CPP 29: Poster: Active Fluids

Time: Wednesday 17:30–19:00 Location: Poster C

CPP 29.1 Wed 17:30 Poster C

Chemotactic predator-prey dynamics — •Ankush Sengupta, Tobias Kruppa, and Hartmut Lowen — Institut für Theoretische Physik II: Weiche Materie, Heinrich-Heine-Universität, Universitätsstrasse 1, D-40225 Düsseldorf, Germany

A discrete chemotactic predator-prey model is proposed in which the prey secrets a diffusing chemical which is sensed by the predator and vice versa. Three different dynamical states are identified which correspond to catching, escaping and steady hunting, and various associated scaling laws are extracted. For the escape process, the predator-prey distance is diffusive for short times but exhibits a transient subdiffusive behaviour which scales as a power law $t^{1/3}$ with time t and ultimately crosses over to diffusion again. The trapping dynamics also shows a scaling of the predator-prey distance with time as $|t - t_{cap}|^{1/3}$, close to the capturing time t_{cap}. We explain these power laws theoretically from the analytic forms of the secreted chemical profiles. This allows us to classify the motility and dynamics of various bacteria and phagocytes.

CPP 29.2 Wed 17:30 Poster C

Interface turbulence in thin liquid films produced by active surfactant — •Sergio Alonso[1] and Alexander S. Mikhailov[2] — [1]Physikalisch-Technische Bundesanstalt, Berlin, Germany — [2]Fritz-Haber-Institut, Berlin, Germany

We consider the case of floating protein machines in a thin liquid film. In this case the propulsion forces are applied to the interface and the asymmetry of the air-water interface produces the alignment of the particles in one direction. By the use of a mesoscopic model for the concentration of the protein machines, we show that the flat interface becomes linearly unstable when the rate of energy supply to the machines exceeds a threshold. Under such conditions an interface turbulence can be observed, characterized by irregular traveling waves and propagating machine clusters. Numerical investigations of this nonlinear regime are performed.

CPP 29.3 Wed 17:30 Poster C

Clockwise-directional circle swimmer moves counter-clockwise in Petri dish- and ring-like confinements — Sven van Teeffelen, •Urs Zimmermann, and Hartmut Löwen — Institut für Theoretische Physik II: Weiche Materie, Heinrich-Heine-Universität Düsseldorf, D-40225 Düsseldorf, Germany

We consider a self-propelled rod driven by a constant internal force and torque that leads to circular motion in two spatial dimensions and therefore is referred to as a circle swimmer with a characteristic radius given by the torque-to-force ratio. The Brownian dynamics of a circle swimmer in confining Petri dish- or ring-shaped geometry are studied with respect to the mean of the swimmer's position, its steady-state properties and its orientational motion by analytical and computational means. For small torque-to-force ratios, the confinement inverts the orientational sense of the motion: a clockwise-directional circle swimmer moves counter-clockwise in the confinement. Examples for our model include self-propelled colloidal rods, vibrated granular rods and motile bacteria in cylindrical confinements.