Sonder-Kolloquium

am Do 4.12.2014, 17:15h
in der Freiburger Physik, Hörsaal II

Active motion: Understanding single microswimmers and their emergent collective behavior

Professor Holger Stark

Institut für Theoretische Physik, Technische Universität Berlin, 10623 Berlin
Holger.Stark@tu-berlin.de

Active motion of artificial and biological microswimmers is relevant in microfluidics and biological applications but also poses fundamental questions in nonequilibrium statistical physics. Mechanisms of single microswimmers need to be understood and a detailed modeling of microorganisms helps to explore their complex cell design and their behavior. The collective motion of microswimmers generates appealing dynamic patterns.

In this talk I review some of our work modeling biological microswimmers such as *E. coli* [1] and the African trypanosome [2], the causative agent of the sleeping sickness, in order to contribute to their better understanding. Using simpler model microswimmers such as active Brownian particles, I will also demonstrate their emerging collective behavior. Hydrodynamic interactions lead to a clustering transition dependent on swimmer type [3] or to the formation of fluid pumps in 3D harmonic traps [4], while self-phoretic active colloids show biomimetic auto-chemotactic behavior, which can induce dynamic clustering or a chemotactic collaps [5].

References

[1] R. Vogel and H. Stark, Rotation-induced polymorphic transitions in bacterial flagella, *Phys. Rev. Lett.* **110**, 158104 (2013).

[2] S. B. Babu and H. Stark, Modeling the locomotion of the African trypanosome using multi-particle collision dynamics, *New Journal of Physics* **14**, 085012 (2012); D. Alizadehrad, T. Krüger, M. Engstler, and H. Stark, Simulating the Complex Cell Design of Trypanosoma brucei, to be published in *PLOS Comp. Biol.*

[3] A. Zöttl and H. Stark, Hydrodynamics determines collective motion and phase behavior of active colloids in quasi-two-dimensional confinement, *Phys. Rev. Lett.* **112**, 118101 (2014).

[4] M. Hennes, K. Wolff, and H. Stark, Self-induced polar order of active Brownian particles in a harmonic trap, *Phys. Rev. Lett.* **112**, 238104 (2014).

[5] O. Pohl and H. Stark, Dynamic clustering and chemotactic collapse of self-phoretic active particles, *Phys. Rev. Lett*. **112**, 238303 (2014).

(Host: A. Rohrbach)