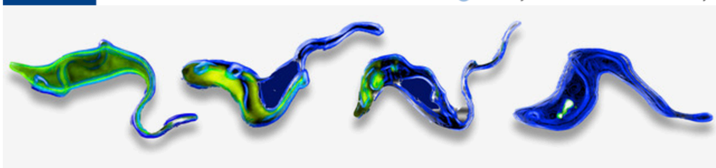

Contribution ID: **54**

Type: **Poster**

A metabolic switch controls bioconvection in a microbial suspension

Photosynthesis is an essential process for life that converts light into energy for higher-level plants and also phototrophic microbes. Even in the absence of light, these microbes can produce energy through other metabolic processes, such as aerobic and anaerobic respiration. In the case of the unicellular microalga Chlamydomonas reinhardtii, the cell's swimming motility is affected by a number of parameters, e.g. the geometry of the confinement [1,2], but also by the cell's metabolic state. Under unfavourable light conditions for photosynthesis, the deprivation of oxygen severely reduces the cell's swimming velocity. In 2D compartments, the switch from photosynthesis to oxygen respiration causes the emergence of self-generated oxygen gradients and, ultimately, the formation of microbial aggregates [3].
In 3D, density patterns in Chlamydomonas suspensions may also form through bioconvection, a phenomenon that rises due to a natural tendency of bottom-heavy cells to move against gravity [4]. Here, we show that the formation of bioconvection patterns can be reversibly triggered by a metabolic switch of the cells. The intensity of light is employed to control the metabolic pathways. We quantify the bioconvection using top- and side-view experiments that allow to access a plethora of characteristic quantities, such as the wavelength, flow-field, and relative cell density. Finally, we directly link the single cell motility at different metabolic states to the spatio-temporal characteristics of the instability.

References

[1] T. Ostapenko, et al., Phys. Rev. Lett. 120, 068002 (2018).
[2] J. Cammann, et al., Proc. Natl. Acad. Sci. U.S.A. 118, 39 (2021).
[3] A.A. Fragkopoulos, et al., J. R. Soc. Interface 18, 185 (2021).
[4] A.M. Roberts, Biol. Bull. 210, 78 (2006).

Primary author: FRAGKOPOULOS, A. A (Chair of Experimental Physics V, University of Bayreuth, 95447 Bayreuth, Germany, Max Planck Institute for Dynamics and Self-Organization, 37077 Göttingen, Germany)

Co-authors: BÖHME, F (Chair of Experimental Physics V, University of Bayreuth, 95447 Bayreuth, Germany); DREWES, N (Max Planck Institute for Dynamics and Self-Organization, 37077 Göttingen, Germany); BÄUMCHEN, O (1Chair of Experimental Physics V, University of Bayreuth, 95447 Bayreuth, Germany, Max Planck Institute for Dynamics and Self-Organization, 37077 Göttingen, Germany)

Presenter: FRAGKOPOULOS, A. A (Chair of Experimental Physics V, University of Bayreuth, 95447 Bayreuth, Germany, Max Planck Institute for Dynamics and Self-Organization, 37077 Göttingen, Germany)