

SCIENTIFIC AND METHOD MODULES

Module name	From Biomolecules to Cells
Number	2016-T5
Aims	The module provides tools and concepts from biophysics, biochemistry, molecular and cell biology, nanophotonics, and theory that are helpful for understanding, measuring, and manipulating live biological cells and their motility and transport properties, as well as self-propelled microorganisms from a bottom-up perspective, i.e. on a mechanistic molecular basis. The emphasis will be on innovative interdisciplinary concepts and methods, and established and emerging physical measurement techniques.
Basics	Knowledge of concepts and methods covered in basic modules B1–B3 (basic concepts in chemistry, biochemistry, and physics), and some familiarity with cell and molecular biology, cell biophysics, biomechanics, scattering, nanophotonics, thermodynamics and statistical mechanics, structure and function of the cytoskeleton, DNA, proteins, and trafficking will be helpful.
Contents	Structure and constituents of the cytoskeleton. Slime molds. Fungi. Self-assembly, cell mechanics, molecular interactions. Intermediate filaments. Established and novel biophysical measurement techniques. Motility of microorganisms, organelles employed to achieve self-propulsion (flagella, cilia). Random walks in biology. Stochastic models used to quantify the motion of cells and of particles inside cells. Bacteria and eukaryotic cells performing chemotaxis. Cell motility beyond random walks.
Methods	Biophysical tools and methods: small angle x-ray scattering, light scattering, microfluidics, microscopy, x-ray imaging, optical tweezers, nanophotonic detection. Theoretical and numerical methods: random walks, Langevin equations, correlation functions, trajectory analysis, nonlinear dynamics, low-Reynolds-number hydrodynamics, Monte Carlo simulations
Type	Two-day block course/ bi-yearly recurrence with modification
Date (month/year)	19.-20.7.2016
Time	11:30-19:00; 8:30-16:00
Work load	15 hours presence/ 45 hours self-study
Examination	Written exam
Credit points	2
Responsible scientists	K. Kroy
International guest lecturers	Dr. Karen Alim (MPI Göttingen), Prof. Carsten Beta (Potsdam), Dr. Benjamin Friedrich (MPI Dresden), Prof. Sarah Köster (Univ. Göttingen), Dr. Frank Vollmer (MPI Erlangen), Dr. Vasily Zaburdaev (MPI Dresden)
Industrial partners	
Recommendations for literature, e-learning	S. Köster et al. "Intermediate filament mechanics in vitro and in the cell: from coiled coils to filaments, fibers and networks", <i>Current Opinion in Cell Biology</i> 2015, 32:82–91; J. Block et al. "Physical properties of cytoplasmic intermediate filaments", <i>Biochimica et Biophysica Acta</i> 1853 (2015) 3053–3064; B. Friedrich "Hydrodynamic synchronization of flagellar oscillators" http://arxiv.org/abs/1509.07849 ; Méndez, V., D. Campos, and F. Bartumeus, <i>Stochastic Foundations in Movement Ecology</i> , Springer 2014; K. Alim, N. Andrew, A. Pringle, <i>Physarum</i> , <i>Curr. Biol.</i> , 23(24), R1082-R1083 (2013) 1; A. Shapiro, M. Jaffrin, S. Weinberg, Peristaltic pumping with long wavelengths at low Reynolds number, <i>J Fluid Mech</i> 37, 799–825 (1969).

SCHEDULE for Module 2016-T5

Time	Lecturer	Programme	Location
Day 1			
9:30	ALL	Informal get-together & welcome	ITP SR 210
10:00	Frank Vollmer	Exploring the nanoscale dynamics of molecules with optical micro-cavities	ITP SR 210
12:00	Karen Alim	Self-Organization via fluid flow in networks	ITP SR 210
14:00	Sarah Köster	Cytoskeletal intermediate filaments - from self-assembly to cell mechanics	ITP SR 210
16:00	Benjamin Friedrich	Dynamics of flagellar cell motility	ITP SR 210
18:00	ALL	Informal discussions	ITP SR 210
19:00	Speakers	Dinner	Cantona
Day 2			
8:30	ALL	Informal get-together & welcome	ITP SR 210
9:00	Carsten Beta	Chemotaxis in bacterial and eukaryotic systems	ITP SR 210
11:00	Vasily Zaburdaev	Towards physical mechanisms of biological phenomena by random walks	ITP SR 210
13:00	ALL	Informal discussions	ITP SR 210

Logistics:

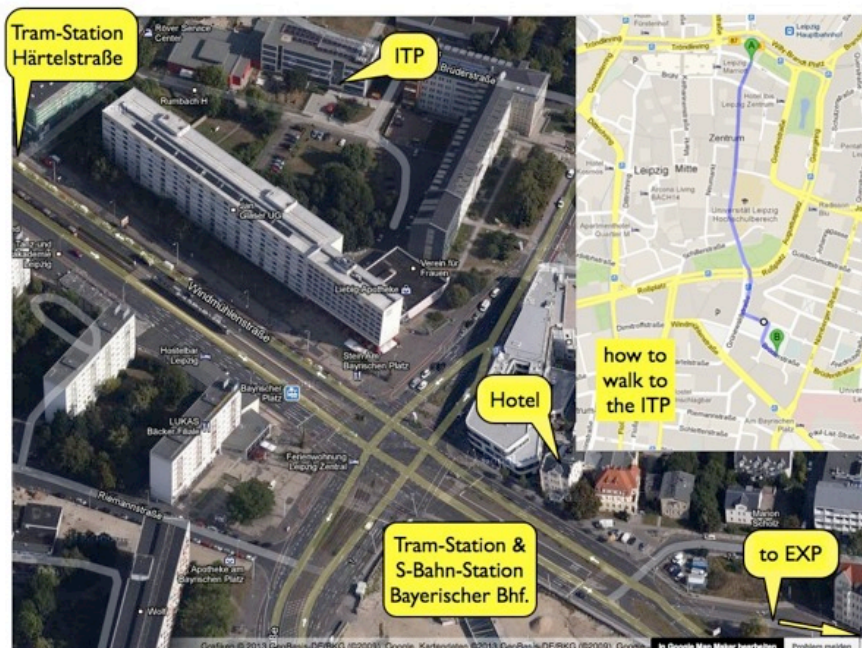
Soft Drinks & Snacks served on site during short breaks, informal get-togethers, and discussions

Didactic elements:

Lectures, discussions

Expected performance:

Active participation in discussions during lab demonstration etc., written exam



To get to the ITP from the main train station take the S-Bahn or (with a short-ride ticket: "Kurzstrecke") the tram No 16 heading for Lößnig to get off at Bayerischer Bahnhof. You find the entrance to the ITP in the backyard behind the large buildings (see map).