BP 33: Posters: Neurobiophysics

Time: Thursday 17:15–20:00 Location: Poster B1

BP 33.1 Thu 17:15 Poster B1

Influence of bilayer substrate fluidity on neuronal growth — •Lydia Woiterski[1], Philipp Rauch[1], Dan Minner[2], Christoph Naumann[2], and Josef Kaes[1] — [1]Universität Leipzig, Germany — [2]Indiana University, Indianapolis, USA

For cell motility it is crucial that cells sense the viscoelasticity of their environment. An important role in this process play focal adhesion complexes where transmembrane proteins of the integrin family bind to proteins of the extracellular matrix or within the cell to the cytoskeleton. Although it is known that the stability of these complexes depends on the stiffness of substrate, the complete mechanism of cell adhesion has not yet been fully understood. A suitable system mimicking the cell surface are tethered bilayers, where the membrane viscosity can be easily modulated by the polymer linker density or the number of bilayer stacks, was established by D. Minner and C. Naumann at the University of Indiana. They showed that the bilayer substrates are stable, have reproducible diffusion properties and that fibroblasts sense the surrounding viscosity of the substrate and change their morphology according to the membrane fluidity. In the present study neuronal cell lines were plated on single tethered bilayers with varied linker density. Preliminary results show that the neurons adhere at all densities but exhibit different dendritic growth - for low bilayer viscosity the growth seems to be faster which is in good agreement with the inverse durotaxis of neurons. This biomimetic system represents a versatile a tool that allows for the quantification of cellular outgrowths, their velocities and can help to understand how these processes form.

BP 33.2 Thu 17:15 Poster B1

Light propagation through the vertebrate retina — •Silke Agte[1,2], Sabrina Matthias[1,2], Stephan Junek[3], Elke Ulbricht[1], Ines Erdmann[1], Detlev Schild[3], Josef Käs[2], and Andreas Reichenbach[1] — [1]Paul-Flechsig-Institute for Brain Research, Department of Neurophysiology, Jahnallee 59, 04109 Leipzig, Germany — [2]Institute of Physics, Department of Soft Matter Physics, Linnèstrasse 5, 04103 Leipzig, Germany — [3]Center of Physiology and Pathophysiology, Department of Neurophysiology and Cellular Biophysics, Humboldtallee 23 37073 Göttingen, Germany

The retina of the vertebrates has an inverted design. Therefore the light has to pass several tissue layers before hitting the signal transducing photoreceptor cells. These layers include structures with sizes on the order of the wavelength of visible light which would result in a scattering and reflection of the photons. We suppose that the Müller cell of the retina is responsible for the light transport where this glial cell channels the light from the vitreous body to the nuclei of the photoreceptor cells. The Müller cell occupies several features which point to the lightguidance ability: e.g. its strategic position in the path of light through the tissue, its funnel shape, its rareness of highly scattering objects and its refractive index. This project investigates the optical properties of the retinal glial cell in its normal tissue by illuminating a single Müller cell endfoot. While the retina is moving with respect to the light source there are changes of the beam structure and thus the Müller cell channels the light to the photoreceptor cells similar to an optic fiber.

BP 33.3 Thu 17:15 Poster B1

Hidden Markov Models reveal distinct mobilities of synaptic vesicles — •Jan-Philipp Spies[1], Christoph Erlenkämper[1], Mathias Pasche[2], Detlef Hof[2], Karsten Kruse[1], Jens Rettig[2], and Ute Becherer[2] — [1]Theoretische Biologische Physik, Universität des Saarlandes, 66041 Saarbrücken — [2]Physiologisches Institut, Universität des Saarlandes, 66421 Homburg

In neurons, release of neurotransmitter occurs through fusion of synaptic vesicles with the plasma membrane. Electrophysiological methods, e.g. membrane capacitance measurements, provide indirect information about distinct vesicle states ("docking" and "priming"). At present, the molecular origin of these states is unknown. To characterize them on the level of individual vesicles, we investigate their mobility using total internal reflection fluorescence (TIRF) microscopy. Employing Hidden Markov Models, we identify several states of different mobilities and propose possible underlying molecular mechanisms.

BP 33.4 Thu 17:15 Poster B1

Up- down state switching in a conductance- based cortical model — Hong-Viet Ngo, •Arne Weigenand, and Jens Christian Claussen — Institut für Neuro- und Bioinformatik, Universität zu Lübeck

In recent experiment [1] investigated the on- and off switching of bursting activity in ferret brain slices. This experiment is seen as a paradigmatic system towards the understanding of the emergence of cortical slow waves. The basic dynamics can be modeled by a simplified discretized integrate-and-fire model including inhibitory currents [2]. Here we use a conductance-based model to reproduce the spike-burst dynamics and the triggering of on-states as obeserved in [1].

[1] Y. Shu, A. Hasenstaub & D.A. McCormick. Nature 423, 288 (2003)
[2] Hong-Viet Ngo et al., submitted.

BP 33.5 Thu 17:15 Poster B1

Triggering bursts in all-to-all coupled neurons with global inhibition — •Hong-Viet Ngo[1], Jan Köhler[2], Jörg Mayer[2], Jens Christian Claussen[1], and Heinz Georg Schuster[2] — [1]Institut für Neuro- und Bioinformatik, Univ. zu Lübeck — [2]Univ. Kiel

Slow-wave sleep in mammals is characterized by a change of large-scale cortical activity currently paraphrased as cortical up-down states. Recently [Y. Shu, A. Hasenstaub & D.A. McCormick. Nature 423, 288 (2003)] demonstrated experimentally a bistable collective behaviour in ferret brain slices, with the remarkable property that the up states can be switched on and off with excitations, whereby the effect of the second pulse significantly depends on the time interval between the pulses. Here we present a time-discrete model of a neural network that reproduces this type of behavior, as well as reproduces the time-dependence found in the experiments. This class of models could be of general interest to various types of coupled systems if control pulses of negative signs cannot be realized, and offers new possibilities to control cortical slow waves.

BP 33.6 Thu 17:15 Poster B1

Critical micellar concentration (CMC) dependence of pluronic effects on neuronal cells in culture — •Vicente D. Samith[1,2,3], María J. Retamal[2], Ignacio Vergara[2], Esteban Ramos-Moore[2], Ulrich G. Volkmann[2], and Ricardo B. Maccioni[1,4] — [1]Laboratory of Cellular and Molecular Neurosciences, Faculty of Sciences, Universidad de Chile, Santiago de Chile — [2]Dept. of Physics, P. Universidad Católica de Chile, Santiago de Chile — [3]Dept. of Chemistry, Universidad Andrés Bello, Santiago de Chile — [4]International Center for Biomedicine (ICC), Santiago de Chile

We are evaluating triblock copolymers, referred to as pluronics, for delivery of anti-inflammatory drugs that normally do not cross the blood-brain barrier. We studied the cytotoxicity of pluronic F68 in human neuroblastoma cells in culture, and analyzed physicochemical parameters of this type of polymeric matrixes such as the critical micellar concentration (CMC). Atomic force microscopy (AFM) was used to investigate the morphological changes in the lipid monolayer as a function F68 concentrations from 0.5 x 10^{-4} M to 10 x 10^{-4} M, adsorbed on a solid substrate (hydrophilic silicon). We observe a gradual change in the morphology of the polymer, from a 'dendritic' to a supramolecular structure (clusters). The analysis of morphological changes of F68 is complemented by measurements of the percentage of film coverage on the silicon substrate as a function of the molar concentration of F68.

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BP 33.7 Thu 17:15 Poster B1

Mechanosensitive Behavior of Neuronal Growth Cones — •Steve Pawlizak[1], Kristian Franze[2], and Josef A. Käs[1] — [1]Institute for Experimental Physics I, Soft Matter Physics Division, University of Leipzig, Germany — [2]Cavendish Laboratory, Biological and Soft Systems, University of Cambridge, UK

Neuronal pathfinding is essential for the development of the central nervous system. Although it is generally accepted that chemotaxis is the major guidance factor, it seems unlikely that this is the only mechanism directing developmental neurons to their target sites, especially when considering the length of some pathways.

In [1], we support the idea that durotaxis also plays a non-negligible

role in this complex process. Our *in vitro* studies show that neurons actively palpate their mechanical environment with the help of their growth cones and retract their neurites from contacts they cannot mechanically deform. After mechanical stimulation of the neuronal growth cones using a modified scanning force microscope (SFM) probe, the neurons retract their processes and re-extend them into a new direction when the exerted mechanical stress exceeds $\sim$ 300 Pa. This threshold corresponds to the maximum substrate stiffness that neurons can visibly deform. Furthermore, an immediate calcium influx through stretch-activated ion channels seems to be correlated with neurite retraction.

[1] K. Franze et al., Biophys. J. **97** (7): 1883–1890 (2009)