Lectures and Seminars of the CUI course programme in the SoSe2014

CUI Main Lecture

Lecture	Lecturers	Start	Time	Place
Light-Matter Interactions: atoms, molecules & (non) linear optics	Prof. C. Bressler Prof. W. Wurth	02.04.14	Wednesdays 14:00-15:30	SemRm 5*

Lectures

Lecture	Lecturers	Start	Time	Place
Methoden moderner Röntgenphysik II – Streuung und Abbildung	Prof. G. Grübel Prof. W. Wurth Dr. M. Martins	01.04.14	Tuesdays 12:45-14:15 Thursdays 08:30-10:00	Hörsaal AP
Ultrafast Optical Physics II	Prof. F. Kärtner Prof. N. Huse	04.04.14	Fridays 08:30-10:00	SemRm 2*
Einführung in die Physik der Quantengase	Prof. A. Hemmerich	02.04.14	Wednesdays 08:30-10:00 Fridays 08:30-10:00	Hörsaal AP
Nanostrukturphysik IV – Energiematerialien und Nanobiotechnologie	Prof. R. Blick Prof. K. Nielsch Dr. M. Rübhausen	03.04.14	Thursdays 10:15-11:45	SemRm 4*
Strukturbiochemie	Prof. C. Betzel Dr. F. Buck Dr. T. Hackl Prof. R. Willumeit	04.04.14	Fridays 10:00-11:30	Hörsaal C FBC

Seminars

Seminar	Lecturers	Start	Time	Place
Multifunktionale Nanostrukturen	Prof. K. Nielsch Dr. D. Görlitz	03.04.14	Thursdays 16:00-17:30	Sitzungs-zimmer AP
Nanostrukturphysik	Dr. G. Meier Dr. K. Buth Dr. T. Matsuyama Prof. U. Merkt	07.04.14	Mondays 14:15-15:45	Bibliothek AP
Quantendynamik von Nanosystemen im Nichtgleichgewicht	Prof. M. Thorwart Dr. P. Nalbach	01.04.14	Tuesdays 14:00-15:30	SemRm 6*
Many-body theory of ultracold atoms and solid state systems	Prof. L. Mathey	02.04.14	Wednesdays 14:00-15:30	ZOQ SemRm, (Bld. 90)
Festkörperlaser	Prof. G. Huber Dr. C. Kränkel	01.04.14	Tuesdays 13:30-15:00	SemRm 052 (Bld. 69) Bahrenfeld
Vielteilchensysteme und quantenstatistische Methoden	Prof. M. Potthoff	02.04.14	Wednesdays 14:30-16:00	SemRm 2*

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 (Jungiusstraße 9, 20355 Hamburg)
DESY = Deutsches Elektronen-Synchrotron
FBC = Fachbereich Chemie (Martin-Luther-King-Platz 6, 20146 Hamburg)

Remark on *Place*:
*The event does 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 straircase)
SemRm 6 = Seminar room (3. Floor, left straircase)

Abstract: CUI Main Lecture

Light-Matter Interactions: atoms, molecules & (non) linear optics: The goal of this course is to deliver the basic ideas behind the description of radiation and atom interactions. This course concentrates on a classical physics approach to various phenomena and focuses on line broadening and shift effects of atomic (and molecular) transitions, including a brief introduction to laser principles.
In addition, the course seeks to introduce the student to the experimental methods and tools (spectrometers and detectors), with which the various atom-radiation phenomena are observed, and an introduction to nonlinear optics is given. To complete the understanding of all optical spectroscopic techniques next to advanced optical setups, an introduction to linear optics will be given. Typical prism and grating, as well as pulse shaping setups will be discussed and evaluated for their optical properties. This will be complemented with a short introduction to nonlinear optics, which will cover the basics of three wave mixing with a possible extension to four wave mixing if time allows.

Required prior knowledge:
Quantum mechanics, Electromagnetism
Bibliographie et matériel:
W. Demtröder: Laser Spectroscopy (Springer Verlag, Berlin 1997, 2000)

Abstracts: Lectures

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 and 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-Pitaevskii 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/

Nanostrukturphysik IV – Energiematerialien und Nanobiotechnologie:

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

Abstracts: Seminars

Multifunktionale Nanostrukturen (Multifunctional Nanostructures): In this seminar talks are given by external guests or group members. The topics are selected from the following 3 categories:

1. Synthesis of nanostructures for magnetic or/and thermoelectric applications (structured thinfilms, nanowires, nanotubes, electrochemical deposition, atomic layer deposition ALD, ...),
2. Magnetic properties of nanostructures (switching behaviour of the magnetization, magnetic interactions, magnetic domain walls, magnetoresistance, magnetocaloric behaviour, ...),
3. Thermoelectric properties of nanostructures (conversion efficiency, Seebeck coefficient, powerfactor, figure of merit ZT, ...).

Nanostruktur: The Seminar is on topics in micro- and nanometer-scale science and technology. Studies range from thin films to micro- and nanostructures and include squares, circles, nanowires, and even more complex micro- and nanoscale geometries. The focus of the seminar is on magnetic nanostructures. Ferromagnetic nanostructures are ideal systems to tailor physical properties of the single object via material parameters, layer sequences, and lithographical processes. Magnetization dynamics on the nanosecond and subnanosecond time scale in ferromagnetic micro- and nanostructures are in the focus of interest in frequency space as well as in real space. E.g., broadband ferromagnetic-resonance measurements obtained by vector-network analyzer spectroscopy are discussed in the presentations of the seminar. Transmission x-ray microscopy with a spatial resolution down to 10 nanometers and a temporal resolution below 100 picoseconds is important to give access to magnetization dynamics on its genuine time- and length scale. Complexity created by periodic arrangement of well-understood building blocks plays not only an important role in biochemistry, photonics, and engineering but is also of increasing importance for magnetism on the nanoscale. Magnetic interactions can be engineered to yield one-, two-, and three-dimensional crystal-like structures that show new intriguing properties that are discussed in the Seminar „Nanostrukturphysik“.

Quantendynamik von Nanosystemen im Nichtgleichgewicht: The seminar addresses the nonequilibrium 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 nonequilibrium 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.

Festkörperlaser: In this seminar, selected guests will report about current topics of solid-state laser research. The topics and precise dates of the respective talks will be announced individually via mailing-lists and the ILP and physics department webpages.

Vielteilchensysteme und quantenstatistische Methoden: 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 behavior 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 webpage http://theorie.physnet.uni-hamburg.de/group_vts/groupseminar.html