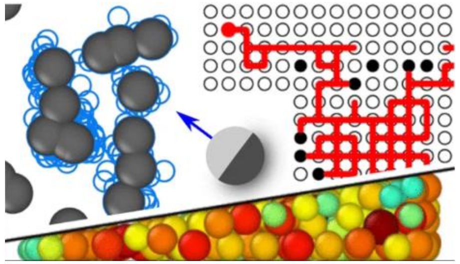
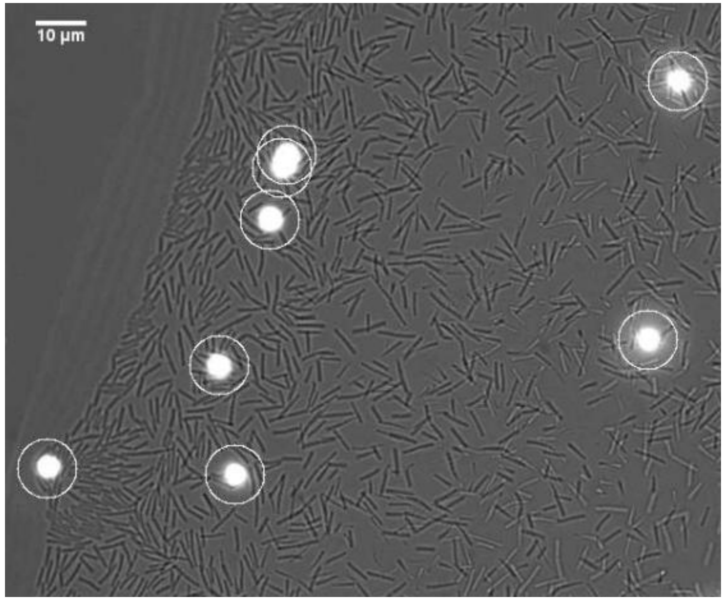
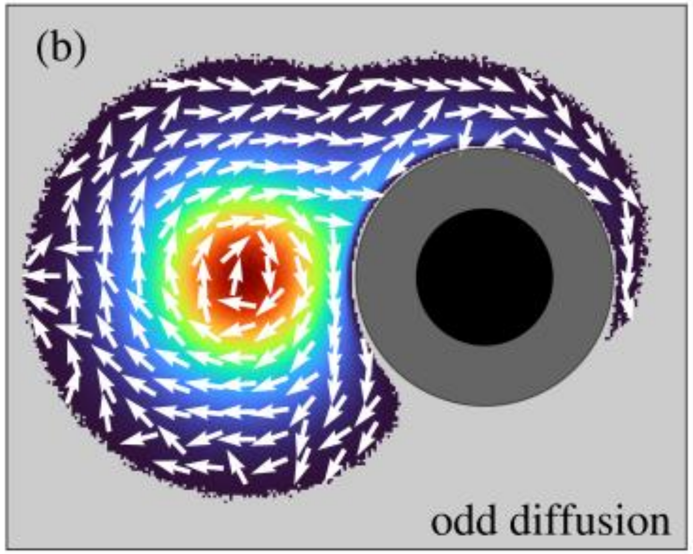
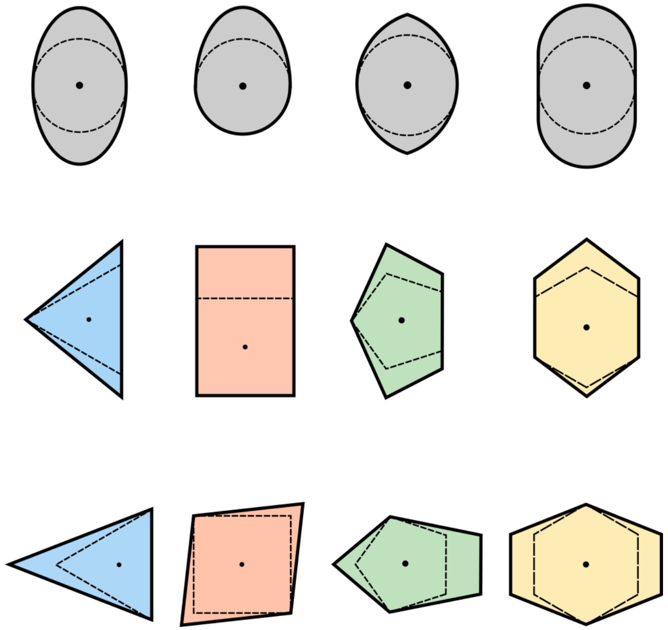


BioNano-Physics







Theoretische Bio-Nano Physik

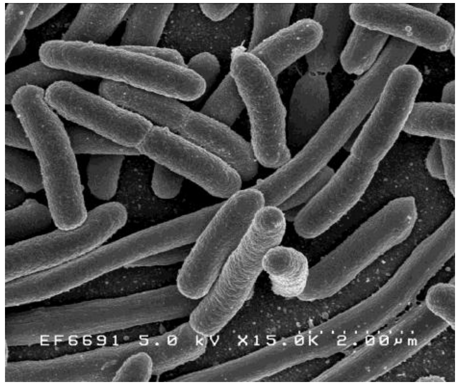
Prof. Thomas Franosch, Gerhard Jung

12.01.2026

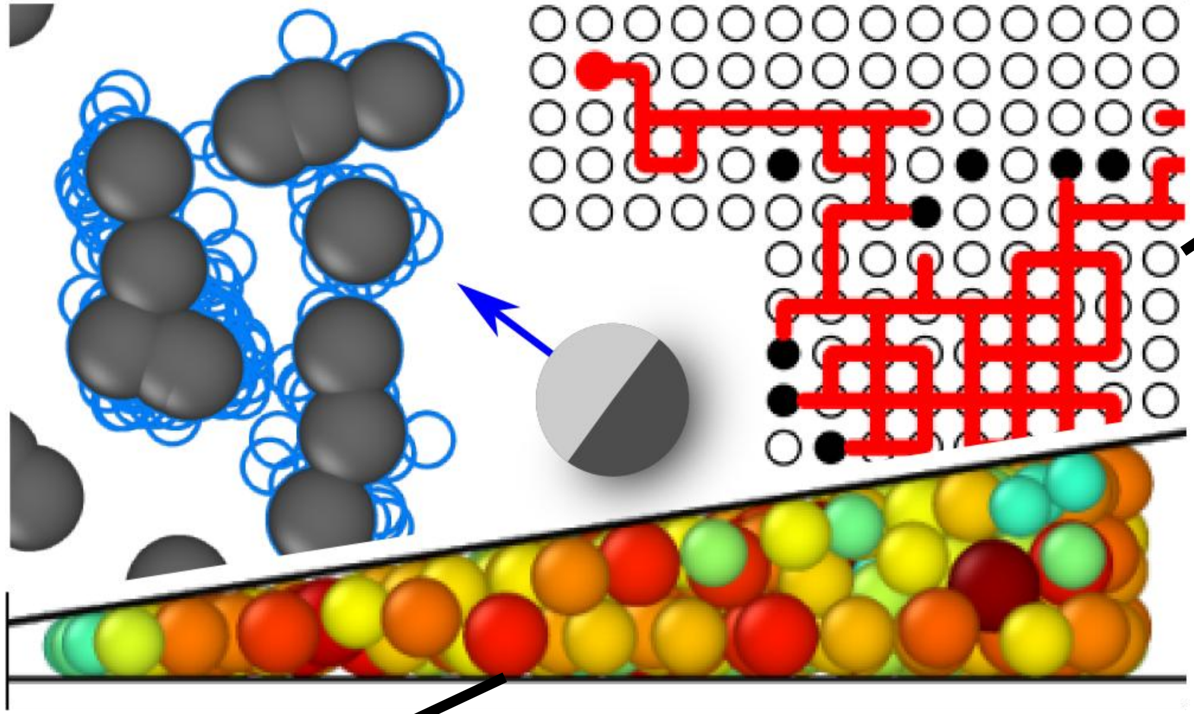
Institut für Theoretische Physik
Universität Innsbruck

Statistical and soft matter physics

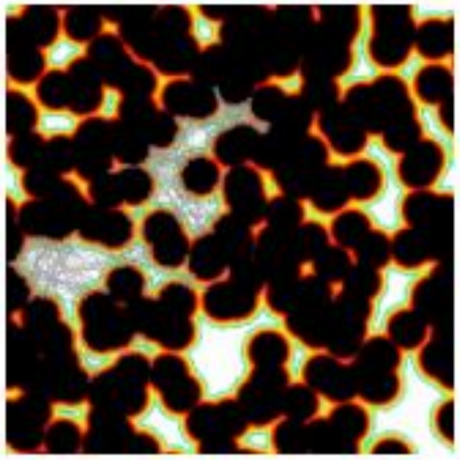
Active matter



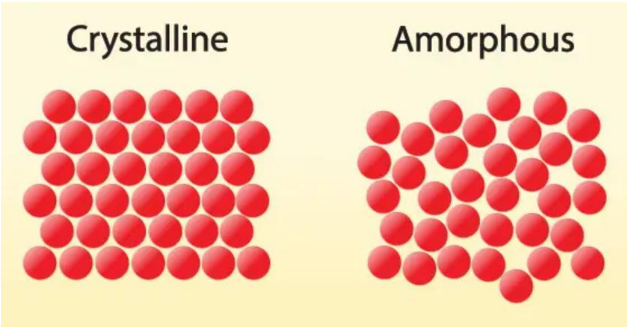
https://de.wikipedia.org/wiki/Escherichia_coli



Complex transport

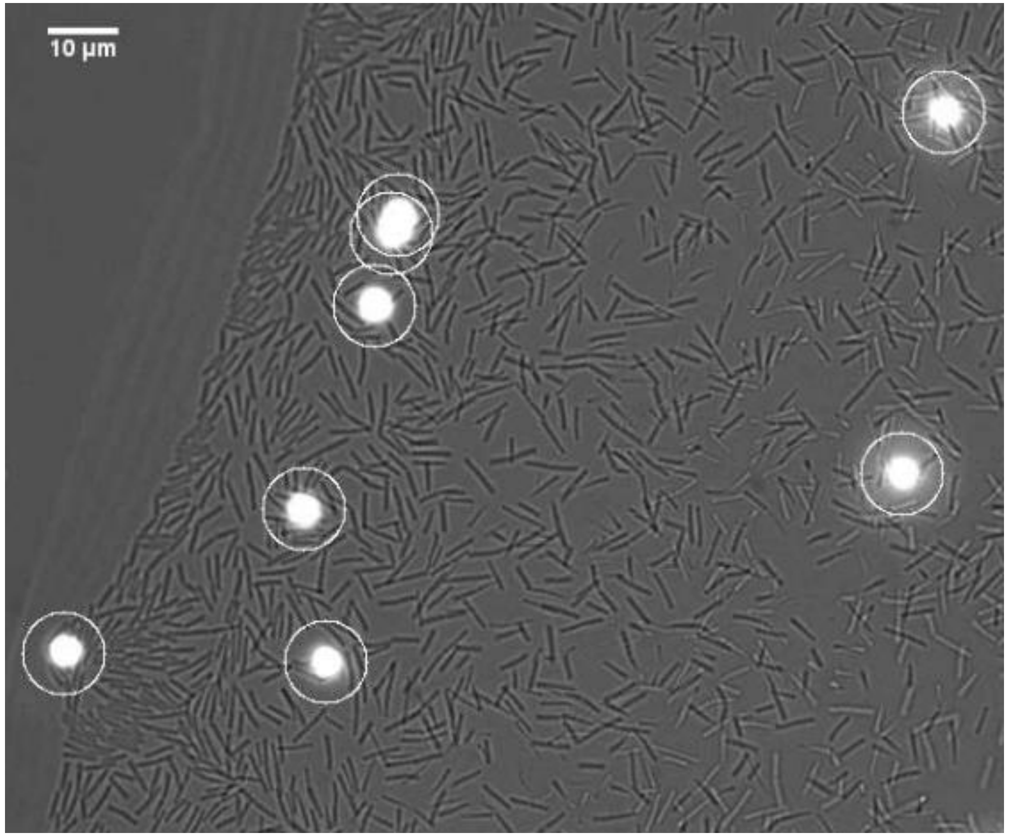


Glassy systems



https://futuretimeline.net/blog/2021/04/9-first-3d-atomic-imaging-amorphous-solid.htm

Dynamics of Colloids in Active Fluids



Soft Matter, 2011,7, 5228-5238

Goal

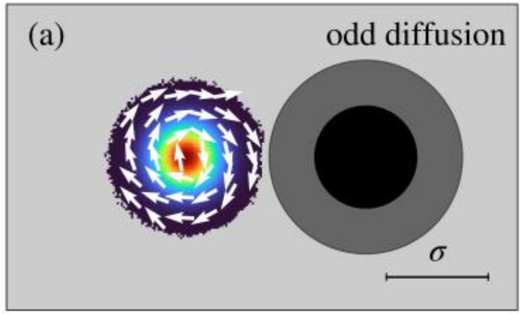
Study the influence of active bacterial motion on the dynamics of passive particles: This investigation is relevant for understanding how transport processes in biological systems are enhanced by the active motion of bacteria and cells within the body.

Learning objectives

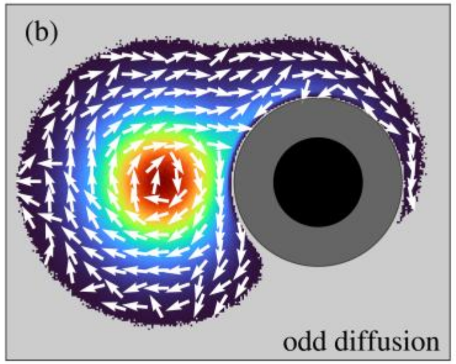
- Understand the fundamental **differences between passive and living** (active) systems.
- Learn how to perform **Molecular Dynamics simulations** of many-body systems.
- Evaluate and interprete **dynamical properties** of soft matter systems.

Self-diffusion in odd-diffusive systems

An odd-diffusive particle near a fixed particle

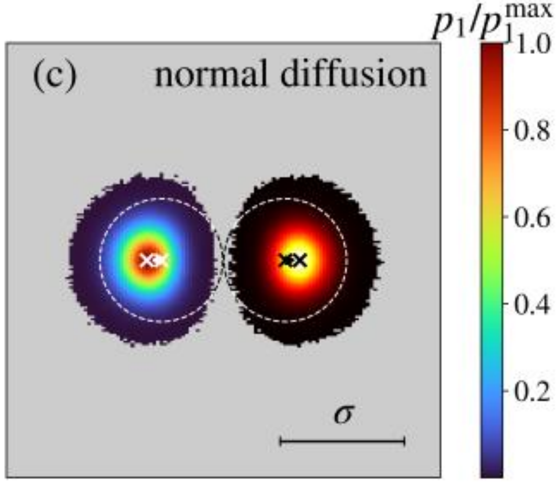


Short time



Long time

How is it different from normal diffusive systems?



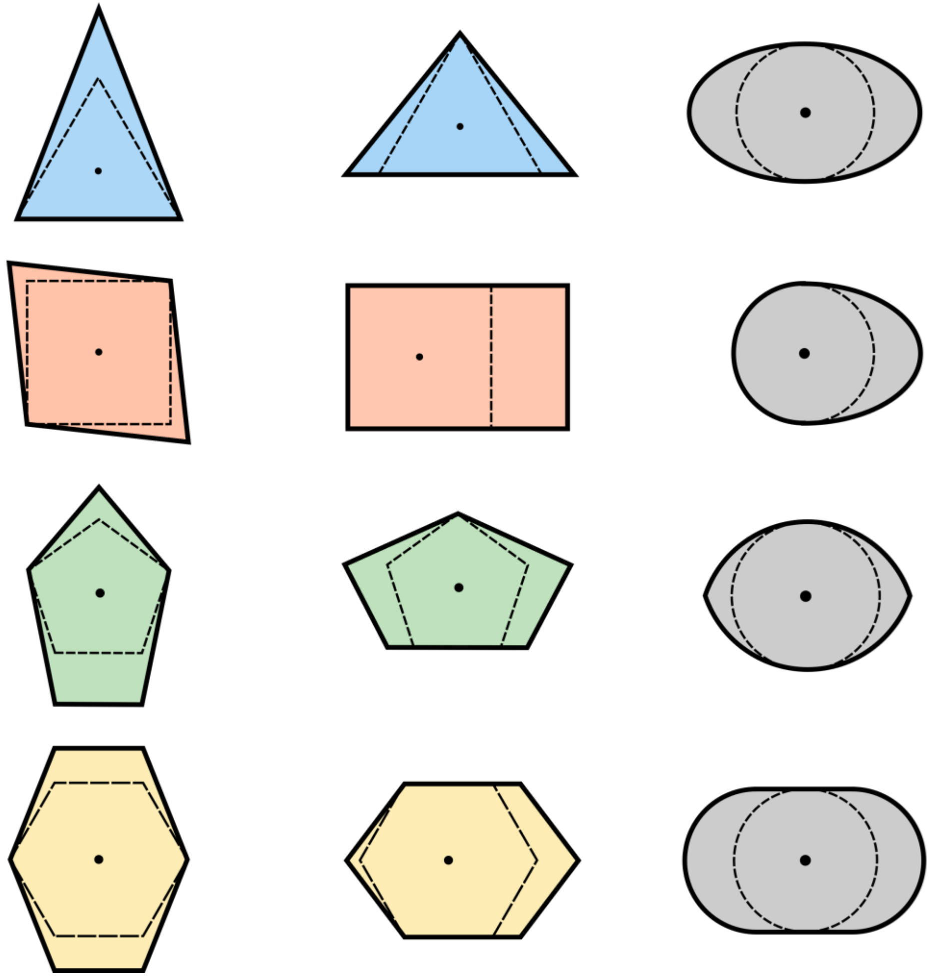
Goal

Understanding the role of odd-diffusion on dynamics and locomotion of a system of particles. Exploring the particle density and odd-diffusivity parameter.

Learning objectives

- Difference between **odd and normal diffusive systems** and its physical implications
- **Setting up a simulation code** for such a system, and using it to generate data
- Analyze the simulation data and **interpret its physical meaning.**

Shape-dependence of hard-body fluids



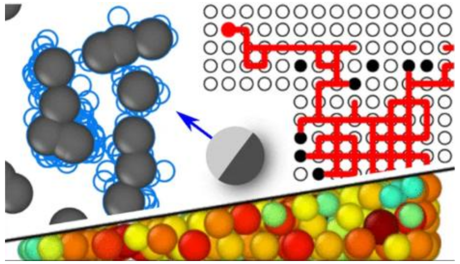
Goal

Influence of shape on the thermodynamics and structure of hard-body fluids: Studying how the degree of anisotropy influences the properties of 2D fluids of different convex hard bodies via simulations and comparing the results with known approximations.

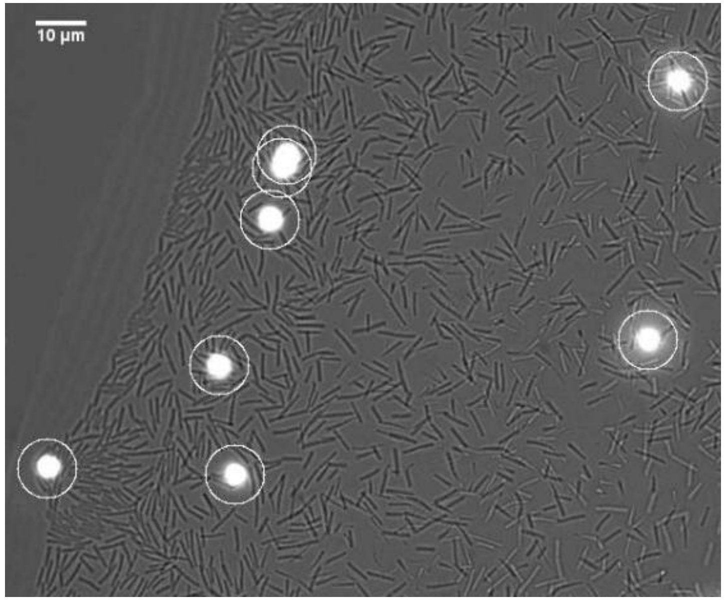
Learning objectives

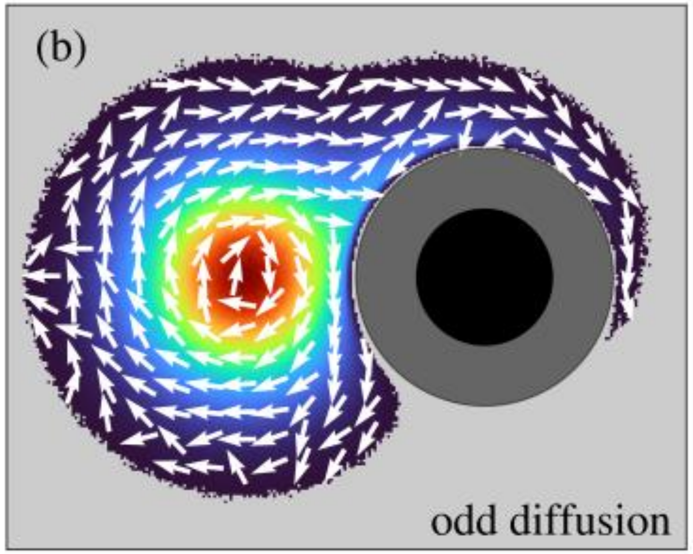
- Getting familiar with **complex fluids with orientation-dependent interactions**
- Learning how to perform **Monte Carlo simulations** of many-body systems (which have a wide range of applications in countless other fields)
- Characterize, interpret, and compare the **equations of state** and important **structural correlations** of different bodies.

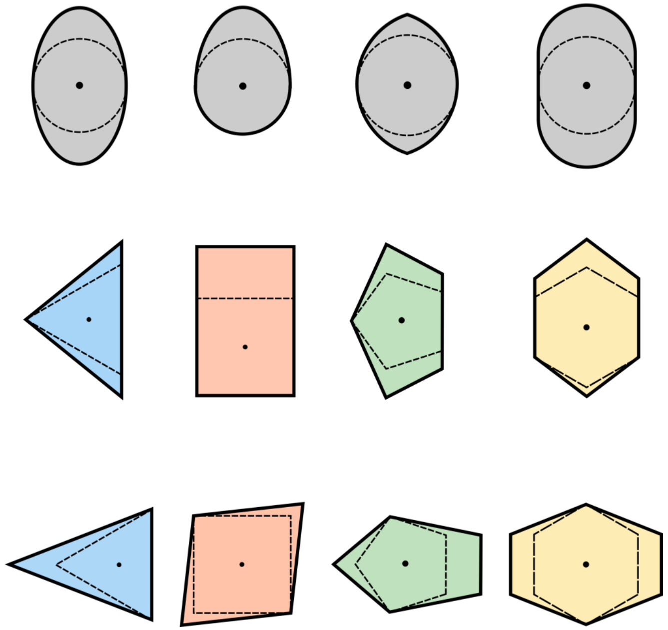
Thank you for your attention!



BioNano-Physics







Potential Master theses are also available

- Glass transition
- Active particles
- Complex transport

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