Physikalisches Kolloquium

Universität Konstanz

Antrittsvorlesung

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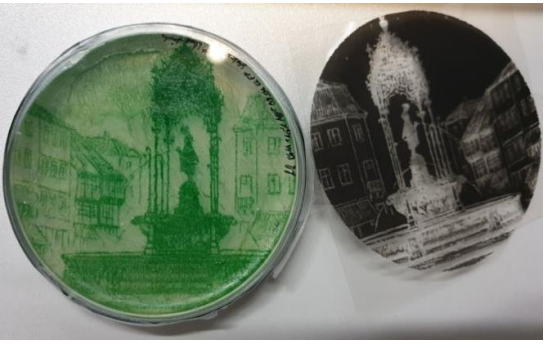
Di 07.11.23
15:15 Uhr
P 603
im Anschluss Umtrunk auf P9

Living Polymers: From Micro-Mechanics to Blooms of Filamentous Cyanobacteria



Active or living matter, intrinsically out of thermodynamic equilibrium, generates mechanical work at the scale of its constituents. This leads to intriguing collective dynamics with no equilibrium analog, most commonly known from flocks of birds or schools of fish. Long before higher life emerged, cyanobacteria dominated Earth's biosphere, generating, for instance, the oxygen we breath. Despite their primitive nature, filamentous cyanobacteria also exhibit remarkably complex collective behavior like aggregation, dispersal, and collective migration, emerging from gliding motility and responsive direction reversals. Although these phenomena are believed to be vital to their evolutionary success, the physics behind them remains elusive.

In this talk, I will present our recent experiments revealing the connection between individual and collective behavior of filamentous cyanobacteria. I will show how propulsion- and friction forces can be determined by analyzing mechanical instabilities of individual filaments, so-called self-buckling. This instability is closely connected to patterns found in quasi-two-dimensional ensembles, which we quantify by polar and nematic order parameters, obtained from deep learning image analysis. In open environments, gliding motility and responsive direction reversals lead to entangled aggregates, capable of collective mechanical action. In combination, these results show how minute changes in the properties of individuals cascade into distinct collective states. More generally, our experiments highlight how active matter physics may bridge length scales between cell biology and ecology.

Host and Organisation:
Prof. Bechinger