Lectures and Seminars of the CUI course programme in the SoSe2017

CUI Main Lecture

Lecture	Lecturers	Start	Time	Place
Nanoelectronics and sensing	Prof. C. Klinke Dr. T. Vossmeyer	03.04.17	Mondays 13.15–14.45 Wednesdays 08:15-09:00	SemRm 261, FBC

Lectures

Lecture	Lecturers	Start	Time	Place
Modern X-Ray Physics II – Scattering and imaging	Prof. G. Grübel Prof. W. Wurth Prof. S. Roth Dr. M. Martins	04.04.17	Tuesdays 12:30-14:00 Thursdays 08:30-10:00	Hörsaal AP*
New experiments with XFEL sources	Prof. C. Bressler Prof. M. Rübhausen	03.04.17	Mondays 09:30-11:00	SemRm 1*
Ultrafast Optical Physics II	Prof. F. Kärtner	07.04.17	Fridays 08:30-10:00	CFEL, SemRm IV (Bld. 99) Bahrenfeld
Condensed matter and ultra-cold atoms	Prof. L. Mathey	03.04.17	Mondays 16:00-17:30	Hörsaal AP*
			Thursdays 12:00-13:30	SemRm 2*
Microfluidics	Prof. M. Trebbin	07.04.17	Fridays 10:15-11:45	SemRm 2*
Structural biochemistry	Prof. C. Betzel Prof. Schülter Dr. M. Perbandt Dr. T. Hackl Dr. Wieland Dr. Trusch	07.04.17	Fridays 10:00-11:30	Hörsaal C FBC

Seminars

Seminar	Lecturers	Start	Time	Place
Special topics on nanochemistry	Prof. H. Weller	04.04.16	Mondays 16:30-18:00	SemRm 261 IPhCh**
Quantum dynamics of out-of-equilibrium nanosystems	Prof. M. Thorwart	04.04.17	Tuesdays 14:00-15:30	SemRm 6*
Many-body theory of ultracold atoms and solid state systems	Prof. L. Mathey	05.04.17	Wednesdays 14:00-15:30	ZOQ SemRm, (Bld. 90) Bahrenfeld
Molecular physics	Prof. J. Küpper	06.04.17	Thursdays 10:00-11:30	SemRm II CFEL (Bld. 99) Bahrenfeld
Many-body systems and quantum statistical methods	Prof. M. Potthoff	05.04.17	Wednesdays 14:15-15:45	SemRm 2*
Theory of solid-state physics	Prof. A. Lichtenstein Prof. D. Pfannkuche Prof. M. Potthoff Prof. M. Thorwart	05.04.17	Wednesdays 16:00-17:30	SemRm 6*

Abbreviations:
SemRm = Seminar room
Bld. = Building
CFEL = Center for Free-Electron Laser Science
IPhCh = Institut für Physikalische Chemie
IMPRS-UFAST = International Max Planck Research School for Ultrafast Imaging and Structural Dynamics
ZOQ = Zentrum für Optische Quantentechnologien
AP = Angewandte Physik (Jungiusstraße 9, 20355 Hamburg)
DESY = Deutsches Elektronen-Synchrotron
FBC = Fachbereich Chemie (Martin-Luther-King-Platz 6, 20146 Hamburg)

Remarks on "Place":
*The event does take place at the department of Physics of the University of Hamburg (Jungiusstraße 9 or 11, 20355 Hamburg). See also the webpage of the Department of Physics of the University of Hamburg: www.physik.uni-hamburg.de.
SemRm 1 and 2 = Seminar room (1. Floor, right staircase)
SemRm 6 = Seminar room (3. Floor, left staircase)
**The event does take place at the Institut für Physikalische Chemie of the University of Hamburg (Grindelallee 117, 20146 Hamburg). See also the webpage of the Department of Chemistry of UHH: http://www.chemie.uni-hamburg.de/pc/index.html.
[§]The meeting on April, 22, 2016, is organised by Skype.
[†]These courses have the format of block-courses. Besides, the attendance to these lectures is limited to a specific number (typically 15). Importantly, the priority is given to the fellows of the IMPR-UFAST School. Hence, if you like to attend one of the courses, please, send first an e-mail to Dr. Julia Quante (julia.quante@mpsd.mpg.de). She will inform you about availability and changes in the course programme.

Abstract: CUI Main Lecture

Nanoelectronics and sensing: In the lecture, the basics of electrical transport through nanostructures and of sensors with nanostructures will be given. The structures are for example carbon nanotubes, two-dimensional nanostructures or thin films of nanoparticles. Often, quantum mechanical effects are exploited in such devices. The basics are then deepened in seminar talks on specific topics.

Abstracts: Lectures

Modern X-Ray Physics – Scattering and imaging: This course will provide an introduction into the methods of modern X-ray physics. It covers the hard x-ray regime with the focus on scattering applications. Knowledge on soft X-ray applications, covered by the precursor course (Methoden moderner Roentgenphysik I) is helpful, but not a prerequisite.
The program will include: Basics of modern X-ray physics (sources, refraction+reflection, kinematical scattering theory and its applications, introduction into small-angle, anomalous and coherent scattering). Basics of modern x-ray applications in biology, surface and interface science and soft matter research are also discussed.
The program will include a site visit to the DESY Photon Science facilities.

Ultrafast Optical Physics II: The content of the course is the following:

- Linear and nonlinear pulse propagation: Optical solitons and pulse compression.
- Laser dynamics: Single-mode, multi-mode, Q-switching, mode locking.
- Pulse characterization: Autocorrelation, FROG, SPIDER and 2DSI
- Noise in mode-locked lasers and frequency combs
- Laser amplifiers and parametric amplifiers and oscillators.
- Soft and hard X-ray sources including attosecond pulse generation
- Nonlinear polarizations in matter: the perturbative expansion approach.
- Ultrafast Fourier-transform spectroscopy: 2 and more dimensions
- From GHz to the ultraviolet: investigating transient states of matter with light
- More ways to see: Raman, CARS & fluorescence - also good for imaging
- High-harmonic generation and its applications
- Ultrafast X-ray science: femtosecond molecular movies w/ atomic resolution

Condensed matter and ultra-cold atoms: We explore the physics of condensates of ultra-cold atoms and related ordered states, such as superconducting states. We describe their properties first within a mean-field description, and then establish the formalism of path integrals, effective actions and spontaneous symmetry breaking. We study Landau theory to describe continuous phase transitions, and introduce and apply the concept of the renormalization group to capture the critical behaviour.

Microfluidics: Microfluidics enables the precise control of fluids on the nanoliter scale by designing, manufacturing, and formulating miniaturized systems ("Lab on a Chip"). These miniaturized devices take advantage the physical and chemical phenomena on the small scale, such as micro- and nanochannels, for fundamental scientific investigations as well as specialized industrial applications. Selected examples include:

- Chemical and biological micro/nanoreactors for chemical synthesis, biosynthesis, high-throughput synthesis, combinatorial chemistry and safer synthesis
- Micro/nanofabrication technologies (in silicon, plastics, glass and other materials) including laser micro/nanofabrication, photochemistry, micro/nanophotolithography, micro/nanomachining etc.

- Micro/nanomechanics and engineering in chip-based systems (MEMS and NEMS)
- Fluidics, fluids for micro/nanosystems, their mobilization and control
- Medical diagnostics and screening, point-of-care clinical analyses, disease detection, drug delivery, and implantable devices
- Micro and nano total analytical systems (μTAS, nTAS), their components and applications
- Reduction of wastes, and increases in efficiency, reliability and performance (decreases in power and reagent consumption, time and cost)

Hence, this research field is attractive for a variety of disciplines including: chemistry, physics, nanoscience, biology, bioengineering, electronics, clinical/medical science, chemical engineering and materials science - across both academic and industrial sectors.

This lecture is an introduction to this multidisciplinary field ranging from the historical background to modern perspectives and application examples. Along the way we will cover the theoretical and practical fundamentals including the physics of miniaturization, fluid mechanics of microflows, electrical and thermal phenomena and an introduction to microfabrication.

It is the goal of this course to convey the fundamental concepts and methods which are relevant for the creation and work with microfluidic systems.

Structural biochemistry: The students will be introduced in structural biology and the analysis of interactions between biological macromolecules. In the lecture methods like protein crystallization, crystallography, nuclear magnetic resonance spectroscopy (NMR), electron microscopy, small angle X-ray scattering and mass spectroscopy will be addressed. The course language will be preferably German.

Abstracts: Seminars

Quantum dynamics of out-of-equilibrium nanosystems: The seminar addresses the non-equilibrium quantum dynamics of systems, which interact with quantum mechanical fluctuations produced from some external environment. They typically lead to decoherence and relaxation phenomena, before a stationary state in the statistical sense is eventually reached. By the framework of open quantum systems, a vast number of physical systems and effects are described, ranging from excitonic energy transfer in biomolecular light-harvesting complexes, to quantum mechanical charge, spin and heat non-equilibrium transport, to activation phenomena in pumped quantum systems, to cooperative effects in ultracold quantum gases, to the dynamics of a ferromagnetic domain wall under the influence of a spin-polarized current, to name only those which are in the focus of our research group. During the seminar, selected topics of these fields will be discussed.

Many-body theory of ultra-cold atoms and solid-state systems: In this research-oriented seminar we discuss many-body effects in ultra-cold atoms and solid-state systems. Subjects include, for example, Bose-Einstein condensation, superconductivity and superfluidity, low-dimensional systems and fluctuating orders, renormalization group methods and many-body dynamics. Presentation subjects can be chosen from a wide range of fields, such as laser physics, solid state physics, quantum field theory, and atomic physics. The presentations can deal with fundamental questions or applied concepts, such as cooling and detecting methods, or technological aspects of ultra-cold atom systems or solid-state systems. Both experimentalists and theorists are very welcome, and a lively discussion is desired.

Molecular physics: This seminar provides a regular lecture series on modern topics in molecular physics. International experts provide introductions and in-depth discussions of

state-of-the-art research in molecular and laser physics. Seminars are held in tutorial style, and questions during talks that help the audience to better follow the presentation are highly appreciated. Students will learn to follow research seminars, to extract useful information from seminars and related discussions, and how to articulate questions and comments.
Speakers typically visit CFEL for one or two days and are available for discussions of their and your work.

Many-body systems and quantum statistical methods: In Potthoff's group the physical properties of quantum systems consisting of a macroscopically large number of strongly interacting fermions are studied. These systems may show collective behaviour that cannot be understood on an independent-particle level. The field covers collective magnetism, correlation-driven metal-insulator transitions, high-temperature superconductivity and unconventional states of matter in general. We are interested in classical and quantum phase transitions in low-dimensional lattice systems and nanostructures, in elementary excitation spectra and in non-equilibrium phenomena. The employed methods range from field-theoretical techniques and exact diagonalization over (dynamical) mean-field theory and cluster techniques to (quantum) Monte-Carlo methods and density-matrix renormalization group. An important focus is on new methodical developments. For further information about the time schedule of the seminar, please, visit the following webpage http://theorie.physnet.uni-hamburg.de/group_vts/groupseminar.html

Theory of solid-state physics: Speakers of the I. Institute of Theoretical Physics or external scientific guests are invited to give a talk on a specific topic of cutting-edge research in the field of solid-state physics.
Further information concerning the speakers will be forwarded to the mailing list of the graduate school of CUI by its coordinator.