Seminar announcement（Prof. Holger Stark）

Title: Insights into Escherichia coli and Trypanosoma brucei using modeling
Speaker: Prof. Holger Stark (Technische Universität Berlin)
Date & Time: 15:00-, Friday, 25th July, 2025
Location: W1-D315

Abstract:

Microorganisms are around us everywhere. They occupy quite diverse natural habitats on the earth and also in the human body, where they have to navigate in complex environments such as the gut, different forms of tissue, and blood vessels. We present our efforts to model two types of microorganisms in order to understand how they move close to surfaces and in confining geometries using elastic theories and hydrodynamic simulations based on the method of multi-particle collision dynamics.

We will start with the E. coli bacterium that uses a bundle of helical flagella to propel itself forward. When one of the driving rotary motors reverses its direction, the bundle disintegrates and the E. coli tumbles. It changes its swimming direction, in order to swim up a chemical gradient known as chemotaxis. In the talk we show that the distribution of tumble angles is modified close to a surface such that increased tumbling in forward direction is observed [1]. This might explain the experimental finding that tumbling close to surfaces is reduced.

The African trypanosome T. brucei causes the life-threatening sleeping sickness. It has a spindle-shaped cell body to which an eukaryotic flagellum is firmly attached. Therefore, when a bending wave runs along the flagellum, the whole cell body is distorted and thereby propels the trypanosome forward. When injected into the skin through a bite of the tsetse fly, the trypanosome
needs to move through different types of tissue before entering the blood flow and ultimately invading the brain. Thereby, it has to move in tight spaces and squeeze through narrow openings. In the talk we discuss how a trypanosome swims in confining geometries such as circular microchannels and how it squeezes through narrow constrictions with the help of its thin anterior end [2].

[1] P. Martin, T. Adhyapak, and H. Stark, to be published in Soft Matter (2025).
[2] Z. Tan, J. I. U. Peters, and H. Stark, New J. Phys. 27, 064401 (2025).

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