Ultra-Bright Light Sources Topical Conference
Room 2001 - Session UB-WeA

Ultra-Bright Light Sources Topical Conference
Moderator: C. Wöll, Ruhr-Universitat Bochum, Germany

2:00pm **UB-WeA1 Science at the BESSY Soft X-Ray FEL in Berlin Adlershof*, W. Eberhardt,*** BESSY GmbH, Germany **INVITED**

BESSY is operating Europe's largest third generation synchrotron radiation user facility for the VUV and Soft X-Ray range. For this presentation special emphasis will be placed upon introducing the BESSY FEL project. BESSY is planning to build a Soft X-Ray FEL facility covering the photon energy range from 24 eV to 1 keV at the site next to the existing BESSY II storage ring. This new facility will offer laser like photon beams with fully coherent, high power (mJ) pulses of < 20 fs duration, enabling a whole set of novel experiments dedicated to understand dynamical processes in matter or for the investigations of very dilute systems. These pulses will be generated in a HGHG scheme (High Gain Harmonic Generation) which offers controlled, reproducible pulses as determined by the external seed UV (430-230 nm) laser pulse. Additionally this scheme allows for an inherent synchronization for pump-probe investigations. The HGHG-FEL covers the traditional BESSY II photon energy range, which is especially suited for electronic structure investigations of atoms, molecules, clusters, and solids. With the anticipated temporal resolution of < 20 fs charge transfer processes and time resolved 'femtochemistry' studies as well as magnetization dynamics in magnetic materials establish some of the major areas of scientific interest in this new facility. Furthermore, in exploiting the coherence of the photon pulses in microscopy applications of soft-matter and biological samples it is possible to acquire an image using a single laser pulse. Thus stroboscopic time resolved images of dynamical processes in living cells become possible. In general, the science planned at this facility is complementary to the science envisioned for the planned TESLA X-FEL facility at DESY and the Linac Coherent Light Source (LCLS) at Stanford.

2:40pm **UB-WeA3 The Next Generation Light Source at Jefferson Lab*, G.P. Williams,*** *FEL Team,* Jefferson Lab **INVITED**

Jefferson Lab operates a fourth generation accelerator-based light source. The facility is based on an Energy Recovered Linac (ERL),@footnote 1@ which has a significant advantage in brightness over a conventional electron storage ring (synchrotron) source. Both terms contributing to the brightness are enhanced. The power is enhanced by multiparticle coherent effects,@footnote 2@ while the source size is smaller because the horizontal emittance is approximately equal to the vertical emittance (round beams). This type of source has additional advantages in that the bunch lengths are in the 100's of femtosecond range, allowing ultrafast phenomena to be studied in the time domain. The JLab facility incorporates 3 sources: (1). A 10 kW av. power 1-14 micron tunable Infrared Free Electron Laser (IRFEL) with energies of 120 microJoules per pulse: (2). A 1 kW av. power 250 nm to 1 micron UVFEL with up to 25 microJoules per pulse: and (3). A 0.1 to 5 THz source@footnote 3@ with 1 microJoule per pulse. All 3 sources can operate at pulse repetition frequencies up to 75 MHz and pulse lengths in the range 250 - 2000 femtoseconds. We will present details of the source, and will make frequent comparisons with storage ring sources and x-ray FELs. We will also discuss and show examples of key scientific applications of this unique light source. These cover the fields of medicine, biology, physics, chemistry and materials science with experiments ranging from dynamics to disease treatment. The applications also include studies of non-linear effects and 2 photon pump-probe dynamics. In addition to this source, Jefferson Lab operates a 6GeV accelerator, which is capable of producing sub-picosecond x-rays with a brightness comparable to dipole radiation at a storage ring. This will also be presented. @FootnoteText@@footnote 1@G.R. Neil et al, Phys. Rev. Let. 84, 662 (2000). @footnote 2@C. J. Hirschmugl, M. Sagurton and G. P. Williams, Physical Review A44, 1316, (1991). @footnote 3@G.L. Carr, et al, Nature 420 153 (2002).

3:20pm **UB-WeA5 THz Technology and Its Applications to the Study of Hydration Layers and Thin Films*, M. Havenith,*** Universität Bochum, Germany **INVITED**

By the development of new, powerful radiation sources the so-called "THz gap" between MW and IR spectroscopy has been closed. This has allowed tackling new applications in various fields. First an overview over the progress over the development of new radiation sources in last years will be given. Then I will focus on applications using a high power laser p-Ge THz spectrometer. By measuring absolute absorption coefficients in the THz region we were able to determine the hydration dynamics of solvated sugars and proteins. Moreover, the setup of a THz cavity enhanced attenuated reflection spectrometer will be discussed. First applications include the investigation of surfaces and thin films.

4:00pm **UB-WeA7 High Harmonics of Ultrashort Laser Pulses as Coherent Soft X-Ray Source for Attosecond Time Resolved Photoemission Spectroscopy*, U. Heinzmann,*** Universität Bielefeld, Germany **INVITED**

The combination of the comb of high harmonics of a phase-stabilized ultrashort laser pulse focussed into a rare gas atomic beam@footnote 1@ with an optimized multilayer mirror system as soft x-ray monochromator@footnote 2@ yields isolated soft x-ray pulses of 200 attoseconds duration.@footnote 3@ Thus photoelectron and Auger electron emission processes have been studied time resolved with a fs and even sub-fs time resolution, which is needed to observe the dynamics of atomic and molecular decay processes.@footnote 4,5@ The report reviews the experimental techniques of production and analysis of the ultrashort pulses, presents recently performed pump-probe photoionization and photodissociation processes and discusses its application to condensed matter studies. @FootnoteText@ @footnote 1@ R. Kienberger et al. Nature 427, 817 (2004)@footnote 2@ A. Wonisch et al. Applied Optics 45, No 17 (2006)@footnote 3@ E. Goulielmakis et al. Science 305, 1267 (2004)@footnote 4@ M. Drescher et al. Nature 419, 803 (2002)@footnote 5@ P. Siffalovic et al. J. Biotechn. 112, 139 (2004).

Author Index

Bold page numbers indicate presenter