Lectures and Seminars of the CUI course programme in the SoSe2013

CUI Main Lecture

Lecture	Lecturers	Start	Time	Place
Methods in current X-ray science: From imaging to spectroscopy	Prof. H. Chapman Dr. T. Laarmann	02.04.13	Tuesdays 14:00-15:30	SemRm II, CFEL (Bld. 99), DESY

Lectures

Lecture	Lecturers	Start	Time	Place
Nichtgleichgewichtsstatistik und Transporttheorie	Prof. M. Thorwart	05.04.13	Tuesdays and Fridays 10:15-11:45	SemRm1
Methoden moderner Röntgenphysik II – Streuung und Abbildung	Prof. G. Grübel Prof. W. Wurth Dr. M. Martins	04.04.13	Tuesdays 12:45-14:15 Thursdays 08:30-10:00	Hörsaal AP
Ultrafast Optical Physics II	Prof. F. X. Kärtner Prof. N. Huse	05.04.13	Fridays 08:30-10:00 10:30-12:00	SemRm 2
Einführung in die Physik der Quantengase	Prof. A. Hemmerich	03.04.13	Wednesdays 09:15-10:45 Fridays 08:30-10:00	Hörsaal AP
Strukturbiochemie	Prof. C. Betzel Dr. F. Buck Dr. T. Hackl Dr. M. Perbandt Prof. R. Willumeit	05.04.13	Fridays 10:00-11:30	Hörsaal C FBC

Seminars

Seminar	Lecturers	Start	Time	Place
Multifunktionale Nanostrukturen	Prof. K. Nielsch Dr. D. Görlitz	04.04.13	Thursdays 16:00-17:30	Sitzungs-zimmer AP
Spektroskopie und Röngtenbeugung mit Synchrotronstrahlung	Prof. M. Drescher Prof. G. Grübel Prof. R. Johnson Prof. E. Weckert Prof. W. Wurth	05.04.13	Fridays 14:15-15:45	SemRm 109, Bld. 25b, DESY
Quantendynamik von Nanosystemen im Nichtgleichgewicht	Prof. M. Thorwart	02.04.13	Tuesdays 14:00-15:30	SemRm 6
Viel-Teilchen Theorie ultrakalter Atome	Prof. L. Mathey	03.04.13	Wednesdays 14:00-15:30	ZOQ SemRm, (Bld. 90)

Lectures organized by IMPRS-UFAST[§]

Lecture	Lecturers	Start	Time	Place
Source Technology	Prof. F. Kärtner Prof. T. Uphues Prof. N. Huse	09.04.13 11.04.13 16.04.13 18.04.13 23.04.13 25.04.13	09:00-11:00	CFEL, SemRm III (ground floor)*
Ultrafast Techniques	Prof. H. Chapman Prof. T. Uphues Prof. N. Huse	01.02.13 05.02.13 11.02.13 12.02.13 14.02.13	09:30-11:30	CFEL, SemRm IV (1.111)
Theory of Electronic Structure and Molecular Dynamics	Dr. O. Vendrell	02.07.13 03.07.13 04.07.13 05.07.13	09:30-13:00	CFEL, SemRm V (01.109)
Theoretical Fundations of Research with X-ray Free Electron Lasers and Synchrotron Radiation Sources**	Prof. V. Elser Dr. G. Geloni Prof. B. Koopmans Prof. R. Santra Prof. van Veendaal Prof. B. Ziaja Dr. N. Rohringer Dr. O. Vendrell	20.03.13 21.03.13 22.03.13	08:00-18:00	FLASH SemRm DESY (Notkestr. 85)

[§] The attendace to these lectures is limited to a specific number (typically 15). Priority is given to members of IMPR-UFAST. If you like to attend, please send first an e-mail to Ms. Anja Bleidorn (Anja.Bleidorn@mpsd.cfel.de).

* Seminar room IV (01.111) at CFEL only for the 25.04.2013.

** This lecture is organized by DESY and registration is required. For the registration visit the link: http://researchcourse2013.desy.de

Abbreviations:
SemRm = Seminar room
Bld. = Building
CFEL = Center for Free-Electron Laser Science
IMPRS-UFAST = International Max Planck Research School for Ultrafast Imaging and Structural Dynamics
SFB = Sonderforschungsbereich
GRK = Graduiertenkolleg
ZOQ = Zentrum für Optische Quantentechnologien
AP = Angewandte Physik
DESY = Deutsches Elektronen-Synchrotron
FBC = Fachbereich Chemie

Remark on *Place*:
If the event does not take place at the DESY campus, then it will take place at the department of Physics of the University of Hamburg (Jungiusstraße 9, 20355 Hamburg). See also www.physik.uni-hamburg.de.
SemRm 1 and 2 = Seminar room (1. Floor, right staircase)
SemRm 6 = Seminar room (3. Floor, left staircase)

Abstract: CUI Main Lecture

Methods in current X-ray science: From imaging to spectroscopy: X-ray science is currently undergoing a revolution, in part due to X-ray free-electron lasers that provide coherent beams with femtosecond pulses. The properties of these sources will allow us to examine matter at the length, energy, and time-scales of atoms and molecules, promising to give new insights in structural dynamics and directly measuring the simplest chemical reactions up to observing the functions of biological macromolecules. In this course we will introduce new experimental methods needed to measure these processes. Starting from the fundamentals of coherent scattering and the interaction of intense pulses with matter, we unify coherent imaging and describe coherent diffractive imaging, holography, tomography, nanocrystallography and single particle imaging, and ptychography. We will introduce different techniques for determining the local geometric and/or electronic structure of matter such as X-ray absorption (XAS) and inelastic X-ray scattering (IXS). In particular, time-resolved methods are in the focus of interest. We will briefly discuss the basics of different X-ray light sources and detectors. Finally, recent progress in non-linear X-ray optics will be highlighted. Participants will be able to search for current (primary) literature to explore a new scientific field and to independently understand articles on state-of-the-art X-ray science.

Abstracts: Lectures

Nichtgleichgewichtsstatistik und Transporttheorie: The content of the course is the following:

- Keldysh-path integral for bosonic and fermionic systems
- Green functions in the Keldysh-formalism
- Effective Hamiltonian description of dissipative systems
- Kinetical equation
- Applications: charge statistics, dynamic of the magnetization in nanoscale systems, dynamic of biological populations and others

Methoden moderner Roentgenphysik II - Streuung und Abbildung: This course (4+2 hours weekly) 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 & interface science and soft matter research.
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

Einführung in die Physik der Quantengase (Introduction to the physics of quantum gases): The lecture has two parts: In part 1 the quantum optical concepts and experimental tools are introduced: two-level atom, dressed states, quantum states of light, laser cooling, atom traps. The second part introduces the basics of Bose-Einstein condensation and the dynamical properties of Bose-Einstein condensates. Among others we will go across the following topics: making and observing Bose-Einstein condensates, Gross-Pitaevsky equation, superfluidity and vortices, phase and interference of Bose-Einstein condensates, optical lattices, quantum phase transition in bosonic Hubbard model, etc. Upon request of the audience, the lecture may be given in english or german. Lecture notes are available at http://photon.physnet.uni-hamburg.de/en/ilp/hemmerich/teaching/

Strukturbiochemie: The course includes: Foundations of crystallization, Röntgen structure analysis, mass spectroscopy, NMR, and small angle Röntgen diffraction.

Abstracts: Seminars

Viel-Teilchen Theorie von Festkörpern und ultrakalten Atomen (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.

Abstracts: Lectures organized by IMPRS-UFAST

Source technology*:* The course provides an overview of the working principles of modern light/x-ray/electron sources, including the respective physics background and their current strengths and limitations. The focus will be on techniques and technical basics.

Ultrafast Techniques: The course focuses on the use of modern light/x-ray/electron sources for investigating the physics/chemistry/biology phenomena. Besides discussing scattering and image reconstruction techniques, detector technology, such as velocity-map imaging (VMI), will be introduced and discussed. Key questions

addressed are which techniques exist, how to use them, and which method is best used to reach a certain goal.

Theory of Electronic Structure and Molecular Dynamics: After covering the basics of molecular electronic structure theory, the adiabatic and diabatic representations of the Hamiltonian for the nuclear degrees of freedom will be discussed. This will lead to the concepts of potential energy surfaces, non-adiabatic effects, and conical intersections. Wave-packet dynamics in closed systems will be covered, along with numerical propagation methods for quantum wave-packet dynamics. The more general case of dynamics of reduced density matrices in open systems will be discussed. Finally, ideas underlying classical molecular dynamics will be presented.

Theoretical Fundations of Research with X-ray Free Electron Lasers and Synchrotron Radiation Sources: Novel X-ray radiation sources provide X-ray radiation of unique properties: coherent, highly brilliant, and emitted in pulses of down to femtosecond duration. This radiation can explore ultra-small spatial scales: the structure of objects down to atomic resolution, ultra-short temporal scales, transitions occurring on timescales down to femtoseconds, and create extreme states of matter. The offered research course shall give an introduction to the theoretical foundations of X-ray science with novel light sources, and to the new research opportunities that they provide. It comprises lectures on the following topics:

1) X-ray coherent diffraction imaging
2) XFEL and synchrotron radiation
3) Ultrafast spin dynamics
4) X-ray absorption and inelastic scattering
5) Atomistic processes
6) X-ray created warm dense matter