SYSX 1: Soft X-ray induced ultrafast processes I

Zeit: Donnerstag 14:00–16:00 Raum: 6G

Hauptvortrag SYSX 1.1 Do 14:00 6G

Unraveling ultra fast dynamic processes at selected atomic sites — •Alexander Foehlisch — Department Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

Ultra fast electron and nuclear dynamics play a decisive role in processes like photo- and electrochemistry as well as in molecular electronics and single electron devices. If we are interested in a dynamic process within a complex systems it is of equal importance to address the temporal evolution of the wave packet and the question at which atomic center the dynamic has started. These requirements can be matched with the element specific information from soft x-ray spectroscopy [1,2]. The novel X-ray source of the Free-Electron-Laser provides us with an unprecedented peak brilliance of femtosecond X-ray pulses. With these femtosecond radiation pulses at the Free Electron Laser in Hamburg (FLASH) we have investigated ultra fast dynamic processes in a pump-probe set-up in combination with an optical short-pulse laser.

[1] A. Föhlisch, P. Feulner, F. Hennies, A. Fink, D. Menzel, D. Sanchez-Portal, P. M. Echenique, W. Wurth, Direct observation of electron dynamics in the attosecond domain. Nature 436, 373 (2005).

[2] S. Vijayalakshmi, A. Föhlisch , F. Hennies, A. Pietzsch, M. Nagasono, W. Wurth. Surface projected electronic band structure and Adsorbate charge transfer dynamics: Ar adsorbed on Cu(111) and Cu(100). Chem. Phys. Lett. 427, 91-95 (2006).

Hauptvortrag SYSX 1.2 Do 14:30 6G

Ultrafast processes on the atomic scale studied with hard (and soft) x-radiation — •Christian Bressler — LSU-ISIC-BSP. EPFL. CH-1015 Lausanne, Switzerland

Electronic structure changes are at the origin of chemical reactivity, which drive the forming and breaking of bonds. Ultrafast x-ray absorption fine structure spectroscopy (XAFS) delivers both the electronic and geometric transient structure changes, when interfaced with a femtosecond laser in a pump-probe scheme. In addition, XAFS methods are element-selective and can be applied to disordered bulk systems, in particular liquids. On the femtosecond time scale one would obtain a rather complete picture via XAFS, since the propagation from a reaction center is limited to a few Angstroms on these time scales. We have recently recorded high-quality transient XAFS spectra at 3rd generation synchrotrons with currently $<$ 100 ps temporal resolution, corresponding to the electron bunch width at the synchrotron. Examples of excited state structures of solvated coordination chemistry compounds and of short-lived atomic radicals in aqueous solution will be presented. Extending these studies into the femtosecond time domain is straightforward in concept, while pico- to nanosecond resolved studies still offer a high potential for research on short-lived reaction intermediates, whose structures can not be determined by other means. The continued efforts using pulsed x-rays on the femto- to nanosecond time scales will be closely linked to the developments of novel photon sources, including, e.g., femtosecond x-rays at SLS and BESSY, next to soft x-rays $<$ 1 keV to become available at FLASH.

Hauptvortrag SYSX 1.3 Do 15:00 6G

Interaction of clusters with intense soft x-ray radiation from the FLASH VUV-FEL — •Christoph Bostedt[1], Heiko Thomas[1], Ekaterina Eremina[1], Matthias Hoener[1], Hubertus Wabnitz[2], Tim Laarmann[3], Rubens de Castro[4], and Thomas Möller[1] — [1]TU Berlin, Germany — [2]DESY, Hamburg, Germany — [3]MBI, Berlin, Germany — [4]LNLS, Campinas, Brazil

The interaction of rare gas clusters with intense vacuum ultraviolet radiation from the DESY free electron lasers has yielded many surprising results. In first experiments with 100 nm radiation unexpected high energy absorption involving plasma heating processes was measured and new theoretical explanations were suggested. The new DESY FLASH FEL delivers radiation down to first 32 and later also 13 nm wavelengths with intensities up to 10^{14} W/cm^2. We have performed first experiments with a combined time-of-flight spectroscopy and imaging approach. The new data give evidence that the dominant physical drivers in the light - matter interaction at reduced wavelength change and plasma heating is only of minor importance. At 32 nm the ionic fragments from the exploding clusters are ejected with only 25 eV and the electrons are emitted from the clusters serially. The atoms within the cluster move by only 3 Angstrom during the pulse duration making imaging experiments possible. At 13 nm wavelength first experiments about the ionization dynamics including core levels could be performed with Xe clusters. These measurements give some hints that the energy absorption involving core levels in the cluster may be reduced compared to atoms.

Hauptvortrag SYSX 1.4 Do 15:30 6G

Elektronendynamik bei der Erzeugung von XUV-Attosekundenpulsen — •Milutin Kovacev — Institut für Quantenoptik, Leibniz Universität Hannover

Die Erforschung ultrakurzer, intensiver Laserpulse und deren Wechselwirkung mit Materie ist ein hochaktuelles Forschungsgebiet. Eine Vielzahl faszinierender Effekte und Anwendungen konnten in den letzten Jahren verwirklicht werden.

Insbesondere die Erzeugung hoher optischer Harmonischer im weichen Röntgenbereich ist durch eine hohe Brillanz (10^{27} Phot/Puls/$mm^2/mrad^2$/0,1%BW), exzellente Kohärenzeigenschaften und eine ultrakurze Pulsdauer gekennzeichnet. Darüber hinaus sind Laser-Erzeugte XUV Strahlungsquellen kompakt und kostengünstig, welches deren vielfältigen Einsatz in Laboratorien begünstigt.

Das Harmonischen-Spektrum ermöglicht durch seine große Bandbreite die Erzeugung ultrakurzer Pulse im Attosekundenbereich ($1as = 10^{-18}s$). Der Erzeugungsprozess dieser Pulse unterliegt einer anspruchsvollen Elektronendynamik, auf die in diesem Beitrag eingegangen wird. Die Kontrolle der Elektronendynamik und insbesondere auch die Synchronisation des Phasenganges der Harmonischen sind für Anwendungen in der Attosekundenphysik entscheidend und sollen hier diskutiert werden.