BuildMoNa

UNIVERSITÄT LEIPZIG

SCIENTIFIC AND METHOD MODULES

Module name	Complex Nanostructures: Active Nanostructures
Number	2015-T3
Aims	The module aims to provide participants with some understanding of the chemical and physical properties of active nanoparticles and nanostructures, such as their synthesis, experimental control, theoretical description, numerical modeling, including specific nano-scale effects and interactions, and emerging complexity. It aims at generating an interdisciplinary perspective covering chemical, physical, experimental, computational, and theoretical aspects.
Basics	Basic knowledge covered in basic modules B3 and B1
Contents	Aspects of driven and self-propelled transport of nanoparticles and nanostructures, thermal and solute gradients and related thermodynamic forces, (self-)phoresis, in driven systems, hydrodynamics, wet electrostatics, topological and geometric effects, energy transfer mechanisms and strong light-matter interactions, the emergence of complexity, collective dynamics, networks and swarm properties, active matter. Theoretical, experimental, and computer simulation methods are introduced along with the phenomenological and conceptual overview.
Methods	Single-particle techniques, nano-optics, theory, computer simulations
Type	Two-day block course/ yearly recurrence with modification
Date (month/year)	27–29 May 2015
Time	See page 2
Work load	15 hours presence/ 45 hours self-study
Examination	written exam, 10 June 2015, 3:30 pm, Lecture Hall for Theoretical Physics, Linnéstr. 5
Credit points	2
Responsible scientists	Cichos, Kroy
International guest lecturers	Ignacio Pagonabarraga (University of Barcelona), Raphael Wittkowski (Universität Düsseldorf), Dipanjan Chakraborty (IISER Mohali), Jean-Babtiste Fleury (Universität des Saarlandes), Markus Selmke (Princeton University), Jérémie Palacci (UC San Diego)
Recommendations for literature, e-learning	Daan Frenkel & Berend Smit: Understanding Molecular Simulation: From Algorithms to Applications, Academic Press; M. P. Allen & D. J. Tildesley: Computer Simulation of Liquids, Oxford University Press; Stephen J. Ebbensa,& Jonathan R. Howse: In pursuit of propulsion at the nanoscale, Soft Matter, 2010,6, 726-738 http://dx.doi.org/10.1039/b918598d; M. C. Marchetti et al.: Hydrodynamics of soft active matter, Rev. Mod. Phys. 85 (2013) 1143 http://dx.doi.org/10.1103/RevModPhys.85.1143; M E Cates: Diffusive transport without detailed balance in motile bacteria: does microbiology need statistical physics? Rep. Prog. Phys. 75 (2012) 042601 http://dx.doi.org/10.1088/0034-4885/75/4/042601; Jonathan R. Howse et al.: Self-Motile Colloidal Particles: From Directed Propulsion to Random Walk, Phys. Rev. Lett. 99 (2007) 048102 http://prl.aps.org/abstract/PRL/v99/i4/e048102; Jeremie Palacci et al.: Living Crystals of Light-Activated Colloidal Surfers, Science 339 (2013) 936-940 http://www.sciencemag.org/content/339/6122/936.full.html; Felix Kümmel et al.: Circular Motion of Asymmetric Self-Propelling Particles, Phys. Rev. Lett. 110 (2013) 198302 http://arxiv.org/abs/1302.5787; S. Herminghaus et al.: Interfacial mechanisms in active emulsions, Soft Matter 10 (2014) 7008 xlink.rsc.org/?DOI=c4sm00550c; S. Thutupalli & S. Herminghaus: Tuning active emulsion dynamics via surfactants and topology, Eur. Phys. J. E 36 (2013) 91 http://link.springer.com/article/10.1140%2Fepje%2Fi2013-13091-2; S. Thutupalli et al.: Swarming behavior of simple model squirmers, New J. Phys. 13 (2011) 073021 http://iopscience.iop.org/1367-2630/13/7/073021, The chapter on swimming and

	motion of the books Philip Nelson, “Introduction to biological Physics” & Rob Phillips “Physical Biology of the cell”, L. Bocquet & P. Tabeling: Physics and technological aspects of nanofluidics, Lab on a chip 14 (2014) 3143 http://www.ncbi.nlm.nih.gov/pubmed/25046581, J.L. Anderson: Colloid transport by interfacial forces, Ann. Rev. Fluid Mech. 21 (1989) 61, http://www.annualreviews.org/doi/abs/10.1146/annurev.fl.21.010189.000425

SCHEDULE for Module 2015-T3

Time	Lecturer	Programme	Location
27 May 2015			
9:00-09:15	Cichos/Kroy	Introduction	ITP, SR113
09:15-10:45	Ignacio Pagonabarraga	Moving and swimming at small scales	ITP, SR113
10:45-12:15	Raphael Wittkowski	Self-propulsion	ITP, SR113
12:15-13:00	All Participants	Discussions	
Lunch Break			
14:00-15:30	Markus Selmke	Hot micro-swimmers	ITP, SR113
15:30-17:00	Dipanjan Chakraborty	Introduction to molecuar dynamics simulations of hot nano swimmers	ITP, SR113
17:00-18:00	Jérémie Palacci	Experimental strategies for Artificial Microswimmers	ITP, SR113
Dinner			
28 May 2015			
9:00-10:30	Jean-Babtiste Fleury	Single motion and collective behavior of self-propelling droplets driven by Marangoni flow	ITP, SR113
10:30-12:00	Markus Selmke	Laser-steering switchable micro-swimmers	ITP, SR113
Lunch Break			
13:00-14:30	Ignacio Pagonabarraga	Phoresis under confinement	ITP, SR113
14:30-16:00	Raphael Wittkowski	Field theory of collective swimming	ITP, SR113
16:00-17:00	All Participants	Discussions	ITP, SR113

29 May 2015			
14:00-18:00	Lab Course (optional)		Linnestr. 5

Didactic elements:
Lecture, discussions, practical training in the lab etc.

Expected performance:
Active participation in discussions, lab training, exam