AKB 2 Membranes: Conformations and Dynamics

Time: Monday 10:30–11:30 Room: ZEU 260

AKB 2.1 Mon 10:30 ZEU 260

Stresses and torques in biological fluid membranes — •Martin Michael Müller[1], Markus Deserno[1], and Jemal Guven[2] — [1]Max Planck Institute for Polymer Research, Ackermannweg 10, D-55128 Mainz, Germany — [2]Instituto de Ciencias Nucleares, UNAM, Apdo. Postal 70-543, 04510 México D.F., Mexico

Forces in fluid membranes can be described with the help of the covariant surface stress tensor, in analogy to classical elasticity theory. Additionally, torques can be written in terms of the surface torque tensor.

In the context of interface mediated interactions, such as the interaction between protein inclusions in a lipid membrane, it has proven advantageous to use this approach: nonlinear expressions for the force and, in some cases, also the sign of the interaction could be derived [1]. The condition of torque balance imposes further restrictions on the solution. Other complications, such as a pressure difference between the two sides of the membrane or a lipid tilt, are readily included in the formalism.

[1] M. M. Müller, M. Deserno, and J. Guven, Europhys. Lett. **69**, 482 (2005).

AKB 2.2 Mon 10:45 ZEU 260

Studying the Curvature Elasticity of Biomembranes Through Numerical Simulations — •VAGELIS HARMANDARIS and MARKUS DESERNO — Max-Planck-Institute for Polymer Research, Ackermannweg 10, D-55128 Mainz, Germany

Biological membranes have been extensively studied in the past using both experimental techniques and simulations [1]. The latter have the advantage of being able to relate the membrane properties with structure and composition at the molecular level. One of the main aspects that can be directly studied this way is the curvature elasticity of membranes. A well known way to do this is from the spectrum of equilibrium membrane fluctuations [2].

Here we propose an alternative methodology for studying the curvature elasticity of membranes. The basic idea is to impose a deformation of the membrane and measure the force required to hold it in the deformed state. We apply this method to a new solvent-free coarse-grained model proposed recently [3]. Specifically we stretch a cylindrical vesicle and measure the force needed for such an extension. Results are presented about the force acting on the stretching cylindrical vesicle, as well as about the bending modulus, and are compared with the predictions from the analysis of the spectrum of equilibrium membrane fluctuations.

\Zitat{1}{Structure and Dynamics of Membranes, R. Lipowsky and E. Sackmann (Eds.), Elsevier, Amsterdam, 1995.} \Zitat{2}{U. Seifert, Adv. Phys. 46, 13 (1997).} \Zitat{3}{I.R. Cooke, K. Kremer and M. Deserno, Phys. Rev. E 72, 011506 (2005).}

AKB 2.3 Mon 11:00 ZEU 260

Collective dynamics of lipid membranes studied by inelastic-neutron scattering — •Maikel C. Rheinstädter[1], Tilo Seydel[1], Wolfgang Häussler[2], and Tim Salditt[3] — [1]Institut Laue-Langevin,B.P. 156,6 rue JulesHorowitz,38042 Grenoble,France — [2]FRM-II,Technische Universität München,85747Garching,Germany — [3]Institut für Röntgenphysik,Friedrich-Hund-Platz1,37077 Göttingen,Germany

While most spectroscopic techniques, as ,e.g., nuclear magnetic resonance or dielectric spectroscopy probe macroscopic responses, neutron and within some restrictions also x-ray scattering experiments give the unique access to microscopic dynamics at length scales of intermolecular distances. Only recently, it has become possible to study collective dynamics, ,i.e., the dispersion relations in the gel and fluid phases of planar lipid bilayers using neutron spectroscopy techniques[1]. By combining neutron three-axis, backscattering and spin-echo spectroscopy, we present measurements of short and long wavelength collective fluctuations in a biological model membrane in a large range in momentum and energy transfer, covering time scales from about 0.1 ps to almost 1 μs and length scales from 3 Å to about 1000 Å. Neutron backscattering technique thereby gives information about molecular dynamics of lipid acyl chains and the water molecules in between the stacked bilayers [2]. The dispersion relation of the long wavelength undulation modes has been determined by quasielastic reflectometry using spin-echo spectrometers.

[1] M.C. Rheinstädter *et al.*, Phys. Rev. Lett. 93, 108107 (2004).
[2] Maikel C. Rheinstädter *et al.*, Phys. Rev. E 71, 061908 (2005).

AKB 2.4 Mon 11:15 ZEU 260

Forced Crumpling of Self-Avoiding Elastic Sheets — •Vliegenthart Gerrit and Gompper Gerhard — IFF, Forschungszentrum Jülich

Thin elastic sheets are important materials across length scales ranging from mesoscopic (polymerized membranes, clay platelets, virus capsids) to macroscopic (paper, metal foils). The crumpling of such sheets by external forces is characterized by the formation of a complex pattern of folds. We have investigated the role of self-avoidance — the fact that the sheets cannot self-intersect — for the crumpling process by computer simulations. The force-compression relations of crumpled sheets for both self-avoiding and phantom sheets are found to obey universal power-law behaviors. However, self-avoiding sheets are much stiffer than phantom sheets, and they develop many more folds. Moreover, self-avoidance is relevant already at very small volume fractions. The fold-length distribution for crumpled sheets is determined and found to be well described by a log-normal distribution. The stiffening due to self-avoidance is reflected in the changing nature of the sheet-to-sheet contacts from line-like to two-dimensionally extended with increasing compression.