabolism in neuronal cell cultures — •Jiraporn Luengviriya[1], Thomas Mair[1], Carina Helemeke[2], Katharina Braun[2], and Stefan C. Müller[1] — [1]Otto-von-Guericke-Universtität Magdeburg, Institut für Experimentelle Physik, Abteilung Biophysik, Universitätsplatz 2, 39106 Magdeburg, Germany — [2]Otto-von-Guericke-Universtität Magdeburg, Institut für Biologie, Lehrstuhl für Zoologie/Entwicklungsbiologie, Brenneckestr.6, 39118 Magdeburg, Germany

Glycolysis is an essential pathway of the energy metabolism in astrocytes which supplies energy-rich intermediates for neurons, via the so

called lactate shuttle, in order to maintain the energy fuel of neurons. We investigated the energy state of cell cultures from the hippocampus of new born rats as a function of their growth state by spatiotemporal recordings of NAD(P)H-fluorescence. We stimulated the cells by local application of different chemicals and found, that cyanid inhibition of respiration leads to a pronounced increase of NAD(P)H fluorescence. This response was growth dependent and increased until about 15 days. Thereafter it decreased again. With the neurotransmitter NMDA as stimulus, we found also an increase of NAD(P)H-fluorescence, but now with 2 optima. The first one between day 6 and 12 and a second one between days 17 to 24. At the optimum of cyanid stimulation there was no response of the cellular NAD(P)H to NMDA. We interpret these data such, that there is a switch between glycolytic and respiratory energy metabolism during growth of these cells.

BP 16.44 Tue 17:00 Poster D

FRAP-Analysis of Protein Exchange Dynamics in Focal Adhesion Sites — •Christoph Möhl, Simone Born, Claudia Schäfer, Bernd Hoffmann, and Rudolf Merkel — Research Center Jülich GmbH, 52425 Jülich, Germany

Cell adhesion is an essential process for tissue integrity and cell movement. The adhesion process itself depends on clustered protein complexes called focal adhesion sites. These adhesion sites form a connection between the extracellular matrix and the actin cytoskeleton. Focal adhesions are characterized by a specific set of proteins such as integrins, regulatory kinases or proteins like vinculin, zyxin and VASP, bridging the integrins to actin fibers. In addition, focal adhesion sites can adapt in size and shape to cellular growth conditions. Thus, formation and release of focal adhesion sites are highly dynamic processes in moving cells but barely detectable when a cell is stationary. If various proteins additionally exchange in stable adhesion sites, and if such putative protein exchange dynamics goes along with the variable formation dynamics of whole adhesion sites is barely known.

Here, we present the analysis of protein exchange kinetics in focal adhesion sites of migrating and stationary cells by fluorescence recovery after photobleaching (FRAP). Experiments were performed with the GFP-labelled adhesion proteins vinculin, zyxin and VASP. The fluorescent label allowed the photobleaching of these proteins at distinct sites using a laser. By measuring the fluorescence recovery in the bleached area over time, we were able to examine significant differences between stable and dynamic adhesion sites.

BP 16.45 Tue 17:00 Poster D

Stochastic description of time delayed feedback oscillators — •Luis G. Morelli and Frank Jülicher — Max Planck Institute for the Physics of Complex Systems

Many cellular processes are regulated or driven by genetic oscillators, as in circadian clocks, the cell cycle, and patterning developing embryos. Due to the stochastic nature of gene expression, the period of such oscillations is subject to fluctuations. The precision of the oscillator can be characterized by the quality factor. We study the precision of genetic oscillators in a generic stochastic feedback system. We include the effects of amplification noise, arising for example from bursts of transcription and translation. We show that high quality is possible for certain parameter ranges even when the number of molecules is low and amplitude fluctuations are large.

BP 16.46 Tue 17:00 Poster D

Cooperativity of Integrin-mediated Adhesion on Nanopatterned Substrates — •Christine Selhuber[1,2], Thorsten Erdmann[3], Ulrich Schwarz[3], Horst Kessler[4], and Joachim Spatz[1,2] — [1]Universität Heidelberg, Physikalisch-Chemisches Institut — [2]Max-Planck-Institut für Metallforschung, Abteilung "Neue Materialien und Biophysik" — [3]Universität Heidelberg, BIOMS — [4]Technische Universität München, Department Chemie

Surfaces of defined adhesion properties are required for a physical and quantitative understanding of cell adhesion in vivo. In this work, biofunctional nanopatterns are employed, which allow adhesion ligands to be positioned in a quasi-hexagonal lattice. Such nanopatterns are used to investigate integrin-mediated cell adhesion, which is a highly complex biological process and essential for numerous cell functions. With nanopatterns the distance between adjacent single integrin binding sites is precisely defined. Recent cell culture experiments have revealed that this distance strongly affects cell adhesion and the formation of adhesion clusters, known as focal contacts. To quantify the adhesion cluster formation for different integrin binding site spacings, cell adhesion forces were studied using atomic force microscopy (AFM). The experiments demonstrate that an integrin binding site spacing of 70 nm and more prevents the cooperative formation of early adhesion clusters in initial adhesion. In long-term adhesion studies, after several hours of cell adhesion, it turned out that focal contact formation cooperatively increases the local adhesion strength. The obtained results were related to theoretical models on adhesion cluster stability.

BP 16.47 Tue 17:00 Poster D

Nonlinear Elasticity of Entangled Actin Networks — •Christine Semmrich[1], Klaus Kroy[2,3], and Andreas Bausch[1] — [1]Lehrstuhl für Biophysik E22, TU München, Deutschland — [2]Institut für Theoretische Physik, Universität Leipzig, Deutschland — [3]Hahn-Meitner-Institut, Berlin, Deutschland

The strain hardening of crosslinked actin networks is currently attracting lots of attention as a paradigm for essential mechanical properties of living cells. The elasticity of such crosslinked networks can vary by more than one order of magnitude in dependence of the applied stress. This has been attributed to the nonlinear mechanical behaviour of single filaments. In contrast, the mechanical response of purely entangled actin is often reported to be shear thinning. By means of different rheological approaches we are able to investigate the nonlinear response of purely entangled actin networks. Interestingly, under standard conditions a strain hardening occurs below a critical temperature while above this critical temperature strain softening is reported. Moreover, this transition is highly dependent on the buffer salt concentration. We suggest a simple theoretical model based on the interaction potential between single actin filaments including temperature and salt dependent effects to rationalize this behaviour.

BP 16.48 Tue 17:00 Poster D

Driven transport through channels: Interaction effects — •Martin Körner[1], Mario Einax[1], Philipp Maass[1], and Abraham Nitzan[2] — [1]Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany — [2]School of Chemistry, The Sackler University of Science, Tel Aviv University, Tel Aviv 69978, Israel

Ionic transport through biological membranes is often modelled by one-dimensional hopping processes between binding sites supplied by a channel protein. This leads to a theoretical description in terms of a bridge that connects two particle reservoirs at different chemical potentials and along which particles can be transported by nearest neighbour hopping processes between sites at different energy levels. Using Monte-Carlo simulations, numerical solutions of the underlying master equation and analytical approximation methods, we study the current-voltage characteristics, current fluctuations and correlation effects in dependence of the chemical potential difference between the reservoirs. In particular the influence of the inhomogeneity of site energies and of the interactions between the particles is discussed.

BP 16.49 Tue 17:00 Poster D

Dynamic light scattering of F-actin solutions — •Jens Glaser and Klaus Kroy — Inst. f. Theoretische Physik, Universität Leipzig, PF 100920, 04009 Leipzig

A network of the semiflexible polymer actin forms an integral part of the eucaryotic cell's cytoskeleton. Structural properties of F-actin solutions can be determined by dynamic light scattering (DLS). While the method is usually successfully applied to determine the size of flexible polymers, a consistent determination of the persistence length of actin has not yet been achieved.

We report measurements of the persistence length by a comprehensive analysis of DLS data, which are in agreement with values obtained by different techniques for unstabilized actin filaments. Collective effects of F-actin networks are also analyzed and they give estimates e.g. of the tube diameter of the filaments which confirm current predictions of the tube model of semiflexible polymers.

BP 16.50 Tue 17:00 Poster D

Untersuchungen tiefenaufgelöster elektrischer Eigenschaften im Kortex von Mongolischen Wüstenrennmäusen — M. Kruse[1], M. Deliano[2], H. Witte[1], F.W. Ohl[2], •A. Reiher[1], A. Krtschil[1] und A. Krost[1] — [1]Inst. Exp. Physik, Uni Magdeburg, 39016 Magdeburg — [2]Leibniz Institut für Neurobiologie, 39008 Magdeburg

Biomedizinisch motivierte Untersuchungen der Stromquellendichte-Verteilung im Gehirn gehen von einer isotropen Verteilung der Leitfähigkeit im Gewebe aus. Diese Annahme ist mit großer Wahrscheinlichkeit falsch; aufgrund des geschichteten Aufbaus des Kortex

ist eine Variation der tangentialen und der radialen Leitfähigkeit zu erwarten. Deshalb wurden im rechten primären auditorischen Kortex von Mongolischen Wüstenrennmäusen tiefenaufgelöste impedanzspektroskopische Untersuchungen vorgenommen. Dabei wurden drei 50μ m dicke Wolframdrähte als Elektroden benutzt, die in tangentialer Richtung jeweils 200μm entfernt waren. Eine Elektrode war 200μm in radialer Richtung verschoben. Durch diese Anordnung kann die räumliche Organisation des Leitfähigkeitstensors durch Triangulation bestimmt werden. Es wurden Impedanzmessungen (20Hz und 1MHz) mit einer örtlichen Tiefenvariation von 30μm aufgenommen. Auf der Grundlage einer intensiven Elektrodencharakterisierung und Analyse der Impedanzspektren wurde ein Ersatzschaltbild zur Identifizierung der Gewebeeigenschaften entworfen. Durch Ableitungsuntersuchungen und histologische Verfahren konnten Änderungen im dielektrischen Verhalten speziellen Schichten zugeordnet werden.

BP 16.51 Tue 17:00 Poster D

Single Molecule Unzipping of Coiled-Coils: The role of neck/hinge interactions for the regulaton of fungal kinesins — •Elisabeth Wasner, Thomas Bornschlögl, and Matthias Rief — Physik Departement E22, Technische Universität München, James-Franck-Straße, 85748 Garching, Germany

A model for the regulation of motor activity in fungal kinesins suggests important amino acid interactions between the hinge and the neck coiled-coil. The hinge sequence follows the neck and shows no specific tertiary structure. It contains an aromatic tryptophan that is strongly conserved among fungal kinesins.

In this AFM experiment, we try to answer the following question: Does the hinge contribute to the stability of the neck in fungal kinesins?

For this reason, three similar proteins were constructed: All of them contain ddFLN 1-5 domains, a well-investigated leucine zipper (based on GCN4-p1) followed by the Neurospora crassa kinesin neck. These constructs dimerize and are crosslinked by a cysteine that replaces the last d-position of the neck coiled-coil. Two of the constructs additionally contain the hinge - in one of it, the hydrophobic tryptophan has been replaced by a hydrophilic glutamine.

The corresponding protein unfolding and refolding force-extension curves can be interpreted by an equilibrium model und therefore the stability profile along the coiled-coil can be read off.

BP 16.52 Tue 17:00 Poster D

Time-Resolved Spectroscopy on Flavoproteins — •Florian Spreitler[1], Astrid Pelzmann[2], Ortwin Meyer[2], and Jürgen Köhler[1] — [1]Experimentalphysik IV and BIMF, Universität Bayreuth, Universitätsstrasse 30, 95447 Bayreuth, Germany — [2]Mikrobiologie, Universität Bayreuth, Universitätsstrasse 30, 95447 Bayreuth, Germany

Flavoproteins are of great importance in nature because they function in several life-sustaining processes, such as cellular respiration, redox biochemistry, purine metabolism and the oxidation of CO. Their common cofactor flavin adenine dinocleotide (FAD), which can be bound in a covalent or non-covalent fashion, is thought to be fine-tuned by the respective protein matrix both in its redox properties and the exposure of certain atoms to the solvent.

Our main objective is to study the fast photophysics of FAD in different enzymes and enzyme mutants on timescales between 1 ps and 10 ns using a streak camera setup. The work will also resolve structure-function relationships of the FAD binding site during catalysis and at different states of reduction.

We are presenting first results from pure FAD in solution and the FAD cofactor of two structurally similar molybdo iron-sulfur flavoproteins, which are the [CuSMoO2] CO dehydrogenase from *Oligotropha carboxidovorans* and the [MoSO2] xanthine oxidase from bovine milk.

BP 16.53 Tue 17:00 Poster D

Investigtion of the first stepsat the CNTF mediated signal transduction by means of fluorescence correlation spectroscopy (FCS) in living cells — •Eva Wallhäusser[1], Felix Neugart[1], Andrea Zappe[1], Deborah Buk[2], Lutz Graeve[2], Carsten Tietz[1], and Jörg Wrachtrupp[1] — [1]3. Physikalisches Institut, Universität Stuttgart, Stuttgart — [2]Institut für Chemische Biologie und Ernährungswissenschaften, Universität Hohenheim, Stuttgart

The investigation of signal transduction in living cells is an important step to understand what is happening in the body during the signal transduction and possibly influence several diseases in the case of a malfunction within the signalling cascade. Due to the tiny concentration of most of the signalling components a very sensitive method like FCS is necessary. In this work the first steps of signal transduction of the cilliary neutrophic factor (CNTF) by the CNTF-receptor complex were investigated. The complex is considered of three components, namely, CNTF-receptor itself, LIF-receptor and gp130. Measuring the diffusion constant of this different GFP-labeled receptors allows us to show if some parts of the receptor are pre-associated.

BP 16.54 Tue 17:00 Poster D

Improving the Functionality of DNA Layers on Gold by Electrically Induced Desorption — •Jelena Knežević[1], Kenji Arinaga[1,2], Ulrich Rant[1], Erika Pringsheim[1], Marc Tornow[1], Shozo Fujita[2], Naoki Yokoyama[2], and Gerhard Abstreiter[1] — [1]Walter Schottky Institut, Technische Universität München, Am Coulombwall 3, 85748 Garching — [2]Fujitsu Laboratories Ltd., 10-1 Morinosato-Wakamiya, Atsugi 243-0197, Japan

Self-assembled DNA layers on solid surfaces have been of great interest and widely introduced to various techniques for bio-molecular investigations. Recently, it has been recognized that the molecular packing density within the DNA layer crucially determines the functionality of the nucleic acids, for instance, the efficiency to hybridize to complementary targets. In this contribution, we describe a novel protocol to adjust the density of oligonucleotide layers by electrical means. At first a densely packed layer is immobilized onto a gold surface, in a second step, a fraction of the DNA molecules are desorbed from the surface by applying a series of electrochemical potentials. By monitoring steric interactions (hindrance) among the nucleic acids within the layer using optical means it is possible to evaluate the packing density in-situ and in real-time. We discuss several parameters which govern the desorption process (desorption potentials, DNA length, competitive adsorbents, etc.) and prove that the method allows a fine-tuning the DNA coverage. Finally, we demonstrate that layers prepared by electro-desorption retain their full bio-functionality by showing that dilute DNA layers exhibit hybridization efficiencies of approx. 100%.

BP 16.55 Tue 17:00 Poster D

How depletion forces affect the organisation and mechanics of actin bundles — •Philipp von Olshausen, Oliver Lieleg, Mireille Claessens, and Andreas Bausch — Lehrstuhl für Biophysik E22, TU München

To organise actin filaments (F-actin) in bundles cells make use of many different types of actin binding proteins (ABPs). In vitro, the bundles' mechanical properties are strongly dependent on ABP type and density. However, in the crowded environment of a cell depletion forces might become important in filaments organisation, since they are known to strongly bundle F-actin. Thus it is an interesting question if cells can use ABPs to tune bundle mechanics and prevent the formation of stiff structures. Different microscopic techniques and an in vitro system of F-actin, ABPs and the depletion agent PEG-6k enable us to shed light on the interplay of specific ABPs and unspecific depletion forces in the process of actin bundling.

BP 16.56 Tue 17:00 Poster D

Electrostatics of DNA complexes with cationic lipids — •Andrey Cherstvy — Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzerstrasse 38, D-01187 Dresden, Germany

We present exact solutions of Poisson-Boltzmann equation for several problems relevant to electrostatics (el) of DNA complexes with cationic lipids [1]. We calculate the el potential and energy for lamellar and inverted hexagonal phases, concentrating on effects of dielectric boundaries. Our results for energy of complexes is in good agreement with known numerical solutions [2]. We calculate compressibility modulus B of lamellar phase and compare it with the experimental data [3]. We suggest a new scaling relation for B as a function of DNA-DNA separation. Also, we treat charge-charge interactions across, along, and in between two low-dielectric membranes. We calculate the strength of el interactions of 1D DNA smectic layers across lipid membrane to treat DNA correlations in neighboring layers in lamellar complexes. We discuss some aspects of 2D DNA condensation and DNA-DNA attraction in DNA-lipid lamellar phase with multivalent cations. We analyze equilibrium DNA-DNA separations in condensed lamellar phase [4] and in 3D DNA condensates [5] using the theory of el interactions of DNA helical charge motifs developed recently [6-8].

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Disordered ocular dominance maps by inter-map coupling — •Lars Reichl[1,2], Siegrid Löwel[3], and Fred Wolf[1,2] — [1]MPI für Dynamik und Selbstorganisation, Göttingen — [2]Bernstein Center for Computational Neuroscience, Göttingen — [3]Friedrich-Schiller-Universität , Jena

In the visual cortex of cats, orientation preference (OP) maps and ocular dominance (OD) maps are spatially irregular. Many models, e.g. [1], predict the formation of spatially periodic cortical maps. Recently it was found that irregular maps can be stabilized by long-range interactions in pattern formation models [2]. Because OD and OP maps are geometrically coupled, we studied whether such a coupling can transfer spatial irregularity from OP to OD maps. To this end we contructed dynamical pattern forming models in which we can continuously vary the strength of the inter-map coupling. The solutions of these models were investigated using coupled amplitude equations for the active Fourier modes of the two patterns. If the coupling enters at seventh order in these equations there is a limit in which the back-reaction of the OD dynamics onto the dynamics of the OP map is negligible. In the uncoupled case, OP maps are pinwheel rich and spatially aperiodic whereas OD maps consist of spatially periodic parallel stripes. Above a critical coupling strength the OD stripe solutions become unstable towards solutions showing a disordered layout. [1] Koulakov, Neuron 29, 519 (2001) [2] Wolf, PRL, 95:208701 (2005) [3] Hübener et al. J. of Neuroscience 17:9270 (1997)

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Floppy modes: low-energy elastic excitations of stiff polymer networks — Claus Heussinger, •Boris Schaefer, and Erwin Frey — Arnold Sommerfeld Center for Theoretical Physics, LMU Muenchen, Theresienstrasse 37, 80333 Muenchen

Stiff polymers, unlike their flexible counterparts, have a highly anisotropic elastic response, where the low-energy elastic excitations are of bending nature, while stretching deformations are energetically highly unfavourable. Based on this scale separation between bending and stretching mode we analyze the elasticity of *networks* of stiff polymers in terms of the "floppy-mode"concept. A floppy mode defines a deformation field that is constructed by requiring polymer end-to-end distances to stay constant during the course of deformation. As a consequence, stretching deformations are avoided and network elasticity is exclusively due to the bending mode. Singular value decomposition of the kinematic matrix is used to construct the orthonormalized set of floppy modes, which may be viewed as the direct analog to the set of vibrational eigenmodes in networks of central force springs.