# BP 27: Posters - Microswimmers

Time: Tuesday 14:00–16:00 Location: P2-EG

BP 27.1 Tue 14:00 P2-EG

**A bacterial swimmer with two alternative movement patterns** — Veronika Waljor, Marius Hintsche, •Zahra Alirezaeizanjani, and Carsten Beta — Institute of Physics and Astronomy, University of Potsdam, Potsdam-Golm, Germany

The soil bacterium *Pseudomonas putida* is a bacterial swimmer that propels itself with the help of several flagella that are polarly arranged at one end of the cell body. Through its chemosensory system, which is coupled to the rotary motors that drive the flagella, *P. putida* senses changes in its environment and responds by altering its motility.

When growing in a medium that offers only minimal amounts of nutrient, *P. putida* exhibits a motion pattern characterized by persistent runs that are interrupted by reversals in the swimming direction. In contrast, when growing under rich medium conditions, the reversal rate is drastically reduced and the swimming pattern is dominated by stopping events that interrupt the episodes of persistent runs.

Additional experiments in microfluidic gradient chambers suggest that the reversals are signatures of a chemotactic strategy, which is activated when food is sparse but not required under rich growth conditions.

BP 27.2 Tue 14:00 P2-EG

**Curvature-Guided Motility of Single Microalgae in Geometric Confinement** — Tanya Ostapenko, Fabian Schwarzendahl, •Thomas Böddeker, Christian T. Kreis, Jan Cammann, Marco G. Mazza, and Oliver Bäumchen — Max Planck Institute for Dynamics and Self-Organization (MPIDS), Am Fassberg 17, 37077 Göttingen, Germany

Microorganisms often live in habitats consisting of a liquid phase and a variety of curved interfaces. Understanding the precise way in which such organisms behave in their environment finds technological relevance with regards to surface colonization leading to biofilm formation. Using experiments, simulations, and analytics, we study the motility of a single *Chlamydomonas* cell in an isolated microhabitat with controlled geometric properties. We provide evidence that the local wall curvature controls the cell's navigation in confinement, where there is an enhanced probability of finding the cell in the vicinity of a wall with high curvature. This probability scales linearly with the curvature of the interface, as seen for both circular and elliptical chambers. Our theory utilizing a dumbbell model of the organism captures our experimental data quantitatively, with no free parameters, evoking only steric wall interactions and the cell's torque at the wall during an interaction event with finite time. Thus, hydrodynamics are not necessary to describe the statistical behavior of the cell's swimming on the compartment length scale. (T. Ostapenko, et al. arXiv:1608.00363, 2016)

BP 27.3 Tue 14:00 P2-EG

**Inertial effects in microswimming** — •Oleg Trosman[1,2], Jayant Pande[1,2], and Ana-Sunčana Smith[1,2,3] — [1]PULS group, Department of Physics, Friedrich-Alexander-University of Erlangen-Nuremberg, Germany — [2]Cluster of Excellence: Engineering of Advanced Materials, Department of Physics, Friedrich-Alexander-University of Erlangen-Nuremberg, Germany — [3]Division of Physical Chemistry, Ruđer Bošković Institute, Zagreb, Croatia

Increased theoretical study in the past few decades has enabled scientists to gain a deeper insight into the motion of micro-swimmers, yet most theoretical approaches addressed the domain of negligible Reynolds number $Re$, ignoring inertia. In nature, however, in an intermediate range of $Re$, before turbulences arise, the inertial effects become important. In this work we conduct a theoretical study of how this regime emerges. For this we extend the swimmer model by Golestanian and Najafi, which has three beads attached in series in a fluid and moving along the axis of the swimmer, by inclusion of the beads' masses. We do this by combining the Oseen-Stokes equations for the coupled motion of distant spheres in a fluid with Newton's force-mass relations and obtain a coupled system of first-order differential equations. Solving these equations allows us to derive a closed-form expression for the velocity of the swimmer which explicitly takes inertia into account. This velocity expression compares considerably better to results obtained from lattice-Boltzmann simulations of the swimmer, for intermediately high bead masses or driving forces, than the inertia-free model of Golestanian and Najafi.

BP 27.4 Tue 14:00 P2-EG

**Light-activated flagella dynamics of *Chlamydomonas* in contact with a surface** — •Christine Linne, Christian Kreis, and Oliver Bäumchen — Max Planck Institute for Dynamics and Self-Organization (MPIDS), Am Faßberg 17, D-37077 Göttingen, Germany

The photoactive microalga *Chlamydomonas reinhardtii* typically lives in complex environments such as soil and has two modes of locomotion: freely swimming in liquid and gliding on a surface. By performing *in vivo* force spectroscopy experiments we discovered that light stimulation regulates the transition between both motility modes, since the adhesiveness of the flagella can be reversibly switched on and off by light [1]. We held a *Chlamydomonas* cell with a micropipette force sensor in close proximity to a substrate, such that the flagella tips can physically sense the surface during every beating cycle. After light stimulation, the flagella provide adhesive contacts with the surface and actively pull the cell body towards the substrate. Time-resolved *in vivo* micropipette experiments reveal the forces exerted by the cell during this process. We explain the flagella dynamics using a model which takes into account the activity of the molecular motors within the flagella. [1] C. Kreis, M. Le Blay, C. Linne, M. Makowski, and O. Bäumchen, in review (2016).