AKB 60 Membranes and Vesicles

Zeit: Dienstag 16:00–17:45 Raum: TU H2013

AKB 60.1 Di 16:00 TU H2013

Efficient tunable generic model for self-assembling fluid bilayer membranes — •Markus Deserno, Ira R. Cooke, and Kurt Kremer — Max-Planck-Institut für Polymerforschung, Ackermannweg 10, 55128 Mainz

We present a new model for the simulation of generic lipid bilayers in the mesoscopic regime (between a few nanometers and many tens of nanometers), which is very robust, versatile, and extremely efficient, since it avoids the need for an embedding solvent. Based entirely on simple pair potentials, it features a wide region of unassisted self assembly into fluid bilayers without the need for careful parameter tuning. The resulting membranes display the correct continuum elastic behavior with bending constants in the experimentally relevant range. It can be readily used to study events like bilayer fusion, bilayer melting, lipid mixtures, rafts, and protein-bilayer interactions.

AKB 60.2 Di 16:15 TU H2013

Shapes of crystalline domains on spherical vesicles — •Stefanie Schneider and Gerhard Gompper — Institut für Festkörperforschung, Forschungszentrum Jülich, D-52425 Jülich, Germany, Email: st.schneider@fz-juelich.de

The background to this work is the experimental observation of a variety of shapes of the crystalline domains on giant unilamellar vesicles, consisting of two different lipids as well as cholesterol [1]. Understanding these systems is important, because they serve as model systems for the far more complex biological lipid bilayers. Important biological functions, such as endocytosis, cell adhesion, signaling and protein organisation, are attributed to the formation of domains in lipid bilayers.

To further understand the domain formation in these systems, we have investigated crystalline domains of different shapes embedded in spherical fluid vesicles using the elasticity theory and Monte Carlo simulations. The stretching energy, which is necessary to deform an ideal crystalline patch onto the surface of a sphere has been calculated for different shapes of the patch (disc, stripe, and a disc including one disclination). A phase diagram has been constructed in which the equilibrium shapes and number of the patches are related to the Young modulus, the line tension between the fluid and the crystalline phase, and the relative area of the vesicle covered by the crystalline phase.

[1] J.Korlach, P. Schwille, W. Webb, G. Feigenson, Proc. Natl. Acad. Sci. USA, **96**, 8461(1999)

AKB 60.3 Di 16:30 TU H2013

Single- and multicomponent vesicles at finite temperature — •Thomas Gruhn, Gunnar Linke, and Reinhard Lipowsky — MPIKG Golm, D-14424 Potsdam

Vesicles at finite temperature are studied with the help of Monte Carlo simulations. At finite temperature, a vesicle with no volume constraint is preferentially aspherical. The free energy has two minima for prolate and oblate configurations. With increasing pressure difference between in- and outside of the vesicle, it becomes more and more spherical.

For vesicles adhered to a substrate the adhesion area decreases linearly with increasing temperature. This is found in simulation studies of adhered vesicles with and without volume constraints. The results allow to obtain experimentally the bending stiffness and the adhesion strength of an adhered vesicle by measuring the temperature dependence of the adhesion area.

In multicomponent vesicles the formation of domains occur for large enough line tensions. The domains may differ in their mechanical and chemical properties, an effect which allows to mimick specific interactions between cells or between a cell and a substrate. Various examples are presented.

AKB 60.4 Di 16:45 TU H2013

Collective Dynamics of Lipid Membranes studied by Inelastic Neutron Scattering — •Maikel Rheinstädter[1], Tilo Seydel[1], Wolfgang Häussler[2], and Tim Salditt[3] — [1]Institut Laue-Langevin, 6 rue Jules Horowitz, B.P. 156, 38042 Grenoble, France — [2]FRM II, Lichtenbergstrasse 1, 85747 München, Germany — [3]Institut für Röntgenphysik, Geiststrasse 11, 37037 Göttingen, Germany

While most spectroscopic techniques, as e.g. nuclear magnetic resonance or dielectric spectroscopy, are limited to the center of the Brillouin zone and probe the macroscopic response, inelastic neutron and X-ray scattering experiments give the unique access to microscopic dynamics at length scales down to intermolecular distances. Only recently, it has become possible to study collective dynamics of planar lipid bilayers using neutron spectroscopy techniques [1]. We determined the dispersion relations in the gel and in the fluid phases of a DMPC model membrane and could shed light on the evolution of structure and dynamics and the relation between them in the range of the gel-fluid main phase transition. Here, the scattering volume restriction for inelastic neutron experiments was overcome by stacking several thousand highly aligned membrane bilayers. By combining neutron triple-axis, backscattering and spin-echo spectroscopy, we present measurements of short and long wavelength collective fluctuations in biomimetic and biological membranes in a large length and energy range. A recent backscattering study for the first time gave access to the dynamics of the "membrane-water", i.e. the water layer in between the stacked membranes.

[1] M.C. Rheinstädter et al., Phys. Rev. Lett. 93, 108107 (2004).

AKB 60.5 Di 17:00 TU H2013

Chemical Switching of Diblock Copolymer Monolayers at the Interface: Controlling Interactions between Solid Substrates and Biological Matter — •Florian Rehfeldt[1], Kirstin Seidel[1], Roland Steitz[2], Regine v. Klitzing[3], Steven P. Armes[4], Alice P. Gast[5], and Motomu Tanaka[1] — [1]Physik Dept. E22, TU München, James-Franck-Str., 85748 Garching, Germany — [2]HMI Berlin GmbH, BENSC SF1, Glienicker Str. 100, 14109 Berlin, Germany — [3]MPI f. Kolloid u. Grenzflächen, Golm, Germany — [4]Dept. of Chemistry, Univ. of Sheffield, South Yorkshire S3 7HF, UK — [5]Dept. of Chemical Engineering, M. I. T. Cambridge, MA 02139, USA

This study aims at the switching of interfacial interactions between soft, biological matter and planar solid substrates. As a switchable interlayer, a monolayer of (DMAEMA-*b*-MMA)is used. Specular neutron reflectivity experiments at solid/liquid interface demonstrated that the polymer chain conformation (thickness, hydration and surface roughness) can reversibly be switched in physiological environments due to charging and de-charging of the hydrophilic DMAEMA block. As next step, we carried out neutron reflectivity measurements of the polymer film with a supported lipid membrane. Upon pH titration between 5.5 and 8.5, we observe a clear switching in the membrane-substrate distance induced by the change in polymer chain conformation. The obtained results demonstrate that the diblock copolymer coating enables us to fine-tune the surface properties. The system established here suggests a great potential towards mimicking the extracellular matrix (ECM) to regulate the interfacial potential at substrate-membrane interface.

AKB 60.6 Di 17:15 TU H2013

Synchrotrondiffraction studies on solid-supported membranes in a microfluidicenvironment — •Bert Nickel[1], Christian Reich[1], Marion Hochrein[1], Bärbel Krause[2] und Joachim Rädler[1] — [1]Ludwig Maximilians Universität, München — [2]ESRF, Grenoble

We have developed a microfluidic flow chamber allowing for synchrotron diffraction studies of solid supported membranes at the solid liquid interface using x-ray energies of 20 keV. We demonstrate the potential of the method by comparing three standart preparation methods of lipid bilayers: (a) vesicle fusion, (b) solvent exchange, and (c) spin-coating. A complementary characterization of the solid supported lipid bilayer using fluorescence microscopy is possible.

AKB 60.7 Di 17:30 TU H2013

In situ Formation of Polyelectrolyte Multilayer Architectures with Embedded Lipids Studied by Neutron Reflectometry — •Thomas Gutberlet[1], Christophe Delajon[2,3], Rumen Krastev[2,4], and Helmut Möhwald[2] — [1]Paul-Scherrer-Institut, Villigen, Switzerland — [2]Max-Planck-Institut of Colloids and Interfaces, Golm, Germany — [3]ISIS Universite Louis Pasteur, Strasbourg, France — [4]Hahn-Meitner-Institut, Berlin, Germany

Biomimetic surfaces with tailored properties are major object of application oriented biophysical studies. Of particular interest are surface-grafted films of hydrophilic polymers which provide a biomimetic environment for membranes-spanning proteins and lipid-protein membranes.

We have studied the coupling of phospholipids to fully hydrated polymer cushions as potential planar biomimetic model membrane. A DMPC lipid bilayer was supported by polyelectrolyte multilayers (PEM). Positively and negatively charged polymer sample terminations were considered. Using neutron reflectometry it was shown that, whereas positively charged terminated samples did not favour deposition of a lipid layer, negatively charged terminated samples allowed deposition of a lipid bilayer. In the latter case, formation of a PEM on the phospholipid layer was possible and the formation of a polymer/lipid/polymer complex sandwich like structure has been proven. the results will be presented and potential applications discussed.