BP 15: Posters: Systems biology and neurosciences

Time: Tuesday 9:30–12:30 Location: P1

BP 15.1 Tue 9:30 P1

Optimization of collective enzyme activity via spatial localization — •Filipe Tostevin, Alexander Buchner, Florian Hinzpeter, and Ulrich Gerland — Arnold Sommerfeld Center for Theoretical Physics, Ludwig-Maximilians-Universität, Munich, Germany

The spatial organization of enzymes often plays a crucial role in the functionality and efficiency of enzymatic pathways. To understand the design and operation of enzymatic pathways, it is therefore important to analyze how the relative arrangement of enzymes affects pathway function. Here we investigate the effect of enzyme arrangements on the flux of a minimal two-enzyme pathway within a reaction-diffusion model. We consider different reaction kinetics, spatial dimensions, and loss mechanisms for intermediate substrate molecules. Our systematic analysis of the different regimes of this model reveals both universal features and distinct characteristics in the phenomenology of these different systems. In particular, the distribution of the second pathway enzyme that maximizes the reaction flux undergoes a generic transition from co-localization with the first enzyme when the catalytic efficiency of the second enzyme is low, to an extended profile when the catalytic efficiency is high. However, the critical transition point and the shape of the extended optimal profile is significantly affected by specific features of the model. We explain the behavior of these different systems in terms of the underlying stochastic reaction and diffusion processes of single substrate molecules.

BP 15.2 Tue 9:30 P1

Reaction kinetics modeling of RNAi: gene silencing dependence of target mRNA concentration — •Simon Dornseifer[1], Georg Sczakiel[1], Tobias Restle[1], and Jens Christian Claussen[2] — [1]IMM, Universität zu Lübeck, Germany — [2]Computational Systems Biology Lab, Research II, Jacobs University Bremen, Germany

The discovery of post-transcriptional gene silencing via RNA interference (RNAi) gave rise to the development of new nucleic acid-based tools. Mechanistic key details of RNAi in human need to be deciphered yet. Here we propose and investigate a computational model of siRNA-mediated RNAi in human cells in order to link precise quantitative kinetic data and new molecular findings with a quantitative and time-resolved understanding of RNAi in the human system. Cell culture experiments suggest that the RNAi machinery adopts to large variations in target mRNA level, independent of siRNA or Ago2 concentrations. These experimental findings are not explained by the common literature view of RNAi, here termed dissociative mechanism, where the departing ligand (here, cleaved RNA fragments) leaves the complex in a slow step. Here, we investigate an alternatice, associative mechanism of target strand recognition by Argonaute 2 (Ago2). The associative model is compatible with the high multiple turnover rates of RNAi-based gene silencing in living cells and accounts for target mRNA concentration-dependent acceleration of the RNAi machinery. The associative model proposed here suggests that the efficacy of an siRNA or miRNA depends on the expression level of its target RNA such that high target levels allow better regulation via RNAi.

BP 15.3 Tue 9:30 P1

Biophysics of mechanosensation in the fruit fly Drosophila — •Achintya Prahlad[1], Christoph F. Schmidt[1], and Martin Göpfert[2] — [1]Third Institute of Physics - Biophysics, Georg-August University, Göttingen — [2]Schwann-Schleiden Research Centre, Faculty of Biology, Georg-August University, Göttingen

The fruit fly Drosophila uses mechanosensation for several purposes. Much of the literature is on a class of organs called chordotonal organs, such as the auditory organ attached to the antennae, and the larval pentamere organ (or lch5). The sensory neurons at the core of these organs have one dendrite, which terminates in a cilium. The cilia are said to be the main transducers. The lch5 organ aids in locomotion by giving feedback to the central nervous system.

Molecular and anatomical aspects of these organs have been studied. Also, there have recently been some exciting discoveries about the mechanics of the external sound receiver. However, an understanding of the internal transduction mechanics and the manner in which membrane channels are activated upon deflection of the cilium is still elusive. Since the inner parts of the antenna organ of an adult fly are difficult to access in a functional state and since flies don't survive under water, we are using a preparation of larvae under buffer solution that allows us to directly access the sensory neurons of the lch5. Our approach is to then use optically-trapped beads to give stimuli to the cilia, and couple that with calcium imaging in the cells.