BP 51: Posters - Cytosceletal Filaments

Time: Wednesday 17:00–19:00 Location: Poster C

BP 51.1 Wed 17:00 Poster C

Cytoskeletal reorganization in human platelets during spreading — •Aishwarya Paknikar, Gerrit Brehm, Tim Dullweber, and Sarah Köster — Institute for X-Ray Physics, Georg-August-Universität Göttingen, Germany

To maintain the life-sustaining process of repairing damaged blood vessels, activated platelets change their shape, adhere, spread and contract in a hemostatic plug to seal the injuries. Dynamic and ordered rearrangements of their acto-myosin and microtubule (MT) cytoskeleton are responsible for these processes. We image the actin and MTs while they remodel in platelets in a time-resolved manner by labeling them with the recently introduced SiR-actin/tubulin probes. We demonstrate the ability to directly observe the formation of F-actin structures and coiling of the MTs as the platelets spread. The averaged actin intensity of single platelets reveals an initial steep rise followed by a linear increase that gradually reaches a plateau indicating the formation and increase in content of polymerized actin until the platelet spreads completely. By treatment of the platelets with pharmacological inhibitors we can indirectly show the crosstalk between the acto-myosin and microtubule dynamics. Our real-time cytoskeletal dynamics are all in agreement to post-fixation literature studies. Our results highlight a novel approach for studying real-time platelet cytoskeleton dynamics which is an important step in understanding the structural and mechanical aspects of platelet function better.

BP 51.2 Wed 17:00 Poster C

Molecular assembly studied in microflow by fluorescence correlation spectroscopy — •Viktor Schroeder[1], Eleonora Perego[1], Harald Herrmann[2], and Sarah Köster[1] — [1]Institute for X-Ray Physics, Georg-August-Universität Göttingen, Germany — [2]Division of Molecular Genetics, German Cancer Research Center (DKFZ), Heidelberg, Germany

We present a combination of microfluidic diffusive mixing and fluorescence correlation spectroscopy (FCS) to study rapid molecular assembly processes. In FCS, information about diffusing fluorescent particles is retrieved by analyzing the correlation of intensity fluctuations. To overcome the limited temporal resolution of FCS caused by long measuring times on the order of at least ten seconds, we use continuous flow microfluidic tools to map the temporal evolution to a spatial axis. Thus we achieve a temporal resolution of milliseconds with a dead time of only one second. Molecular assembly processes are initiated by the inflow of trigger molecules. The macromolecules of interest then spread over the whole cross section of the channel via diffusion, thus leading to a constant concentration downstream. Data are collected at different positions along the channel. As an example, we employ this method for studying the assembly of vimentin intermediate filament protein.

BP 51.3 Wed 17:00 Poster C

Stochastic Mechanochemical Simulation of Microtubules — •Matthias Schmidt and Jan Kierfeld — Theoretische Physik I, Technische Universität Dortmund

Microtubules are tubular filaments in eukaryotic cells made of α-/β-tubulin heterodimers. They have distinct growth dynamics called dynamic instability which is characterized by catastrophes, i.e. sudden changes from the growing phase to fast shrinkage, and rescues after which the microtubule starts to grow again.

We implement a stochastic simulation which combines the mechanics of the microtubule on tubulin molecule level with the chemical processes like depolymerization into a mechanochemical model. The mechanics of the microtubule are described by longitudinal bonds between tubulin dimers in the same protofilament, lateral interactions between adjacent tubulin molecules via springs and inter- and intradimer curling of hydrolyzed tubulin dimers.

BP 51.4 Wed 17:00 Poster C

A diffusion and capture mechanism creates large-scale correlations in the enzyme distribution on biofilaments — •Emanuel Reithmann, Louis Reese, and Erwin Frey — Arnold Sommerfeld Center for Theoretical Physics and Center for NanoScience, Ludwig-Maximilians-Universität, Munich, Germany

Diffusive motion on filaments with eventual capture at a reaction site is a common feature of regulating proteins in cell biology. Using a lattice gas model we study the impact of diffusion and capture for two central microtubule regulating proteins, which promote microtubule growth and shrinkage, respectively. We show that the capture mechanism has highly significant implications: It localizes the proteins at the reaction site and creates large-scale spatial correlations in the protein distribution along the filament. The latter finding leads to the failure of standard analytic approximation methods such as mean-field theories. To overcome this limitation, we develop an analytic approximation that globally accounts for relevant correlations and yields results that are in excellent agreement with experimental data. Our results show that diffusion and capture operates most efficiently at cellular enzyme concentrations which points to in vivo relevance.

BP 51.5 Wed 17:00 Poster C

Complex thermorheology of living cells — •Enrico Warmt, Sebastian Schmidt, Tobias Kiessling, and Josef Käs — Universität Leipzig, Soft Matter

Temperature has a reliable and nearly instantaneous influence on mechanical responses of cells. As recently published, MCF-10A normal epithelial breast cells follow time-temperature superposition (TTS) principle. Here, we measured thermorheological behaviour of eight common cell types within physiologically relevant temperatures and applied TTS to creep compliance curves. Our results showed that superposition is not universal and was seen in four of the eight investigated cell types. For the other cell types, transitions of thermorheological responses were observed at 36 °C. Activation energies (EA) were calculated for all cell types and ranged between 50 and 150 kJ/mol. The scaling factors of the superposition of creep curves were used to group the cell lines into three categories. They were dependent on relaxation processes as well as structural composition of the cells in response to mechanical load and temperature increase. This study supports the view that temperature is a vital parameter for comparing cell rheological data and should be precisely controlled when designing experiments.