IMPRS on Multiscale Biosystems

Title: Cooperative transport by amoeboid micro-trucks — a cellular tug-of-war

PI: Carsten Beta

Collaboration with: Stefan Klumpp and Reinhard Lipowsky

Project description: Directed transport of micro-objects in the complex, crowded environment of the human body is among the prime challenges of non-invasive medical treatments. How can we assemble micro-implants in a small blood vessel, or position particles for drug delivery at a site of inflammation with minimal outside impact? In the Biological Physics Group at the University of Potsdam, we have started to explore the potential of motile cells to transport micro-objects in a directed fashion. While single cells can reliably shuffle micro-cargo over long distances, the situation becomes more complicated, when the concerted action of several cells is required to achieve larger forces. In some cases, the cells successfully act in synchrony, but in other cases they hinder each other and cargo motion is stalled in a tug-of-war. To address the question of cooperative cell-driven transport, we will team up with researchers from the Theory and Bio-Systems Department at the MPI of Colloids and Interfaces, where ample theoretical expertise in the field of directed transport has been developed. Together, we will address to following questions. How can cells cooperate to move larger objects? Under what conditions do they act in synchrony, when do they hinder each other? What are the underlying sensing processes and signaling mechanisms that establish synchronous mechanical action? In particular, we will relate the characteristics of the transport process to the dynamics of protrusion formation and to the underlying cytoskeletal processes.

Required background: We seek a candidate with a background in physics, preferentially biophysics. Applications of interested students from other related fields (e.g. cell biology) are also welcome. Experience with imaging and cell culture techniques are appreciated but not required. A background in mathematical modeling and statistical physics is helpful. The project has both experimental and theoretical components. Depending on the background and the preferences of the candidate, both an experimental or theoretical focus is possible. A good level of English is indispensable.

Paper to read before the interview:

C. Westendorf, et al., Actin cytoskeleton of chemotactic amoebae operates close to the onset of oscillations, PNAS **110**, 3853 (2013).

R. Marathe, et al., Bacterial twitching motility is coordinated by a two-dimensional tug-of-war with directional memory, Nature Commun. **5**, 3759 (2014).

Contact:

Carsten Beta, Email: beta@uni-potsdam.de,
Web: http://www.bio.physik.uni-potsdam.de/